

Permian spores from the Gondwana Succession in India

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ABSTRACT

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The deposits of Permian sediments (Figs 1 & 2) are spread in a wide spatial extent on the Indian Peninsula. Palynological studies of the glacial sediments of earliest Permian (Talchir Formation) through the coal horizon of Upper Permian represent a high degree of morphographical variations among spores and pollen grains. These adequately identified taxa exhibit many kinds of exinal features that include simple, cingulate and zonate spores. The spores recovered are the optimum representation of the producing plants in the contemporaneous flora. The Permian sediments in India are mostly deposited under terrestrial environment, and these deposits are variedly interrupted by regional breaks. The microstructures of exine among these spores have great potential that determine the primitive and advanced states in morphological lineages through time and this variability of exine structures are effectively used in biostratigraphy. The objective of this publication is to put together the available published data on the morphotaxonomy of spores from the Permian sediments in India. These spores are placed in accordance with classification proposed by Potonié, 1956. In the description part, each taxon includes its type species, salient features of the genus and the species described under the genus, locality, horizon and age. The holotype figure of each species has been scanned from the original publication. The species under a taxon are arranged in the ascending order of their year of publication (Pl. 1–10). Here, the geological age is dealt in the standard time scale. In the last chapter, stratigraphical occurrences along with the First Appearance Datum (FAD) of some distinct species are commented, which are significant in the Assemblage Zones of key pollen taxa described by Tiwari and Tripathi, 1992. The literature consulted herein is given in the bibliography that dates up to 2011.

Key-words—Permian spores, Gondwana Succession, Morphotaxonomy, Stratigraphy.

भारत में गोंडवाना अनुक्रमों से प्राप्त पर्मियन बीजाणु

विजया एवं श्रीकांत मूर्ति

सारांश

पर्मियन अवसादों (चित्र 1 एवं 2) के निक्षेप भारतीय प्रायद्वीप पर अतिविस्तृत स्थानिक में फैले हैं। ऊपरी पर्मियन के कोयला क्षितिज में पूर्वतम पर्मियन (तल्चिर शैलसमूह) के हिमनदीय अवसादों से परागाणविक अध्ययन बीजाणु व पराग दानों में आकृतिक परिवर्तनों का उच्च अक्षांश निरूपित करते हैं। ये पर्याप्त रूप से अभिनिर्धारित टैक्सा बाह्य चोल लक्षणों के विविध प्रकार प्रदर्शित करती हैं जिसमें बीजाणुओं के साधारण, सिंगुलेट व धारीदार रूप सम्मिलित हैं। प्राप्त बीजाणु समकालीन वनस्पतिजात में उत्पादी पादपों के अनुकूलतम निरूपण हैं। भारत में पर्मियन अवसाद उष्णकटिबंधीय पर्यावरण के अंतर्गत ज़्यादातर निक्षेपित हुए हैं तथा ये निक्षेप आंचलिक वर्णनों से परिवर्तित रूप से विषम हैं। इन बीजाणुओं में बाह्य चोल की सूक्ष्मसंरचनाओं से असीम संभावनाएं हैं जो काल के माध्यम से आकारिकीय वंश परंपराओं में आदि एवं उच्च दशाएं निर्धारित करती हैं तथा बाह्य चोल संरचनाओं की यह परिवर्तनीयता जैवस्तरक्रमविज्ञान में प्रभावी रूप से प्रयुक्त होती हैं। इस प्रकाशन का उद्देश्य भारत में पर्मियन अवसादों से प्राप्त बीजाणुओं के आकार-वर्गीकरणविज्ञान पर उपलब्ध प्रकाशित आंकड़ा को एक साथ रखना है। इन बीजाणुओं को पोतोनी 1956 द्वारा प्रस्तावित वर्गीकरण के अनुसार रखा गया है। व्याख्या भाग में प्रत्येक टैक्सॉन का जाति प्रकार, वंश की मुख्य विशेषताएं तथा वंश, उपबरती, क्षितिज व आयु के अंतर्गत वर्णित जाति दी गई हैं। प्रत्येक जाति की मूलप्ररूप आकृति मूल प्रकाशन से क्रमवीक्षित की गई है। प्रकाशन (1–10 प्लेटें) के उनके वर्ष के आरोही क्रम में टैक्सॉन के अंतर्गत जाति व्यवस्थित की गई हैं। यहां भू-वैज्ञानिक आयु मानक समय तालिका में है। अंतिम अध्याय में कुछ विशिष्ट जातियों के प्रथम उद्भव विभव आधार (एफएडी) सहित स्तरिकीय प्राप्तिओं पर टिप्पणियां की गई हैं, जो तिवारी एवं त्रिपाठी द्वारा 1992 में वर्णित मुख्य पराग टैक्सा के समुच्चय मंडल में सार्थक हैं। यहां परामर्शित साहित्य 2011 तक की ग्रंथसूची में दिया गया है।

संकेत-शब्द—पर्मियन बीजाणु, गोंडवाना अनुक्रम, आकार-वर्गीकरणविज्ञान, स्तरक्रमविज्ञान।

INTRODUCTION

On the basis of palynological data published from the Lower Gondwana succession in India, it is surmised that the spore species occur in each horizon either in isolation or in a group. Species of a taxon do not occur consistently throughout the Permian succession. Moreover, a group of species prevails within each horizon of the Permian sequence, with variable quantitative counts.

The occurrence of spore taxa (Fig. 3) from the basalmost Permian (Talchir Formation) to latest Permian (Raniganj Formation) has already been dealt previously (Tiwari & Singh, 1981; Vijaya & Tiwari, 1987; Tiwari & Vijaya, 1995; Vijaya, 1996; Jha & Srivastava, 1996; Tripathi, 1996; Vijaya *et al.*, 2001). The spores vary in diversity throughout the Permian. Such inconsistencies among these spores are the result of habitat of the parent plants. Presently, the groups of species have been defined in the abundant population of monosaccate (*Parasaccites*, *Plicatipollenites*, *Potonieisporites* and *Densipollenites*) and bisaccate (*Scheuringipollenites*, *Faunipollenites*, *Striatopodocarpites* and *Crescentipollenites*) pollen taxa. Among these spore species, it has been observed that as a group, some of the characteristic species made their first appearance at different horizons as shown in Fig. 3. Later some of these species either continued or discontinued in the subsequent younger horizons. Moreover, most of the species (Fig. 3) occur throughout the Permian succession with varied frequencies.

In the oldest horizon, the glaciogene sediments (mudstone mixed with boulder bed) from Talchir Formation, *Leiotriletes* sp., *Callumispora* sp., *Microfoveolatispora* sp., *Apiculatisporis* sp. and *Verrucosisporites* sp. of Group A, do occur but very meagrely (1 or 2 specimens). Up in the khaki-green needle shales and sandstone facies, new forms of Group B, occur in (*Callumispora gretensis*, *Plicatisporites distinctus*, *Imparitriletes korbaensis*, *Microfoveolatispora foveolata*, *Verrucosisporites varius* and *Dentatispora* sp.) along with Group A.

Patterns in the evolutionary morphology of spores have been observed within transitional facies from the glaciogene sediments into the carbonaceous and coal facies (Lele, 1975; Tiwari *et al.*, 1981; Venkatachala *et al.*, 1995). At the transition from khaki green into carbonaceous facies (Karharbari Formation), species of Group C—*Callumispora barakarensis*, *Jayantisporites* spp., *Dentatispora* spp. and *Indotriradites* sp. have made their first appearances and continue throughout this lithounit. At this level, diversity is displayed, both in quantity and quality among *Jayantisporites*, *Callumispora* and *Varitriletes* group.

In the first phase of coal facies (Barakar Formation), species diversity among the spore taxa *Microbaculispora*, *Microfoveolatispora*, *Horriditriletes* and *Godavarisporites* had attained its maximum (Bharadwaj & Tripathi, 1978).

Group D includes species—*Microbaculispora barakarensis*, *Microfoveolatispora bokaroensis*, *Horriditriletes novus* and *H. curvibaculosus*, which occur at the bottom of coal facies. Within the total extent of Barakar Formation, species among the taxa *Brijrajisporites*, *Microbaculispora*, *Microfoveolatispora*, *Horriditriletes*, *Godavarisporites*, *Dentatispora* and *Indotriradites* had flourished and captured the scenario. This composition reflects the diversified and rich nature of the then vegetation.

In the Barren Measures Formation, the kind and numbers of species decline in comparison to those of Barakar Formation. This might be due to relatively warmer and less humid climate in the Barren Measures Formation, which was not suited for the newer crop of species. Hence, no new morphology of the spore species had appeared. An abundance of enveloping monosaccate pollen taxa (*Densipollenites*) dominate. The next level of proliferation in the species occur at the onset of second phase of coal horizon in the Upper Permian. This is marked by the FAD of species in Group E—*Microbaculispora villosa*, *Microfoveolatispora raniganjensis*, *Didecitriletes ericianus* and *Gondisporites raniganjensis*.

Furthermore, through this major coal horizon (not so well developed in all the basins), major species diversity had been attained in kind and number, as represented by the species in Group F—*Cyclobaculisporites* spp., *Microbaculispora* spp., *Horriditriletes* spp., *Indospora* spp. and *Indotriradites* spp. (Fig. 3).

Moreover, other index species—*Striatosporites brazilensis*, *Navalesporites spinosus* and *Triquitrites* sp. are indicative of proximity level of Late Permian. The sporadic occurrences of species in Group G—*Densosporites playfordia* and *Verrucosisporites raniganjensis* identifies the closing phase for the coal facies. The steady occurrences of the species in Group G, in the khaki-green facies of Panchet Formation delimit the basalmost Triassic. The above mentioned species groups alongwith an abundance of monosaccate and bisaccate pollen taxa (Tiwari & Tripathi, 1992) are applicable in delimiting the different levels in the Permian successions in India.

CHECK-LIST OF SPORES ON RECORD IN THE PERMIAN SUCCESSION OF INDIA

Anteturma: Sporites Potonié 1893

Turma: Monoletes Ibrahim 1933

Subturma: Azonomonoletes Lubert 1935

Infraturma: Psilamonoleti v.d. Hammen 1955

Genus: *Altimonoletes* Kar 1969

A. flavatus Kar 1969

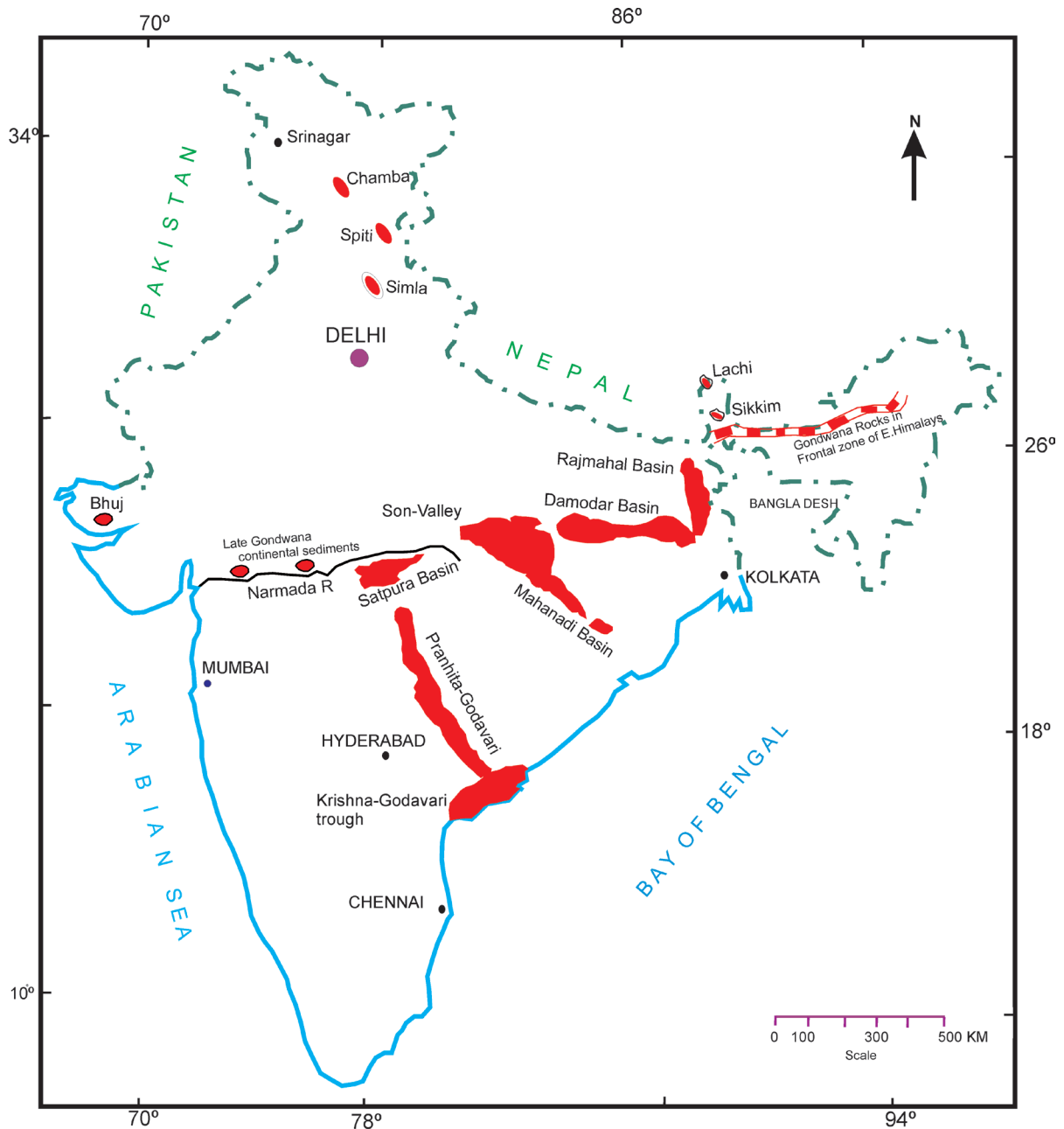


Fig. 1—Map showing the coalfields on peninsular and extra peninsular India, where in the Permian successions had been studied palynologically (after Datta *et al.* 1983).

Infraturma: Laevigatomoleti (B & K) Potonié 1956

Genus: *Laevigatosporites* (Ibrahim) Schopf *et al.* 1944
L. vulgaris Ibrahim 1933
L. minimus (Wilson & Coe) Schopf *et al.* 1944
L. colliensis (Balme & Hennelly) Venkatachala & Kar 1968
L. plicatus Kar 1968
L. punctatus Venkatachala & Kar 1968

Genus: *Latosporites* Potonié & Kremp 1954

L. latus (Kosanke) Potonié & Kremp 1954
L. colliensis (Balme & Hennelly) Bharadwaj 1962
L. striatus Salujha 1964

Infraturma: Ornati Potonié 1956

Genus: *Leschikisporis* Potonié 1958

L. aduncus (Leschik) Potonié 1958
L. baculatus Venkatachala & Kar 1968

- Genus:** *Punctatosporites* Ibrahim 1933
P. minutus Ibrahim 1933
P. dulcis Venkatachala & Kar 1968
P. morosus Venkatachala & Kar 1968
- Genus:** *Navalesporites* Sarate & Ram–Awatar 1984
N. spinosus Sarate & Ram–Awatar 1984
- Genus:** *Tiwariaspis* Maheshwari & Kar 1967
T. flavatus Maheshwari & Kar 1967
T. gondwanensis (Tiwari) Maheshwari & Kar 1967
T. simplex (Tiwari) Maheshwari & Kar 1967
T. indicus Srivastava 1970
T. novus (Srivastava 1970) Bharadwaj & Dwivedi 1981
- Genus:** *Thymospora* Wilson & Venkatachala 1963
T. thiessenii (Kosanke) Wilson & Venkatachala 1963
T. gondwanensis Bharadwaj & Salujha 1964
T. raniganjensis Venkatachala & Kar 1968
- Genus:** *Striatosporites* Bharadwaj emend. Playford & Dino 2000
S. major Bharadwaj 1954
S. brazilensis Bharadwaj *et al.* 1976
S. ovalis (Pepper) Playford & Dino 2000
- Infraturma:** *Sculptatomoleti* Dybova & Jackowitz 1957
- Genus:** *Spinospores* Alpern 1958
S. spinosus Alpern 1958
- Infraturma:** *Varimonoleti* Kar 1969
- Genus:** *Ghoshiasporites* Kar 1969
G. didecus Kar 1969
- Turma:** *Triletes* (Rheinsch) Potonié & Kremp 1954
- Subturma:** *Azonotriletes* Lubert 1935
- Infraturma:** *Laevigati* (Bennie & Kidston) Potonié 1956
- Genus:** *Aulisporites* (Leschik) Klaus 1960
A. canalis Leschik 1955
A. rarus Kar 1968
- Genus:** *Calamospora* Schopf *et al.* 1944
C. hartungiana Schopf *et al.* 1944
C. microrugosus (Ibrahim) Schopf *et al.* 1944
C. pedata Kosanke 1950
C. aplata Bharadwaj & Salujha 1964
- C. exila* Bharadwaj & Salujha 1964
C. rotata Salujha 1965
C. plicata Tiwari & Navale 1967
C. ovalis Saksena 1971
C. majus Saksena 1971
- Genus:** *Callumispora* Bharadwaj & Srivastava emend. Tiwari *et al.* 1989
C. barakarensis Bharadwaj & Srivastava emend. Tiwari *et al.* 1989
C. fungosa (Balme) Bharadwaj & Srivastava emend. Tiwari *et al.* 1989
C. gretensis (Balme & Hennelly) Bharadwaj & Srivastava emend. Tiwari *et al.* 1989
C. paliensis Tiwari & Ram–Awatar 1988
- Genus:** *Concavisporites* Plug emend. Delcourt & Sprumont 1955
C. rugulatus Plug in Thomson & Plug 1953
C. bankolensis Bharadwaj & Salujha 1964
Callumispora saksenae Tiwari & Ram–Awatar 1988
- Genus:** *Eupunctisporites* Bharadwaj 1962
E. poniatiensis Bharadwaj 1962
E. gravus Bharadwaj & Salujha 1964
- Genus:** *Hennellysporites* Tiwari 1968
H. diversiformis (Balme & Hennelly) Tiwari 1968
H. indicus Tiwari 1968
- Genus:** *Leiotriletes* (Naumova) Potonié & Kremp 1954
L. sphaerotriangulus (Loose) Potonié & Kremp 1954
L. virkkii Tiwari 1965
L. erectus Kar 1968
L. conspicuous Saxena 1971
L. brevis Sinha 1972
- Genus:** *Psilalacinites* Kar 1969
P. triangulus Kar 1969
P. indicus Lele & Makada 1974 (placed under *Lecinitirletes*)
- Genus:** *Punctatisporites* (Ibrahim) Potonié & Kremp 1954
P. punctatus Ibrahim 1933
P. minutus Kosanke 1950
P. gretensis Balme & Hennelly 1956
P. priscus Bharadwaj & Salujha 1965
P. reticulatus Pant & Srivastava 1965
P. indicus Tiwari 1968
P. ganjrensis Lele & Maithy 1969
P. plicatus (Tiwari & Navale) Lele & Makada 1974

Gondwana Basins Age	MAHANADI VALLEY BASIN	KAMTEE-WARDHA VALLEY BASIN	RAJMAHAL-PURNEA-GALSI BASIN	DAMODAR BASIN	SOUTH REWA BASIN	SATPURA BASIN	GODAVARI VALLEY BASIN			
PERMIAN Upper	Upper Kamthi Member	K A M T H I FORMATION	Panchet Formation		F p O R A M A L T I I O N Upper Member Middle Member Lower Member	Bijori Formation	Kamthi Formation			
	Lower Kamthi Member (coal)		H I A T U S	Raniganj Formation				Barren Measures	Motur Formation	Barren Measures
	Barren Measures			Barren Measures						
PERMIAN Lower	Barakar Formation	Barakar Formation	Barakar Formation	Barakar Formation	Barakar Formation	Barakar Formation	Barakar Formation			
	Karharbari Formation			Karharbari Formation	Karharbari Formation					
	Talchir Formation	Talchir Formation	Talchir Formation	Talchir Formation	Talchir Formation	Talchir Formation	Talchir Formation			

Fig. 2—Lithostratigraphy of the Permian sediments in different basins of India (after Datta *et al.* 1983).**Genus:** *Retusotriletes* Naumova 1953*R. simplex* Naumova 1953*R. diversiformis* (Balme & Hennelly) Bharadwaj 1962*R. aridus* Venkatachala & Kar 1968*R. dejersey* Venkatachala & Rawat 1978**Genus:** *Ricaspora* Bharadwaj & Salujha 1964*R. granulata* Bharadwaj & Salujha 1964**Infraturma:** Apiculati (Bennie & Kidston) Potonié 1956**Genus:** *Acanthotriletes* (Naumova) Potonié & Kremp 1954*A. ciliatus* (Knox) Potonié & Kremp 1954*A. filiformis* (Balme & Hennelly) Tiwari 1965*A. jhariaensis* Kar 1968**Genus:** *Altitriletes* Venkatachala & Kar 1968*A. densus* Venkatachala & Kar 1968**Genus:** *Anapiculatisporites* Potonié & Kremp 1954*A. isselburgensis* Potonié & Kremp 1954*A. longispinosus* Bharadwaj & Salujha 1965*A. consonus* Venkatachala & Kar 1968*A. veritas* Venkatachala & Kar 1968*A. ericinus* (Balme & Hennelly) Venkatachala & Kar 1965 (under *Didectriletes*)**Genus:** *Apiculatisporis* (Ibrahim) Potonié & Kremp 1956*A. aculeatus* (Ibrahim) Potonié & Kremp 1956*A. grandis* Salujha 1965*A. inconspicuus* Salujha 1965*A. weylandii* Bharadwaj & Salujha 1965*A. levis* (Balme & Hennelly) Tiwari 1968*A. secretus* Venkatachala & Kar 1968**Genus:** *Arasporites* Srivastava & Saxena 1984*A. crassus* Srivastava & Saxena 1984**Genus:** *Brijrajisporites* Tiwari 1968*B. distinctus* Tiwari 1968*B. fuscus* Tiwari 1968**Genus:** *Cyclogranisporites* Potonié & Kremp 1954*C. leopoldi* (Kremp) Potonié & Kremp 1954*C. gondwanensis* Bharadwaj & Salujha 1964*C. optimus* Bharadwaj & Salujha 1965*C. barakarensis* Srivastava 1970*C. triletus* Kar 1970**Genus:** *Cyclobaculisporites* Bhardwaj 1955*C. grandiverrucosus* (Kosanke) Bhardwaj 1955*C. minutus* Bharadwaj & Salujha 1964*C. indicus* (Bharadwaj) Bharadwaj & Salujha 1964*C. bharadwajii* Salujha 1965*C. proprius* Bharadwaj & Salujha 1965*C. minimus* Kar 1968**Genus:** *Godavarisporites* Tiwari & Moiz 1971*G. indicus* Tiwari & Moiz 1971

- G. tentulus* Tiwari & Moiz 1971
G. parmatus (Balme & Hennelly) Tiwari & Moiz
 1971
G. jamottei (Kar & Bose) Tiwari & Moiz 1971

Genus: *Granulatisporites* (Ibrahim) Potonié & Kremp 1954
G. granulatus (Ibrahim) Potonié & Kremp 1954

- Genus:** *Horriditriletes* Bharadwaj & Salujha 1964
H. curvibaculosus Bharadwaj & Salujha 1964
H. brevis Bharadwaj & Salujha 1964
H. ramosus (Balme & Hennelly) Bharadwaj &
 Salujha 1964
H. elegans Bharadwaj & Salujha 1965
H. splendidus Bharadwaj & Salujha 1965
H. bulbosus Tiwari 1965
H. novus Tiwari 1965
H. unicus Tiwari 1965
H. rampurensis Tiwari 1968
H. pathakheraensis Anand–Prakash 1972
H. pseudoseptatus Sinha 1972
H. rajmahalensis D’Rozario & Banerjee 1987

Infraturma: *Verrucati* Dyb. Jacho. 1957

Genus: *Lalmatiasporites* D’Rozario & Banerjee 1987
L. indicus D’Rozario & Banerjee 1987
L. barakarensis D’Rozario & Banerjee 1987

Genus: *Lobatosporites* Tiwari & Moiz 1971
L. gondwanensis Tiwari & Moiz 1971
L. brevibaculosus Tiwari & Moiz 1971

Infraturma: *Apiculati* (Bennie & Kidston) Potonié 1956

Genus: *Lophotriletes* (Naumova) Potonié & Kremp 1954
L. gibbosus (Ibrahim) Potonié & Kremp 1954
L. rectus Bharadwaj & Salujha 1964
L. rarus Bharadwaj & Salujha 1964
L. pseudogranus Bharadwaj & Salujha 1964
L. frequens Tiwari 1965
L. minimus Salujha 1965
L. novus Kar 1968
L. latiangulatus Kar 1968

Genus: *Osmundacidites* Couper 1953
O. wellmanii Couper 1953
O. baculatus Tiwari & Ram–Awatar 1988
O. Pilatus Tiwari & Rana 1981
O. senectus Balme emend. Srivastava & Jha 1989

Genus: *Verrucosisporites* (Ibrahim) emend. Smith &
 Butterworth 1971
V. verrucosus (Ibrahim) Potonié & Kremp 1954

- V. donarii* Potonié & Kremp 1955
V. distinctus Tiwari 1965
V. diversus Bharadwaj & Salujha 1965
V. varius Maheshwari 1967
V. ambiplicatus Kar 1968
V. gondwanensis Srivastava 1970
V. narmianus Balme 1970
V. maiturensis Bharadwaj & Dwivedi 1981
V. raniganjensis Bharadwaj & Dwivedi 1981

Infraturma: *Varitriletes* Venkatachala & Kar 1965

Genus: *Brevitriletes* Bharadwaj & Srivastava emend.
 Tiwari & Singh 1981
B. communis Bharadwaj & Srivastava emend.
 Tiwari & Singh 1981
B. unicus (Tiwari) Bharadwaj & Srivastava emend.
 Tiwari & Singh 1981

Genus: *Didicitriletes* Venkatachala & Kar emend. Tiwari
 & Singh 1981
D. horridus Venkatachala & Kar emend. Tiwari &
 Singh 1981
D. ericianus (Balme & Hennelly) Venkatachala &
 Kar 1965
D. dentatus (Balme & Hennelly) Venkatachala &
 Kar 1965
D. uncinatus (Balme & Hennelly) Venkatachala &
 Kar 1965

Genus: *Imparitriletes* Tiwari & Singh 1981
I. korbaensis Tiwari & Singh 1981

Genus: *Jayantiasporites* Lele & Makada 1972
J. pseudozonatus Lele & Makada 1972
J. conatus Lele & Makada 1972
J. indicus Lele & Makada 1972
J. pseudozonatus var. *minor* Chandra & Lele 1972

Genus: *Lacinitriletes* Venkatachala & Kar emend. Tiwari &
 Singh 1981
L. badamensis Venkatachala & Kar emend. Tiwari
 & Singh 1981
L. minutus Venkatachala & Kar emend. Tiwari &
 Singh 1981

Genus: *Microbaculispora* Bharadwaj 1962
M. gondwanensis Bharadwaj 1962
M. villosa (Balme & Hennelly) Bharadwaj emend.
 Tiwari & Singh 1981
M. tentula Tiwari 1965
M. indica Tiwari emend. Tiwari & Singh 1981
M. barakarensis Tiwari emend. Tiwari & Singh
 1981

Species	Talchir		Karharbari	Karharbari–Barakar transition	Barakar	Basal most Raniganj	Raniganj	P/T
	Basal most	Upper						
Group A								
<i>Hennellysporites</i> sp.	+							
<i>Granulatisporites</i> sp.	+							
<i>Microfoveolatispora</i> sp.	+							
<i>Verrucosisporites donarii</i>	+							
Group B								
<i>Callumispora gretensis</i>		+						
<i>Microfoveolatispora foveolata</i>		+						
<i>Plicatisporites distinctus</i>		+						
<i>Cyclogranisporites plicatus</i>		+						
<i>Verrucosisporites varius</i>		+						
<i>Imparitriletes korbaensis</i>		+						
<i>Microbaculispora tentula</i>		+						
Group C								
<i>Jayantisporites</i> spp.		+		+				
<i>Acanthotriletes filiformis</i>			+					
<i>Dentatispora</i> spp.			+					
Group D								
<i>Horriditriletes</i> spp.				+				
<i>Microbaculispora barakarensis</i>				+				
<i>Microfoveolatispora bokaroensis</i>					+			
<i>Godavarisporites</i> spp.					+			
<i>Indotriradites</i> spp.					+			
<i>Pseudoreticulatispora barakarensis</i>					+			
<i>Labatosporites</i> spp.					+			
<i>Didecitriletes horridus</i>					+			
Group E								
<i>Indospora clara</i>							+	
<i>Didecitriletes ericianus</i>							+	
<i>Microbaculispora gondwanensis</i>							+	
<i>Microfoveolatispora raniganjensis</i>							+	
<i>Triquitrites proratus</i>							+	
<i>Gondisporites</i> spp.							+	
Group F							+	
<i>Navalesporites spinosus</i>							+	
<i>Striatosporites</i> spp.							+	
Group G								
<i>Verrucosisporites raniganjensis</i>								+
<i>Densosporites playfordia</i>								+

Fig. 3—Showing the first occurrences of key spore species at each horizon in the Permian Succession.

- Genus:** *Microfoveolatispora* Bharadwaj 1962
M. raniganjensis Bharadwaj emend. Tiwari & Singh 1981
M. bokaroensis Tiwari 1965
M. foveolata Tiwari emend. Tiwari & Singh 1981
- Infraturma:** Muornati Potonié & Kremp 1954
- Genus:** *Camptotriletes* (Naumova) Potonié & Kremp 1954
C. corrugatus Potonié & Kremp 1954
C. bellus Venkatachala 1968
- Genus:** *Cyclofoveolatispora* Venkatachala & Kar 1968
C. caecus Venkatachala & Kar 1968
C. plicatus Venkatachala & Kar 1968
C. minutus Venkatachala & Kar 1968
- Genus:** *Dictyotriletes* (Naumova) Potonié & Kremp 1954
D. bireticulatus (Ibrahim) Potonié & Kremp 1954
D. invisus Bharadwaj & Salujha 1964
- Genus:** *Ghoshiatriletes* D'Rozario & Banerjee 1987
G. gondwanensis D'Rozario & Banerjee 1987
- Genus:** *Plicatisporites* Lele & Makada 1972
P. distinctus Lele & Makada 1972
- Genus:** *Pseudoreticulatispora* Bharadwaj & Srivastava 1969
P. barakarensis Bharadwaj & Srivastava 1969
- Genus:** *Reticulatisporites* (Ibrahim) Potonié & Kremp 1954
R. reticulatus Ibrahim 1933
- Genus:** *Varireticulates* Kar 1969
V. varius Kar 1969
- Infraturma:** Striasporiti Kar 1969
- Genus:** *Striasporis* Kar 1969
S. striatus Kar 1969
- Infraturma:** Perinotrileti Erdtman 1947
- Genus:** *Velamisporites* Bharadwaj & Venkatachala 1968
V. pukraensis Venkatachala & Kar 1968
- Subturma:** Zonotriletes Waltz 1935
- Infraturma:** Cingulati Potonié & Klaus 1954
- Genus:** *Densosporites* (Berry) Potonié & Kremp 1954
D. convensis Berry 1937
- D. splendens* Saksena 1971
- Genus:** *Dentatispora* Tiwari 1964
D. indica Tiwari 1964
D. crassa Tiwari 1965
D. gondwanensis Tiwari 1965
D. implicata Tiwari 1965
D. lacunata Tiwari 1965
D. mammoida Tiwari & Ram-Awatar 1988
D. reticulata Tiwari & Ram-Awatar 1988
- Infraturma:** Zonati Potonié & Kremp 1954
- Genus:** *Cirratriradites* Wilson & Coe 1940
C. maculatus Wilson & Coe 1940
C. gondwanensis Tiwari 1965
- Genus:** *Gondisporites* Bharadwaj 1962
G. raniganjensis Bharadwaj 1962
G. imbricatus Segroves 1970
G. reticulatus Tiwari & Ram-Awatar 1988
- Genus:** *Indotriradites* Tiwari 1964
I. korbaensis Tiwari 1964
I. sparsus Tiwari 1965
I. surangei Tiwari 1965
I. varius Venkatachala & Kar 1968
- Genus:** *Insignisporites* Bharadwaj & Dwivedi 1977
I. barakarensis Bharadwaj & Dwivedi 1977
- Genus:** *Potonieitriradites* Bharadwaj & Sinha 1969
P. barakarensis Bharadwaj & Sinha 1969
P. tuberculatus Sinha 1972
P. subtilis Sinha 1972
P. angustus (Bose & Kar) Bharadwaj & Dwivedi 1981
P. mercenierii (Bose & Kar) Bharadwaj & Dwivedi 1981
P. renierii (Bose & Kar) Bharadwaj & Dwivedi 1981
- Turma: Zonales** (Bennie & Kidson) Potonié 1956
- Subturma:** Auritotriletes Potonié & Kremp 1954
- Infraturma:** Auriculati (Schopf) Potonié & Kremp 1954
- Genus:** *Indospora* Bharadwaj 1962
I. clara Bharadwaj 1962
I. macula Bharadwaj & Salujha 1964
I. laevigata Bharadwaj & Salujha 1964

Genus: *Lycospora* (Schopf *et al.*) Potonié & Kremp 1954
L. micropapillatus Schopf *et al.* 1944
L. minuta Saksena 1971

Genus: *Triquitrites* Wilson & Coe 1940 emend. Potonié & Kremp 1954
T. reticulatus Wilson & Coe 1940
T. valvetus Saksena 1971

DESCRIPTION OF GENERA AND SPECIES OF PERMIAN SPORES

Turma: Monoletes Ibrahim 1933

Subturma: Azonomonoletes Lubert 1935

Infraturma: Psilamonoleti v.d. Hammen 1955

Genus: *Altimonoletes* Kar 1969

Type species: *Altimonoletes flavatus* Kar 1969.
Locality, Horizon & Age: Borecore K2, 61.09–61.19 m, North Karanpura Coalfield, Damodar Basin, Jharkhand, India; Raniganj Formation, Late Permian.

Salient features: Oval–elliptical; monolete highly raised; exine finely punctate, puncta irregularly distributed all over surface.

Altimonoletes flavatus Kar 1969

Holotype: Kar, 1969; pl. 1, figs 8, 9; size 53 x 38 μm .
Locality, Horizon & Age: Borecore K2, 61.09–61.19 m, North Karanpura Coalfield, Damodar Basin, Jharkhand, India; Raniganj Formation, Late Permian.

Salient features: Size 40–65 x 30–50 μm ; monolete high up to 5 μm ; exine ± 1 μm thick, puncta ± 0.5 μm in diameter, closely placed, sometimes not distinctly visible.

Infraturma: Laevigatomonoleti (B & K) Potonié 1956

Genus: *Laevigatosporites* (Ibrahim) Schopf *et al.* 1944

Type species: *Laevigatosporites vulgaris* Ibrahim 1933.
Locality, Horizon & Age: Ruhrgebiet, Flöz Agir, Germany; Westphalian B/C, Late Carboniferous.

Salient features: Bilateral, elliptical; monolete distinct along longitudinal axis; exine smooth proximally, indistinctly punctate on distal face.

Laevigatosporites vulgaris Ibrahim 1933

Holotype: Ibrahim 1933; pl. 2, fig. 16; size 54 x 69.5 μm .

Locality, Horizon & Age: Ruhrgebiet, Flöz Agir, Germany; Westphalian B/C, Late Carboniferous.

Salient features: Size 35–77 μm ; monolete indistinct; exine faintly micropunctate.

Laevigatosporites minimus (Wilson & Coe) Schopf *et al.* 1944

Holotype: Wilson & Coe, 1940; pl. 1, pl. 5; size 21 μm .
Locality, Horizon & Age: Des Moines Series, Iowa, USA; Pennsylvanian, Late Carboniferous.

Salient features: Size 21–29 μm long; monolete, exine thin, smooth.

Laevigatosporites plicatus Kar 1968

Holotype: Kar, 1968; pl. 1, fig. 28; size 41 μm .
Locality, Horizon & Age: Borehole No. J.K. 5, Jharia Coalfield, Damodar Basin, Jharkhand, India; Barren Measures Formation, Late Permian.

Salient features: Size 41–55 μm ; monolete obscure; exine less than 1 μm thick, folded all over body surface.

Laevigatosporites punctatus Venkatachala & Kar 1968

Holotype: Venkatachala & Kar, 1968; pl. 1, fig. 7; size 84 x 60 μm .

Locality, Horizon & Age: Lungatoo, North Karanpura Coalfield, Damodar Basin, Bihar, India; Barakar Formation, Early Permian.

Salient features: Size 56–65 x 86–100 μm ; monolete distinct, extend $\frac{3}{4}$ along longitudinal axis; exine up to 2 μm thick, puncta 0.5 μm in diameter.

Genus: *Latosporites* Potonié & Kremp 1954

Type species: *Latosporites latus* (Kosanke) Potonié & Kremp 1954.

Locality, Horizon & Age: Mc Cleary's bluff coal bed, Wabash County, Illinois, USA; Pennsylvanian, Late Carboniferous.

Salient features: Oval; monolete distinct, extend up to $\frac{3}{4}$ along longitudinal axis; exine laevigate to intrareticulate.

Latosporites latus (Kosanke) Potonié & Kremp 1954

Holotype: Potonié & Kremp 1954; pl. 5, fig. 11; size 63 x 54.6 μm .

Locality, Horizon & Age: Mc Cleary's bluff Coal bed, Wabash County, Illinois, USA; Pennsylvanian, Late Carboniferous.

Salient features: Size 57–66 μm ; monolete distinct, extend $\frac{3}{4}$ along longitudinal axis; exine laevigate, 1.5–2 μm thick.

Latosporites colliensis (Balme & Hennelly) Bharadwaj
1962

Holotype: Balme & Hennelly, 1956; pl. 1, fig. 1; size 75 x 50 µm.

Locality, Horizon & Age: Main Seam, Proprietary Colliery, western Australia; Permian.

Salient features: Size 50–76 x 31–51 µm; monolete exine thin, folded and teared.

Latosporites striatus Salujha 1964

Holotype: Bharadwaj & Salujha, 1964; pl. 3, fig. 64; size 96–120 µm.

Locality, Horizon & Age: IX upper Kajora Seam, Jaipuria Colliery, Raniganj Coalfield; Raniganj Stage; Upper Permian.

Salient features: Size 120 µm; monolete clearly seen, exine lavigate, proximally bearing 4–6 striation parallel to monolete.

Infraturma: Ornati Potonié 1956

Genus: *Leschikisporis* Potonié 1958

Type species: *Leschikisporites aduncus* Leschik 1955.

Locality, Horizon & Age: Neuwelt bei Basel, Switzerland; Keuper, Late Triassic.

Salient features: Rounded to oval; mono to asymmetrical trilete mark, one ray being shorter than other two; exine beset with the granular sculpture.

Leschikisporis aduncus Potonié 1958

Holotype: Leschik 1955; pl. 3, fig. 17; size 43 µm.

Locality, Horizon & Age: Neueselt bei Basal, Switzerland; Keuper, Late Triassic.

Salient features: Size 33–48 µm; exine less than 1 µm thick, sculptured with grana, less than 0.5 µm in diameter.

Leschikisporis baculatus Venkatachala & Kar 1968

Holotype: Venkatachala & Kar, 1968; pl. 1, fig. 23; size 46 x 36 µm.

Locality, Horizon & Age: Badam, North Karanpura Coalfield, Damodar Basin, Jharkhand; Barakar Formation, Early Permian.

Salient features: Size 27–41 x 32–46 µm; unequal trilete rays, wide obtuse, third ray almost perpendicular; exine 1.5 µm thick, beset with coni, ±1 µm high and wide, closely spaced.

Genus: *Punctatosporites* Ibrahim 1933

Type species: *Punctatosporites minutus* Ibrahim 1933.

Locality, Horizon & Age: Ruhrgebiet, Flöz Agir, Germany; Westphalian B/C, Late Carboniferous.

Salient features: Bilateral, oval; monolete distinct, extend up to ¾ along longer axis; exine thin, microgranulose on both faces.

PLATE 1



Genus: *Altimonoletes* Kar 1969

1. *A. flavatus* Kar 1969 (source of photograph: Kar, 1969)

Genus: *Laevigatosporites* (Ibrahim) Schopf *et al.* 1944

2. *L. vulgaris* Ibrahim 1933 (source of photograph: Ibrahim, 1933)

3. *L. minimus* (Wilson & Coe) Schopf, *et al.* 1944 (source of photograph: Wilson & Coe, 1940)

4. *L. plicatus* Kar 1968 (source of photograph: Kar, 1968)

5. *L. punctatus* Venkatachala & Kar 1968 (source of photograph: Venkatachala & Kar, 1968)

Genus: *Latosporites* Potonié & Kremp 1954

6. *L. latus* (Kosanke) Potonié & Kremp 1954 (source of photograph: Potonié & Kremp, 1954)

7. *L. colliensis* (Balme & Hennelly) Bharadwaj 1962 (source of photograph: Balme & Hennelly, 1956)

8. *L. striatus* Salujha 1965 (source of photograph: Salujha, 1965)

Genus: *Leschikisporis* Potonié 1958

9. *L. baculatus* Venkatachala & Kar 1968 (source of photograph: Venkatachala & Kar, 1968)

Genus: *Punctatosporites* Ibrahim 1933

10. *P. minutus* Ibrahim 1933 (source of photograph: Ibrahim, 1933)

11. *P. dulcis* Venkatachala & Kar 1968 (source of photograph: Venkatachala & Kar, 1968)

12. *P. morosus* Venkatachala & Kar 1968 (source of photograph: Venkatachala & Kar, 1968)

Genus: *Navalesporites* Sarate & Ram–Awatar 1984

13. *N. spinosus* Sarate & Ram–Awatar 1984 (source of photograph: Sarate & Ram–Awatar, 1984)

Genus: *Tiwariaspis* Maheshwari & Kar 1967

14. *T. flavatus* Maheshwari & Kar 1967 (source of photograph: Maheshwari & Kar, 1967)

15. *T. gondwanensis* (Tiwari) Maheshwari & Kar 1967 (source of photograph: Tiwari, 1965)

16. *T. simplex* (Tiwari) Maheshwari & Kar 1967 (source of photograph: Tiwari, 1965)

17. *T. indicus* Srivastava 1970 (source of photograph: Srivastava, 1970)

18. *T. novus* (Srivastava) Bharadwaj & Dwivedi 1981 (source of photograph: Srivastava, 1970)

Genus: *Thymospora* Wilson & Venkatachala 1963

19. *T. thiessenii* (Kosanke) Wilson & Venkatachala 1963 (source of photograph: Wilson & Venkatachala, 1963)

20. *T. gondwanensis* Bharadwaj & Salujha 1964 (source of photograph: Bharadwaj, 1962)

21. *T. raniganjensis* Kar, 1969 (source of photograph: Kar, 1969)

Genus: *Striatosporites* Bharadwaj 1954

22. *S. major* Bharadwaj 1954 (source of photograph: Bharadwaj, 1954)

23. *S. brasiliensis* Bharadwaj *et al.* 1974 (source of photograph: Bharadwaj, Kar & Navale, 1976)

24. *S. ovalis* (Pepper) Playford & Dino 2000 (source of photograph: Peppers, 1964)

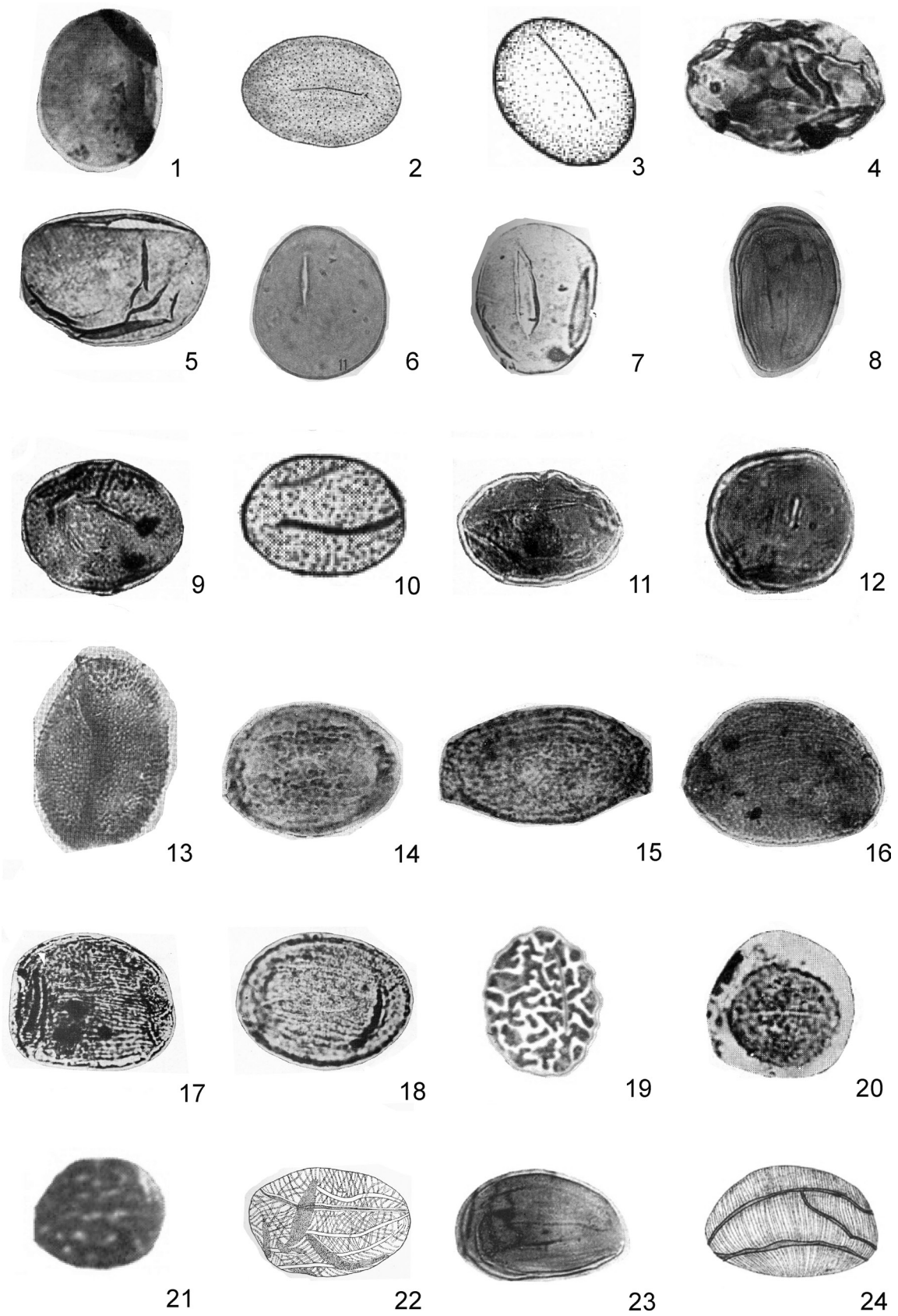


PLATE 1

Punctatosporites minutus Ibrahim 1933

Holotype: Ibrahim, 1933; pl. 5, fig. 33; size 22.5 x 25.5 μm .

Locality, Horizon & Age: Ruhrgebiet, Flöz Agir, Germany; Westphalian B/C, Late Carboniferous.

Salient features: Size 16–25 μm , monolete distinct extend; exine less than 1 μm thick, grana 0.5 μm in diameter.

Punctatosporites dulcis Venkatachala & Kar 1968

Holotype: Venkatachala & Kar, 1968; pl. 3, fig. 52; size 59 x 32 μm .

Locality, Horizon & Age: Badam, North Karanpura Coalfield, Damodar Basin, Jharkhand, India; Barakar Formation, Early Permian.

Salient features: Size 28–57 x 50–82 μm ; monolete extend $\frac{3}{4}$ along longitudinal axis; exine irregularly folded, 1 μm thick, microverrucose or granulose, elements less than 1 μm high.

Remark: From the photomicrographs of the specimen illustrated, no sculpture is visible. Hence, this species is suggested to be placed under genus *Laevigatosporites*.

Punctatosporites morosus Venkatachala & Kar 1968

Holotype: Venkatachala & Kar, 1968; pl. 3, fig. 57; size 36 x 36 μm .

Locality, Horizon & Age: Badam, North Karanpura Coalfield, Damodar Basin, Bihar, India; Barakar Formation, Early Permian.

Salient features: Size 36–46 x 36–50 μm ; monolete sometimes bent or bifurcated; exine less than 1 μm thick; finely microverrucose or granulose, less than 0.5 μm across.

Remarks: This species compares with *Leschikisporis aduncus* Potonié (1958) Potonié 1958 in the nature of germinal aperture.

Genus: *Navalesporites* Sarate & Ram–Awatar 1984

Type species: *Navalesporites spinosus* Sarate & Ram–Awatar 1984.

Locality, Horizon & Age: Sukh–Tawa River section, South Rewa Basin, Madhya Pradesh, India; Sukh–Tawa Formation, Upper Permian to Lower Triassic.

Salient features: Broadly bean shaped; monolete mark distinct, extending more than $\frac{3}{4}$ longitudinally; exine thin, beset with spines.

Navalesporites spinosus Sarate & Ram–Awatar 1984

Holotype: Sarate & Ram–Awatar, 1984; pl. 1, fig. 1; size 59 x 77 μm .

Locality, Horizon & Age: Sukh–Tawa River section, South Rewa Basin, Madhya Pradesh, India; Sukh–Tawa Formation, Upper Permian to Lower Triassic.

Salient features: Size 45–75 x 62–81 μm ; monolete mark distinct; exine $\pm 1 \mu\text{m}$ thick, beset with spinose sculpture, 2.0–3.5 μm high, 1–2 μm broad.

Genus: *Tiwariasporis* Maheshwari & Kar 1967

Type species: *Tiwariasporis flavatus* Maheshwari & Kar 1967.

Locality, Horizon & Age: North Karanpura Coalfield, Damodar Basin, Jharkhand, India; Barakar Formation, Early Permian.

Salient features: Oval–elliptical; monolete with incipient mark; exine thick, sculptured with closely spaced verrucae.

PLATE 2



- | | |
|---|---|
| Genus: <i>Spinisporites</i> Alpern 1958 | Genus: <i>Callumispora</i> Bharadwaj & Srivastava emend. Tiwari <i>et al.</i> 1989 |
| 1. <i>S. spinosus</i> Alpern 1958 (source of photograph: Alpern, 1958) | 12. <i>C. barakarensis</i> Bharadwaj & Srivastava emend. Tiwari <i>et al.</i> 1989 (source of photograph: Bharadwaj & Srivastava, 1969) |
| Genus: <i>Ghoshiasporites</i> Kar 1969 | 13. <i>C. fungosa</i> (Balme) Bharadwaj & Srivastava emend. Tiwari <i>et al.</i> 1969 (source of photograph: Balme, 1963) |
| 2. <i>G. didecus</i> Kar 1969 (source of photograph: Kar, 1969) | 14. <i>C. gretensis</i> (Balme & Hennelly) Bharadwaj & Srivastava emend. Tiwari <i>et al.</i> 1989 (source of photograph: Balme & Hennelly, 1956) |
| Genus: <i>Aulisporites</i> (Leschik) Klaus 1960 | 15. <i>C. paliensis</i> Tiwari & Ram–Awatar 1988 (source of photograph: Tiwari & Ram–Awatar, 1988) |
| 3. <i>A. rarus</i> Kar 1969 (source of photograph: Kar, 1969) | 16. <i>C. saksenae</i> Tiwari & Ram–Awatar 1988 (source of photograph: Tiwari & Ram–Awatar, 1988) |
| Genus: <i>Calamospora</i> Schopf <i>et al.</i> 1944 | Genus: <i>Concavisporites</i> Plug emend. Delcourt & Sprumont 1955 |
| 4. <i>C. microrugosus</i> (Ibrahim) Schopf <i>et al.</i> 1944 (source of photograph: Ibrahim, 1932) | 17. <i>C. bankolensis</i> Bharadwaj & Salujha 1964 (source of photograph: Bharadwaj & Salujha, 1964) |
| 5. <i>C. pedata</i> Kosanke 1950 (source of photograph: Kosanke, 1950) | Genus: <i>Eupunctisporites</i> Bharadwaj 1962 |
| 6. <i>C. aplata</i> Bharadwaj & Salujha 1964 (source of photograph: Bharadwaj & Salujha, 1964) | 18. <i>E. poniatensis</i> Bharadwaj 1962 (source of photograph: Bharadwaj, 1962) |
| 7. <i>C. exila</i> Bharadwaj & Salujha 1964 (source of photograph: Bharadwaj & Salujha, 1964) | 19. <i>E. gravus</i> Bharadwaj & Salujha 1964 (source of photograph: Bharadwaj & Salujha, 1964) |
| 8. <i>C. rotata</i> Salujha 1965 (source of photograph: Salujha, 1965) | |
| 9. <i>C. plicata</i> Tiwari & Navale 1967 (source of photograph: Tiwari & Navale, 1967) | |
| 10. <i>C. majus</i> Saksena 1971 (source of photograph: Saksena, 1971) | |
| 11. <i>C. ovalis</i> Saksena 1971 (source of photograph: Saksena, 1971) | |

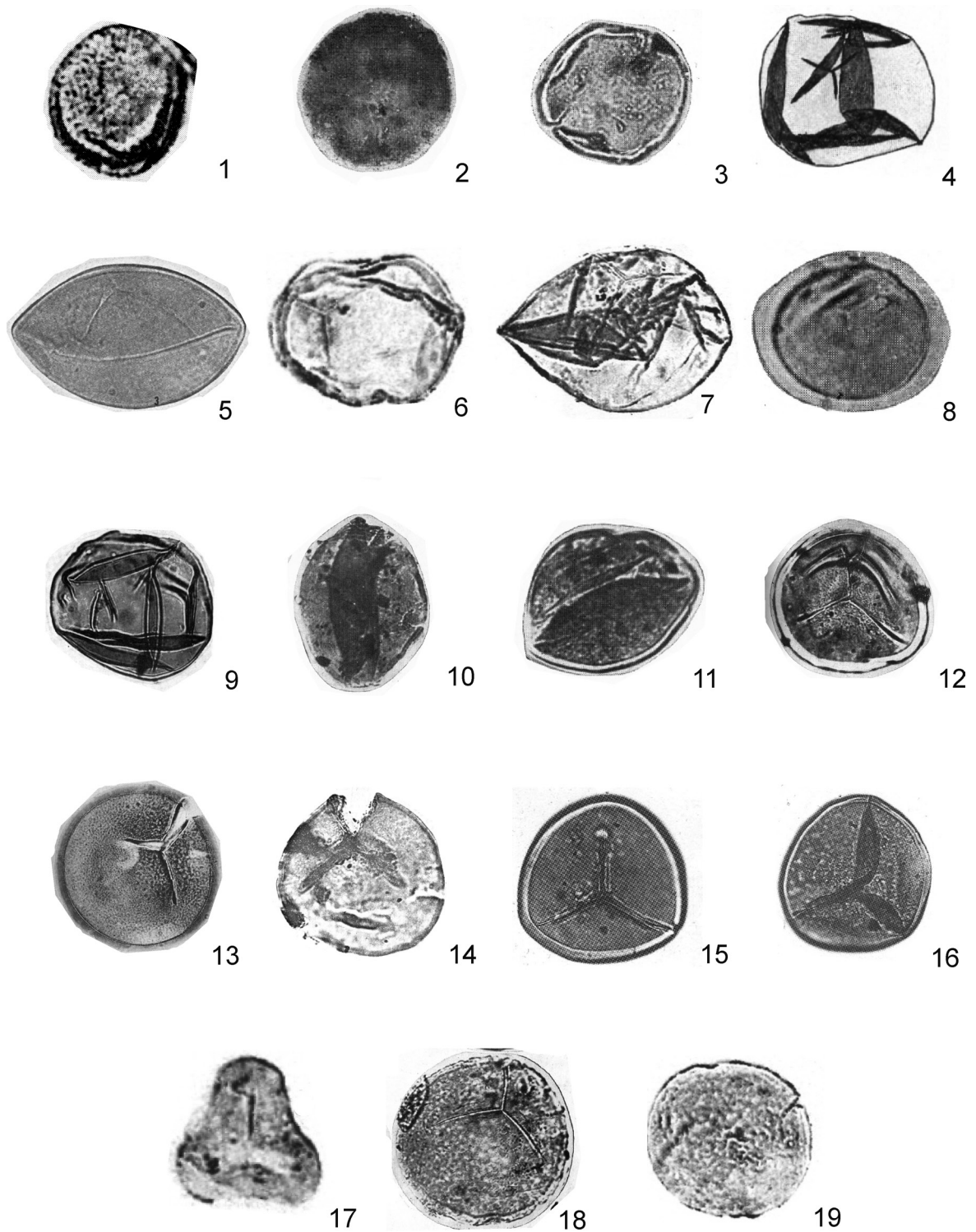


PLATE 2

Tiwariaspis flavatus Maheshwari & Kar 1967

Holotype: Maheshwari & Kar, 1967; figs 1 & 2; size 62 µm.

Locality, Horizon & Age: North Karanpura Coalfield, Damodar Basin, Jharkhand, India; Barakar Formation, Early Permian.

Salient features: Length 62–68 µm; laesura indistinct; exine up to 3 µm thick, beset with verrucae, ca 2 µm wide, densely spaced, evenly arranged in more than 20 rows, forming pseudo-striations; at extreme lateral ends very narrow flap like folds, up to 2 µm wide.

Tiwariaspis gondwanensis (Tiwari) Maheshwari & Kar 1967

Holotype: Tiwari, 1965; pl. 8, fig. 195; size 95–53 µm.

Locality, Horizon & Age: 202 (IV Seam), borehole R–34, Korba Coalfield, Son Valley, Chhattisgarh, India; Barakar Formation, Early Permian.

Salient features: Size 72–100 x 40–66 µm; exine ca 2 µm thick, verrucae closely set, 2–3 µm diameter, arranged irregularly forming 16–18 longitudinal striations on proximal face, inter-connected, striae forming a reticuloid pattern on distal face; at the lateral termini, 3–8 µm wide protuberances, appearing rudimentary sacci.

Tiwariaspis simplex (Tiwari) Maheshwari & Kar 1967

Holotype: Srivastava, 1970; pl. 2, fig. 20; size 100 x 78 µm.

Locality, Horizon & Age: Dera Colliery, Talchir Coalfield, Orissa, India; Barakar Formation, Early Permian.

Salient features: Size 60–110 x 45–82 µm; exine ca 2 µm thick, infrapunctate, puncta 0.5 µm in diameter; 12–24 pseudo-striations developed proximally consisting of bifurcated furrows, 2–3 µm wide; distal ornament reticuloid to

verrucoid, verrucae 2–4 µm in diameter; equatorial rib present; flap-like folds at lateral termini, 2–5 µm wide.

Tiwariaspis indicus Srivastava 1970

Holotype: Srivastava, 1970; pl. 2, fig. 20; size 100 x 78 µm.

Locality, Horizon & Age: Dera Colliery, Talchir Coalfield, Orissa, India; Barakar Formation, Early Permian.

Salient features: Size 60–110 x 45–85 µm; thick as perceptible; intrapunctate, puncta less than 0.5 µm in size, reticuloid-verrucoid, 12–24 pseudo-striations developed proximally and simple also locally dichotomized, slightly converging and end at or near the poles, equatorial ribs present.

Tiwariaspis novus (Srivastava) Bharadwaj & Dwivedi 1981

Holotype: Srivastava, 1970; pl. 2, fig. 22; size 92 x 70 µm.

Locality, Horizon & Age: Deulbera Colliery, Talchir Coalfield, Orissa, India; Barakar Formation, Early Permian.

Salient features: Size 65–120 x 45–90 µm; laesura perceptible; exine ca 1 µm thick, micropunctate, bearing horizontal 11–26 dichotomous pseudo-striations, inter-connected by transverse portions, furrows 3–5 µm wide, distal formed of irregularly arranged verrucae 3–5 µm in diameter; flap like folds, 5–8 µm wide, are developed at lateral termini.

Genus: *Thymospora* Wilson & Venkatachala 1963

Type species: *Laevigatosporites thiessenii* (Kosanke) Wilson & Venkatachala 1963.

Locality, Horizon & Age: Pennsylvania, USA; Late Carboniferous–Permian.

Salient features: Oval to bean-shaped; simple monolete; exine thin, verrucose, vermiculate to rugose sculpture.

PLATE 3



Genus: *Hennellysporites* Tiwari 1968

1. *H. diversiformis* (Balme & Hennelly) Tiwari 1968 (source of photograph: Balme & Hennelly, 1956)
2. *H. indicus* Tiwari 1968 (source of photograph: Bharadwaj & Tiwari, 1964)

Genus: *Leiotriletes* (Naumova) Potonie & Kremp 1954

3. *L. virkkii* Tiwari 1965 (source of photograph: Tiwari, 1965)
4. *L. erectus* Kar 1968 (source of photograph: Kar, 1968)
5. *L. conspicuous* Saxena 1971 (source of photograph: Saksena, 1970)
6. *L. brevis* Sinha 1972 (source of photograph: Sinha, 1972)

Genus: *Psilalacinites* Kar 1969

7. *P. triangulus* Kar 1969 (placed under *Lecinitriletes*) (source of photograph: Kar, 1969)
8. *P. indicus* Lele & Makada 1974 (placed under *Lecinitriletes*) (source of photograph: Lele & Makada, 1974)

Genus: *Punctatisporites* (Ibrahim) Potonie & Kremp 1954

9. *P. punctatus* Ibrahim 1933 (source of photograph: Ibrahim, 1933)
10. *P. minutus* Kosanke 1950 (source of photograph: Kosanke, 1950)

11. *P. gretensis* Balme & Hennelly 1956 (source of photograph: Balme & Hennelly, 1956)
 12. *P. priscus* Bharadwaj & Salujha 1965 (source of photograph: Bharadwaj & Salujha, 1965)
 13. *P. reticulatus* Pant & Srivastava 1965 (source of photograph: Pant & Srivastava, 1965)
 14. *P. indicus* Tiwari 1968 (source of photograph: Tiwari, 1968)
 15. *P. ganjrensis* Lele & Maithy 1969 (source of photograph: Lele & Maithy, 1969)
 16. *P. plicatus* (Tiwari & Navale) Lele & Makada 1974 (source of photograph: Tiwari & Navale, 1967)
- Genus: *Retusotriletes* Naumova 1953
17. *R. diversiformis* (Balme & Hennelly) Bharadwaj 1962 (source of photograph: Naumova, 1953)
 18. *R. aridus* Venkatachala & Kar 1968 (source of photograph: Venkatachala & Kar, 1968)
 19. *R. dijerseyi* Venkatachala & Rawat 1978 (source of photograph: Venkatachala & Rawat, 1978)

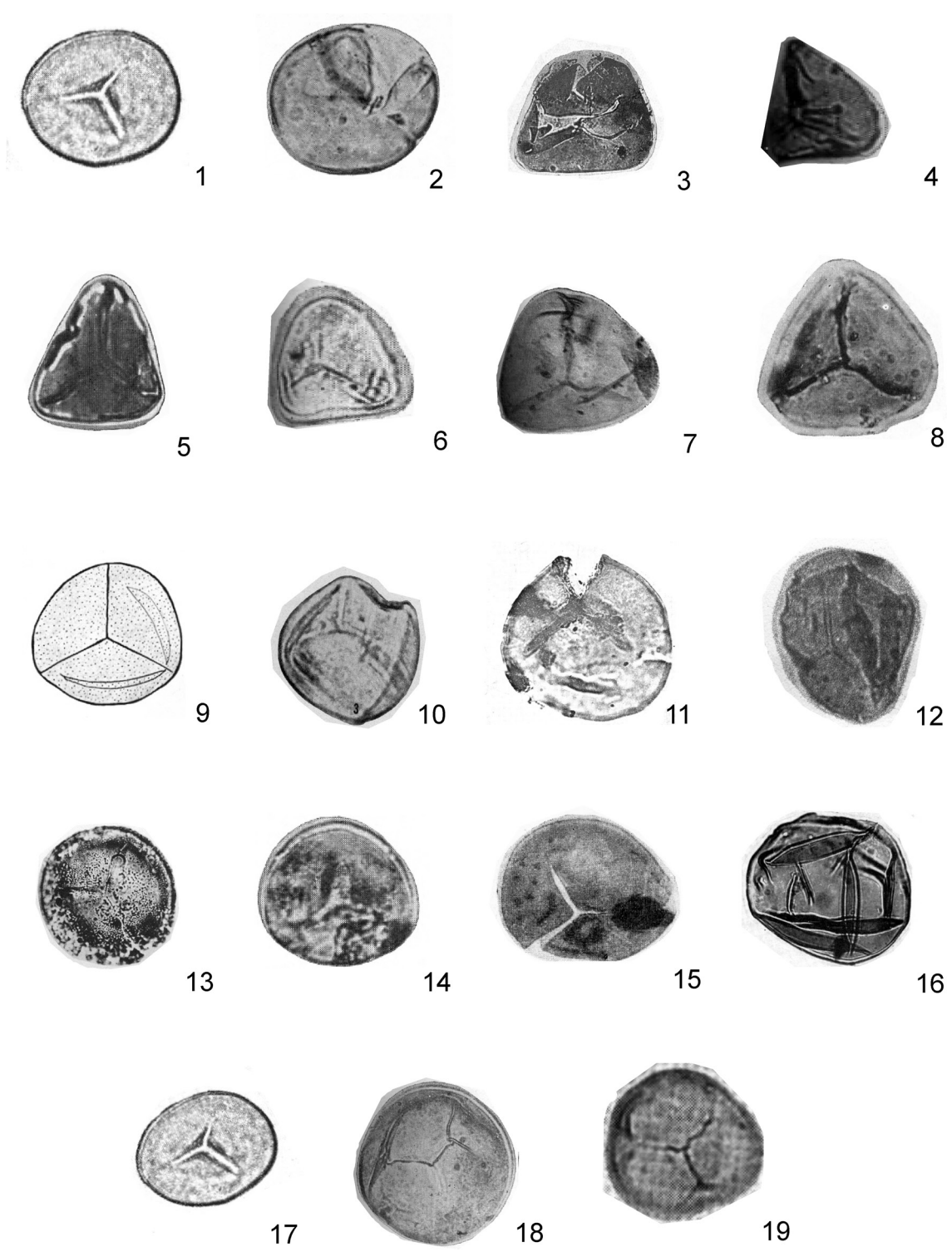


PLATE 3

Thymospora thiessenii (Kosanke) Wilson & Venkatachala
1963

Holotype: Wilson & Venkatachala, 1963; pl. 1, fig. 1; size 18 µm.

Locality, Horizon & Age: Pennsylvania, USA; Late Carboniferous–Permian.

Salient features: Size 18–44 µm; exine 1–2 µm thick, verrucae 1–2 µm in diameter.

Thymospora gondwanensis Bharadwaj & Salujha 1964

Holotype: Bharadwaj, 1962; pl. 5, fig. 80; size 28 µm.

Locality, Horizon & Age: Samla Seam, Raniganj Coalfield, Damodar Basin, West Bengal, India; Raniganj Formation, Late Permian.

Salient features: Size 22–34 µm; exine ± 1 µm, beset with up to 2 µm broad verrucae, confluence resulting in pseudo reticulum.

Thymospora raniganjensis Kar 1968

Holotype: Kar, 1969; pl. 1, fig. 7; size 22 x 18 µm.

Locality, Horizon & Age: Lungatoo, North Karanpura Coalfield, Damodar Basin, Jharkhand, India; Raniganj Formation, Late Permian.

Salient features: Size 18–27 x 22–41 µm; exine 1.5–2 µm thick, verrucae 2–4 µm in diameter.

Genus: *Striatosporites* Bharadwaj emend. Playford & Dino
2000

Type species: *Striatosporites major* Bhardwaj 1954.

Locality, Horizon & Age: Labachgrube, Breitenbach, Germany; Sarr Coals, Late Carboniferous.

Salient features: Bilateral, oval; monolete might extend full length horizontally; exine beset with two sets of ridges, one parallel to longitudinal axis, other inter-connected by transverse, fine muri.

Remarks: For details see in Vijaya (2010, p. 94).

Striatosporites major Bhardwaj 1954

Holotype: Bharadwaj, 1954; fig. 6; size 140 x 94 µm.

Locality, Horizon & Age: Labachgrube, Breitenbach, Germany; Sarr Coals, Late Carboniferous.

Salient features: Size 120 x 160 µm; monolete flanked by ca 2 µm thick elevated labra; exine ±2 µm thick, beset with 5–6 ridges, each ridge 2–3 µm wide, connected by thin, oblique transverse muri.

Striatosporites brazilensis Bharadwaj *et al.* 1976

Holotype: Bharadwaj *et al.*, 1976; pl. 2, fig. 32; size 110 x 65 µm.

Locality, Horizon & Age: Borecore C, Sample 12, Maranhao Basin, Brazil; Middle Rio Bonito Formation, Early Permian.

Salient features: Size 60–83 µm long; exine 1.5–3 µm thick, bearing 4–8 longitudinal ridges, each ridge 2–7 µm broad, 12–30 µm apart, inter-connected by thick transverse partitions, appear as fish bones.

Striatosporites ovalis (Peppers) Playford & Dino 2000

Holotype: Peppers 1964; pl. 1, fig. 11; size 48.9 x 32.4 µm.

Locality, Horizon & Age: Illinois Basin, USA; McLeansboro Group; Late Pennsylvanian.

PLATE 4



Genus: *Ricaspora* Bharadwaj & Salujha 1964

1. *R. granulata* Bharadwaj & Salujha 1964 (source of photograph: Bharadwaj & Salujha, 1964)

Genus: *Acanthotriletes* (Naumova) Potonié & Kremp 1954

2. *A. ciliatus* (Knox) Potonié & Kremp 1954 (source of photograph: Potonié & Kremp, 1955)

3. *A. filiformis* (Balme & Hennelly) Tiwari 1965 (source of photograph: Balme & Hennelly, 1956)

4. *A. jhariaensis* Kar 1968 (source of photograph: Kar, 1968)

Genus: *Altitriletes* Venkatachala & Kar 1968

5. *A. densus* Venkatachala & Kar 1968 (source of photograph: Venkatachala & Kar, 1968)

Genus: *Anapiculatisporites* Potonié & Kremp 1954

6. *A. isselburgensis* Potonié & Kremp 1954 (source of photograph: Potonié & Kremp, 1954)

7. *A. longispinosus* Bharadwaj & Salujha 1965 (source of photograph: Bharadwaj & Salujha, 1965)

8. *A. consonus* Venkatachala & Kar 1968 (source of photograph: Venkatachala & Kar, 1968)

9. *A. veritas* Venkatachala & Kar 1968 (source of photograph: Venkatachala & Kar, 1968)

Genus: *Apiculatisporis* (Ibrahim) Potonié & Kremp 1956

10. *A. aculeatus* (Ibrahim) Potonié & Kremp 1956 (source of photograph: Ibrahim, 1933)

11. *A. grandis* Salujha 1965 (source of photograph: Salujha, 1965)

12. *A. inconspicuus* Salujha 1965 (source of photograph: Salujha, 1965)

13. *A. weylandii* Bharadwaj & Salujha 1965 (source of photograph: Bharadwaj & Salujha, 1965)

14. *A. levis* (Balme & Hennelly) Tiwari 1968 (source of photograph: Balme & Hennelly, 1956)

15. *A. secretus* Venkatachala & Kar 1968 (source of photograph: Venkatachala & Kar, 1968)

Genus: *Arasporites* Srivastava & Saxena 1984

16. *A. crassus* Srivastava & Saxena 1984 (source of photograph: Srivastava & Saxena, 1984)

Genus: *Brijrajisporites* Tiwari 1968

17. *B. distinctus* Tiwari 1968 (source of photograph: Tiwari, 1968)

18. *B. fuscus* Tiwari 1968 (source of photograph: Tiwari, 1968)

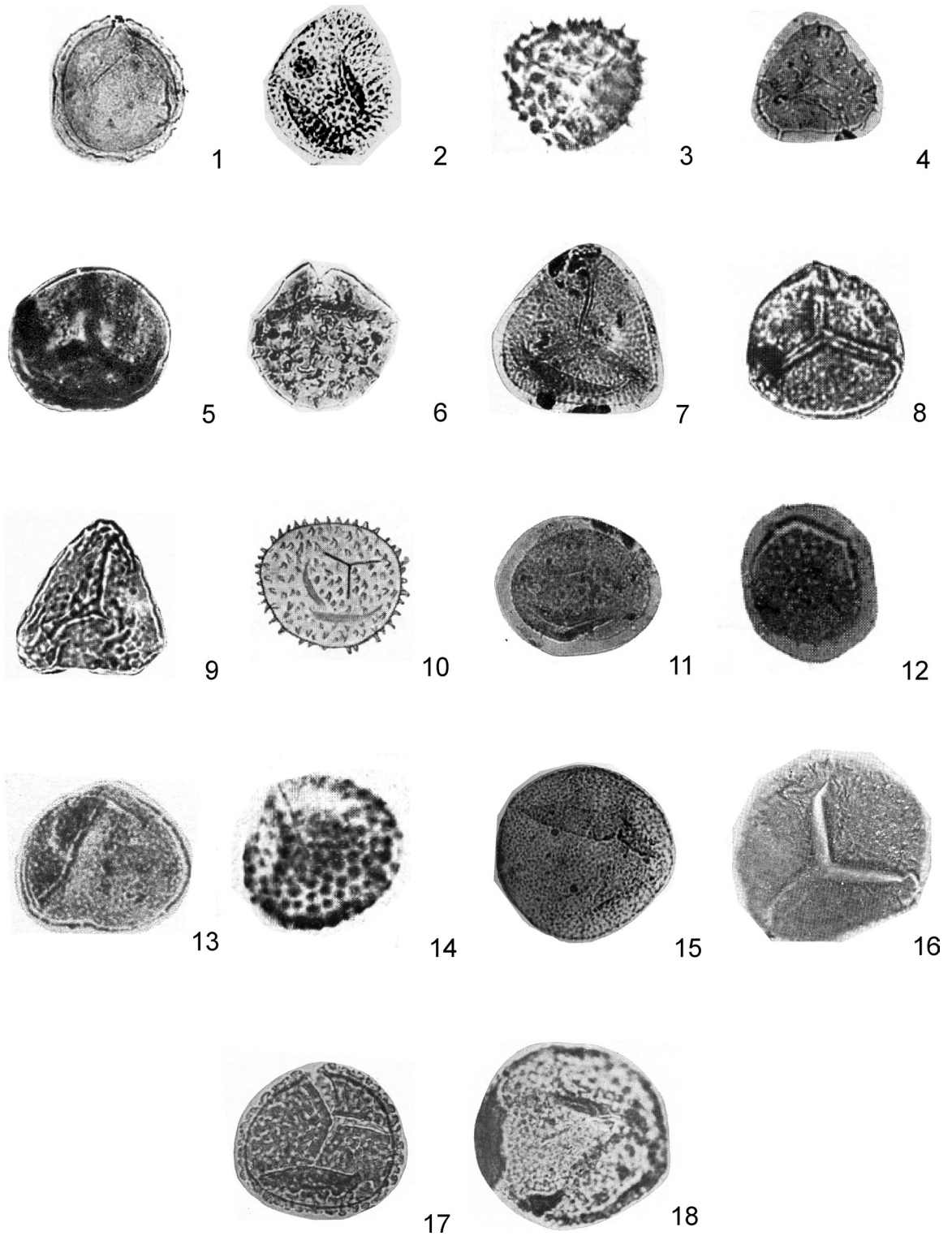


PLATE 4

Salient features: Size: Length 37–81 µm; incipient laesura evident; exine 1–2 µm thick, three too many major parallel ridges that are elevated, 2–3 µm wide, branched, transversely inter-connected by thin partitions.

Infraturma: Sculptatomoleti Dybova & Jackowitz 1957

Genus: *Spinosporites* Alpern 1958

Type species: *Spinosporites spinosus* Alpern 1958

Locality, Horizon & Age: Frankreich; Autunien

Salient features: Broadly oval–elongate; monolete mark not very distinct, transverse folds common; exine beset with closely spaced spines.

Spinosporites spinosus Alpern 1958

Holotype: Alpern 1958; pl. 2, fig. 4; size 50 x 58 µm

Locality, Horizon & Age: Frankreich; Autunien

Salient features: Size 25–55 µm, monolete mark often distinct; exine 1 µm thick beset with spines, 1–2 µm high, 1 µm at the base, closely spaced surface folded.

Infraturma: Varimonoleti Kar 1969

Genus: *Ghoshiasporites* Kar 1969

Type species: *Ghoshiasporites didecus* Kar 1969.

Locality, Horizon & Age: Borecore K2, 275.62–275.72 m, North Karanpura Coalfield, Damodar Basin, Jharkhand, India; Raniganj Formation, Late Permian.

Salient features: Oval, bean-shaped; monolete distinct to discernible; exine proximally laevigate, on distal face

coni mixed with spines and verrucae; differential pattern of sculpture on body surface.

Ghoshiasporites didecus Kar 1969

Holotype: Kar, 1969; pl. 1, fig. 10; size 61 x 50 µm

Locality, Horizon & Age: Borecore K2, 275.62–275.72 m, North Karanpura Coalfield, Damodar Basin, Jharkhand, India; Raniganj Formation, Late Permian.

Salient features: Size 50–80 x 30–55 µm; monolete elevated; exine 2–3.5 µm thick, coni 1–2.5 µm high, closely placed, uniformly distributed.

Antiturma: Sporites H. Potonié 1893

Turma: Triletes (Reinsch) Potonié & Kremp 1954

Subturma: Azonotriletes Lubert 1935

Infraturma: Laevigati (Bennie & Kidson) Potonié 1956

Genus: *Aulisporites* (Leschik) Klaus 1960

Type species: *Aulisporites canalis* Leschik 1955.

Locality, Horizon & Age: Neuwelt bei Basal, Switzerland; Keuper, Late Triassic.

Salient features: Circular; trilete mark faint, ray–ends curvurate; exine thick, smooth to finely punctate.

Aulisporites canalis Leschik 1955

Holotype: Leschik, 1955; pl. 1, fig. 18; size 63 µm.

PLATE 5



Genus: *Cyclogranisporites* Potonié & Kremp 1954

1. *C. leopodii* (Kremp) Potonié & Kremp 1954 (source of photograph: Potonié & Kremp, 1954)

2. *C. gondwanensis* Bharadwaj & Salujha 1964 (source of photograph: Bharadwaj & Salujha, 1964)

3. *C. optimus* Bharadwaj & Salujha 1965 (source of photograph: Bharadwaj & Salujha, 1964)

4. *C. barakarensis* Srivastava 1970 (source of photograph: Srivastava, 1970)

5. *C. triletes* Kar 1970 (source of photograph: Kar, 1970)

Genus: *Cyclobaculisporites* Bhardwaj 1955

6. *C. grandiverrucosus* (Kosanke) Bhardwaj 1955 (source of photograph: Bharadwaj, 1955)

7. *C. minutus* Bharadwaj & Salujha 1964 (source of photograph: Bharadwaj, 1962)

8. *C. indicus* (Bharadwaj) Bharadwaj & Salujha 1964 (source of photograph: Bharadwaj, 1962)

9. *C. bharadwajii* Salujha 1965 (source of photograph: Salujha, 1965)

10. *C. proprius* Bharadwaj & Salujha 1965 (source of photograph: Bharadwaj & Salujha, 1965)

11. *C. minimus* Kar 1968 (source of photograph: Kar, 1968)

Genus: *Godavarisporites* Tiwari & Moiz 1971

12. *G. indicus* Tiwari & Moiz 1971 (source of photograph: Tiwari & Moiz, 1971)

13. *G. tentulus* Tiwari & Moiz 1971 (source of photograph: Tiwari & Moiz, 1971)

14. *G. parmatus* (Balme & Hennelly) Tiwari & Moiz 1971 (source of photograph: Balme & Hennelly, 1956)

15. *G. jamottei* (Kar & Bose) Tiwari & Moiz 1971 (source of photograph: Kar & Bose, 1967)

Genus: *Granulatisporites* (Ibrahim) Potonié & Kremp 1954

16. *G. granulatus* (Ibrahim) Potonié & Kremp 1954 (source of photograph: Ibrahim, 1933)

Genus: *Horriditriletes* Bharadwaj & Salujha 1964

17. *H. curvibaculosus* Bharadwaj & Salujha 1964 (source of photograph: Bharadwaj & Salujha, 1964)

18. *H. brevis* Bharadwaj & Salujha 1964 (source of photograph: Bharadwaj & Salujha, 1964)

19. *H. ramosus* (Balme & Hennelly) Bharadwaj & Salujha 1964 (source of photograph: Balme & Hennelly, 1956)

20. *H. elegans* Bharadwaj & Salujha 1965 (source of photograph: Bharadwaj & Salujha, 1965)

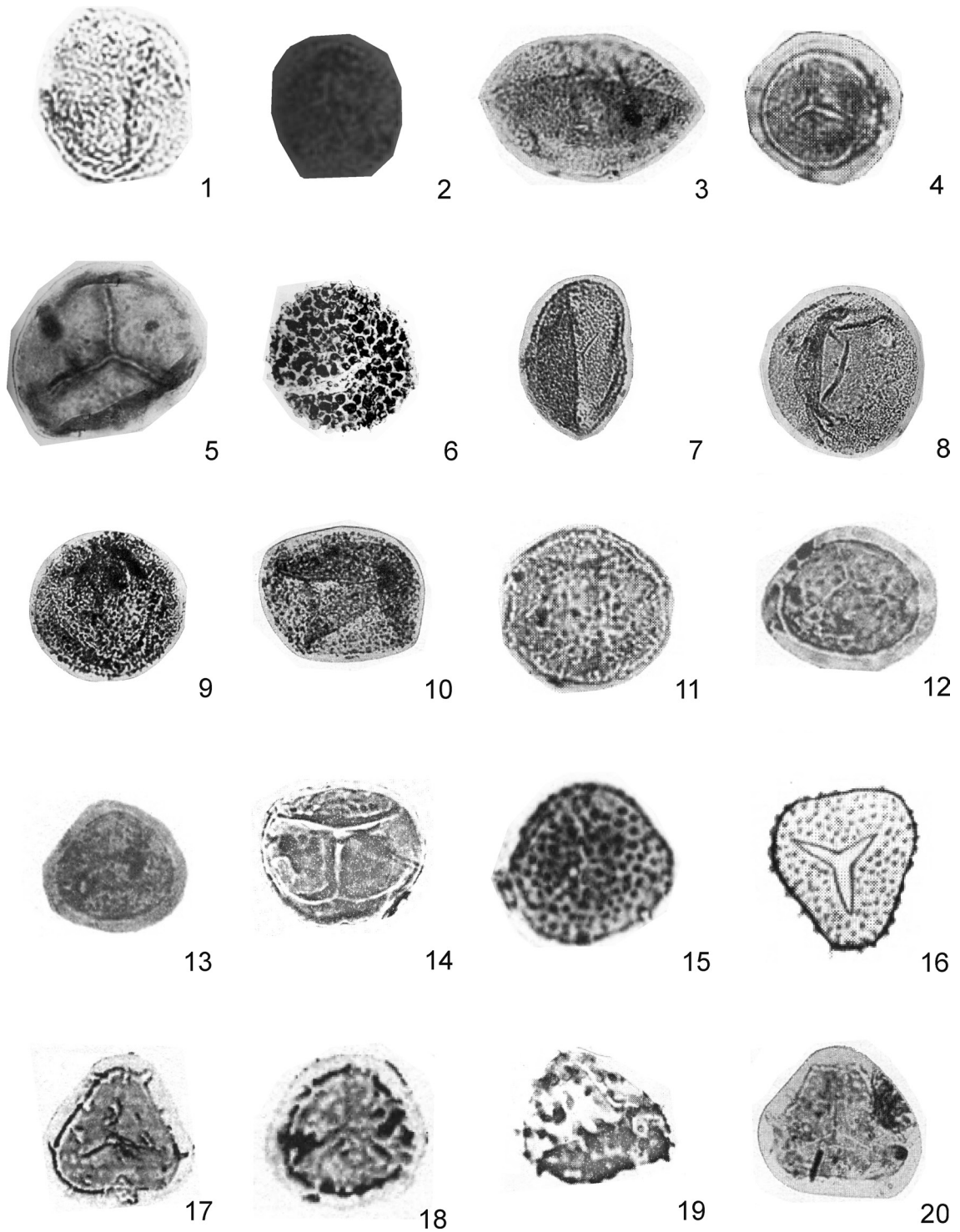


PLATE 5

Locality, Horizon & Age: Neuwelt bei Basal, Switzerland; Keuper, Late Triassic.

Salient features: Size 43–63 µm; exine 1.5 µm thick, smooth to finely punctate.

Aulisporites rarus Kar 1968

Holotype: Kar, 1968; pl. 1, fig. 6; size 35 µm

Locality, Horizon & Age: Borechole No. J.K. 5, Jharia Coalfield, Damodar Basin, Jharkhand; Barren Measures, Late Permian.

Salient features: Size 28–35 µm; exine 2–3 µm thick, ornamented with puncta, variable shape, irregularly distributed all over.

Genus: *Calamospora* Schopf *et al.* 1944

Type species: *Calamospora hartungiana* Schopf *et al.* 1944

Locality, Horizon & Age: Vermilion County, Salt Fark, NW Faimont, Illinois, USA; Palaeozoic.

Salient features: Spherical, crescentic folds on body surface; trilete mark distinct, rays extend less than ½ of radius; exine thin, finely microgranulose–rugose.

Calamospora hartungiana Schopf *et al.* 1944

Holotype: Schopf in Schopf *et al.* 1944; pl. 52, fig. 1; size 100 µm.

Locality, Horizon & Age: Vermilion County, Salt Fark, NW Faimont, Illinois, USA; Palaeozoic.

Salient features: Size 80–100 µm; exine heavily folded; exine ±1 µm thick, finely microgranulose–rugose.

Calamospora microrugosus (Ibrahim) Schopf *et al.* 1944

Holotype: Ibrahim, 1933; pl. 14, fig. 9; size 77 x 77 µm.

Locality, Horizon & Age: Floz, Agir, Ruhr–reviers, Germany; Carboniferous

Salient features: Size 58–96 µm; all over surface heavily folded.

Calamospora pedata Kosanke 1950

Holotype: Kosanke, 1950; pl. 9, fig. 3; size 44.1 x 70.3 µm.

Locality, Horizon & Age: Coal bed No. 8, Peoria County, Illinois, USA; Pennsylvanian, Carboniferous.

Salient features: Size 41–75 µm; exine 2–3 µm thick, laevigate.

Calamospora aplata Bharadwaj & Salujha 1964

Holotype: Bharadwaj & Salujha, 1964; pl. 1, fig. 13; size 54 µm.

Locality, Horizon & Age: Seam VIII, Raniganj Coalfield, Damodar Basin, West Bengal India; Raniganj Formation, Late Permian.

Salient features: Size 35–55 µm; exine less than 1 µm thick, surface much folded, infrapunctate.

Calamospora exila Bharadwaj & Salujha 1964

Holotype: Bharadwaj & Salujha, 1964; pl. 1, fig. 16; size 76 µm.

Locality, Horizon & Age: Seam VIII, Raniganj Coalfield, Damodar Basin, West Bengal India; Raniganj Formation, Late Permian.

Salient features: Size 76–110 µm; trilete mark subdued due to body folds; exine thin, finely microgranulose.

Calamospora rotata Salujha 1965

Holotype: Salujha, 1965; pl. 1, fig. 1; size 32 µm.

PLATE 6



1. *H. splendidus* Bharadwaj & Salujha 1965 (source of photograph: Bharadwaj & Salujha, 1965)
 2. *H. bulbosus* Tiwari 1965 (source of photograph: Tiwari, 1965)
 3. *H. novus* Tiwari 1965 (source of photograph: Tiwari, 1965)
 4. *H. unicus* Tiwari 1965 (source of photograph: Tiwari, 1965)
 5. *H. rampurensis* Tiwari 1968 (source of photograph: Tiwari, 1968)
 6. *H. pathakheraensis* Anand–Prakash 1972 (source of photograph: Anand–Prakash, 1972)
 7. *H. pseudoseptatus* Sinha 1972 (source of photograph: Sinha, 1972)
 8. *H. rajmahalensis* D’Rozario & Banerjee 1987 (source of photograph: D’Rozario & Banerjee, 1987)
- Genus: *Lalmatiasporites* D’Rozario & Banerjee 1987
9. *L. indicus* D’Rozario & Banerjee 1987 (source of photograph: D’Rozario & Banerjee, 1987)
 10. *L. barakarensis* D’Rozario & Banerjee 1987 (source of photograph: D’Rozario & Banerjee, 1987)
- Genus: *Lobatosporites* Tiwari & Moiz 1971
11. *L. gondwanensis* Tiwari & Moiz 1971 (source of photograph: Tiwari & Moiz, 1971)
 12. *L. brevivaculosus* Tiwari & Moiz 1971 (source of photograph: Tiwari & Moiz, 1971)
- Genus: *Lophotriletes* (Naumova) Potonié & Kremp 1954
13. *L. gibbosus* (Ibrahim) Potonié & Kremp 1954 (source of photograph: Ibrahim, 1933)
 14. *L. rectus* Bharadwaj & Salujha 1964 (source of photograph: Bharadwaj & Salujha, 1964)
 15. *L. rarus* Bharadwaj & Salujha 1964 (source of photograph: Bharadwaj & Salujha, 1964)
 16. *L. pseudogramus* Bharadwaj & Salujha 1964 (source of photograph: Bharadwaj, 1962)
 17. *L. frequens* Tiwari 1965 (source of photograph: Tiwari, 1965)
 18. *L. minimus* Salujha 1965 (source of photograph: Salujha, 1965)
 19. *L. novus* Kar 1968 (source of photograph: Kar, 1968)
 20. *L. latiangularatus* Kar 1968 (source of photograph: Kar, 1968)

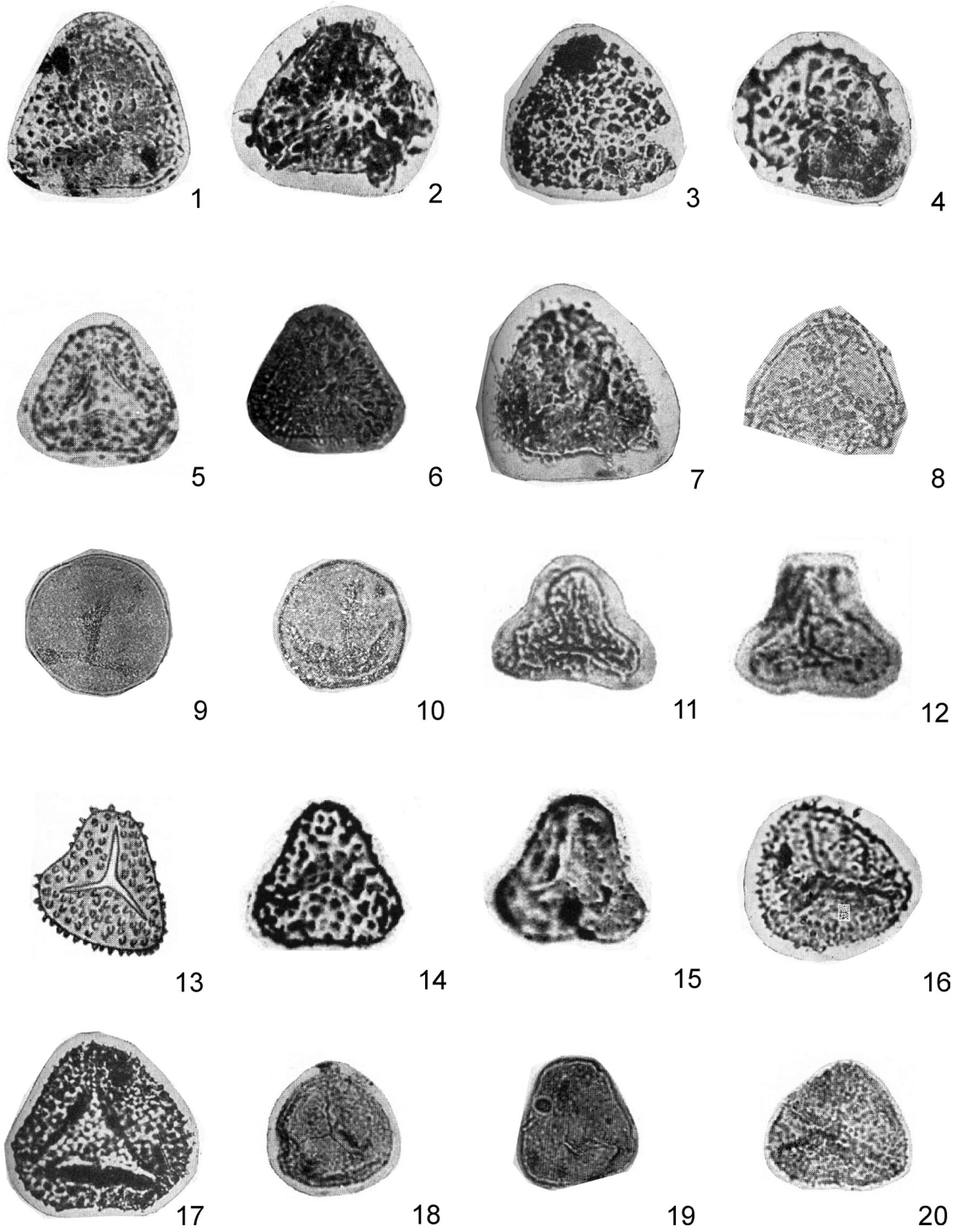


PLATE 6

Locality, Horizon & Age: Seam VIII, Raniganj Coalfield, Damodar Basin, West Bengal, India; Raniganj Formation, Late Permian.

Salient features: Size 28–40 µm; exine smooth to finely scabrate.

Calamospora plicata Tiwari & Navale 1967

Holotype: Tiwari & Navale, 1967; pl. 1, fig. 2; size 100 x 110 µm.

Locality, Horizon & Age: Sample No. 1911, Rio Grande do sul, Candiota, Santa Catrina Coalfield, Brazil; Permian.

Salient features: Size 96–120 µm; exine 1–2 µm thick, finely infra-micropunctate, much thick folds on surface.

Remarks: Lele and Makada (1974) have made new combination of this species as *Punctatisporites plicatus*.

Calamospora ovalis Saksena 1971

Holotype: Saksena, 1971; pl. 1, fig. 10; size 51 µm.

Locality, Horizon & Age: Ganjra Nala bed, Johilla Coalfield, South Rewa Basin, Madhya Pradesh, India; Barakar Formation, Early Permian.

Salient features: Size 51 µm; exine smooth, less than 1 µm thick.

Calamospora majus Saksena 1971

Holotype: Saksena, 1971; pl. 1, fig. 11; size 90 x 70 µm.

Locality, Horizon & Age: Ganjra Nala bed, Johilla Coalfield, South Rewa Gondwana Basin, Madhya Pradesh, India; Barakar Formation, Early Permian.

Salient features: Size 85–104 µm; trilete mark not visible due to heavy body folds; exine smooth, 2–3 µm thick.

Genus: *Callumispora* Bharadwaj & Srivastava emend. Tiwari *et al.* 1989

Type species: *Callumispora barakarensis* Bharadwaj & Srivastava 1969.

Locality, Horizon & Age: Nandira Colliery, Talchir Coalfield, Mahanadi Basin, Orissa, India; Barakar Formation, Early Permian.

Salient features: Circular; trilete mark with distinct labra; exine thin to thick, laevigate to finely punctate, microverrucose in inter-ray area.

Callumispora barakarensis Bharadwaj & Srivastava emend. Tiwari *et al.* 1989

Holotype: Bharadwaj & Srivastava, 1969; pl. 1, fig. 1; size 117 µm.

Locality, Horizon & Age: Nandira Colliery, Talchir Coalfield, Mahanadi Basin, Orissa, India; Barakar Formation; Early Permian.

Salient features: Size 88–140 µm; exine 4–6 µm thick, stratified, laevigate to infrapunctate.

Callumispora fungosa (Balme) Bharadwaj & Srivastava emend. Tiwari *et al.* 1969

Holotype: Balme, 1963; pl. 4, fig. 10; size 114 µm.

Locality, Horizon & Age: Well at point 217, Upper Greenough River area, sample 4070, western Australia; Kockatea shale, Early Triassic.

Salient features: Size 83–119 µm; exine 6–7 µm thick, infrapunctate with irregularly dispersed shallow pits.

PLATE 7



Genus: *Osmundacidites* Couper 1953

1. *O. wellmanii* Couper 1953 (source of photograph: Couper, 1953)
2. *O. baculatus* Tiwari & Ram-Awatar 1988 (source of photograph: Tiwari & Ram-Awatar, 1988)
3. *O. pilatus* Tiwari & Rana 1981 (source of photograph: Tiwari & Rana, 1981)
4. *O. senectus* (Balme) Bharadwaj & Tiwari 1977 (source of photograph: Balme, 1963)

Genus: *Verrucosisporites* (Ibrahim) emend. Smith 1971

5. *V. verrucosus* (Ibrahim) Potonié & Kremp 1954 (source of photograph: Ibrahim in Potonié *et al.*, 1932)
6. *V. donarii* Potonié & Kremp 1955 (source of photograph: Potonié & Kremp, 1955)
7. *V. distinctus* Tiwari 1965 (source of photograph: Tiwari, 1965)
8. *V. diversus* Bharadwaj & Salujha 1965 (source of photograph: Bharadwaj & Salujha, 1965)
9. *V. varius* Maheshwari 1967 (source of photograph: Maheshwari, 1967)
10. *V. ambiplicatus* Kar 1968 (source of photograph: Kar, 1968)
11. *V. gondwanensis* Srivastava 1970 (source of photograph: Srivastava, 1970)

12. *V. narmianus* Balme 1970 (source of photograph: Balme, 1970)
 13. *V. maiturensis* (Bharadwaj & Tiwari) Bharadwaj & Dwivedi 1981 (source of photograph: Bharadwaj & Tiwari, 1977)
 14. *V. raniganjensis* (Bharadwaj & Tiwari) Bharadwaj & Dwivedi 1981 (source of photograph: Bharadwaj & Tiwari, 1977)
- Genus: *Brevitriletes* Bharadwaj & Srivastava emend. Tiwari & Singh 1981
15. *B. communis* Bharadwaj & Srivastava emend. Tiwari & Singh 1981 (source of photograph: Bharadwaj & Srivastava, 1969)
 16. *B. unicus* (Tiwari) Bharadwaj & Srivastava emend. Tiwari & Singh 1981 (source of photograph: Bharadwaj & Srivastava, 1969)
- Genus: *Didecitriletes* Venkatachala & Kar emend. Tiwari & Singh 1981
17. *D. horridus* Venkatachala & Kar emend. Tiwari & Singh 1981 (source of photograph: Venkatachala & Kar, 1965)
 18. *D. ericianus* (Balme & Hennelly) Venkatachala & Kar 1965 (source of photograph: Balme & Hennelly, 1956)
 19. *D. dentatus* (Balme & Hennelly) Venkatachala & Kar 1965 (source of photograph: Balme & Hennelly, 1956)
 20. *D. uncinatus* (Balme & Hennelly) Venkatachala & Kar 1965 (source of photograph: Balme & Hennelly, 1956)

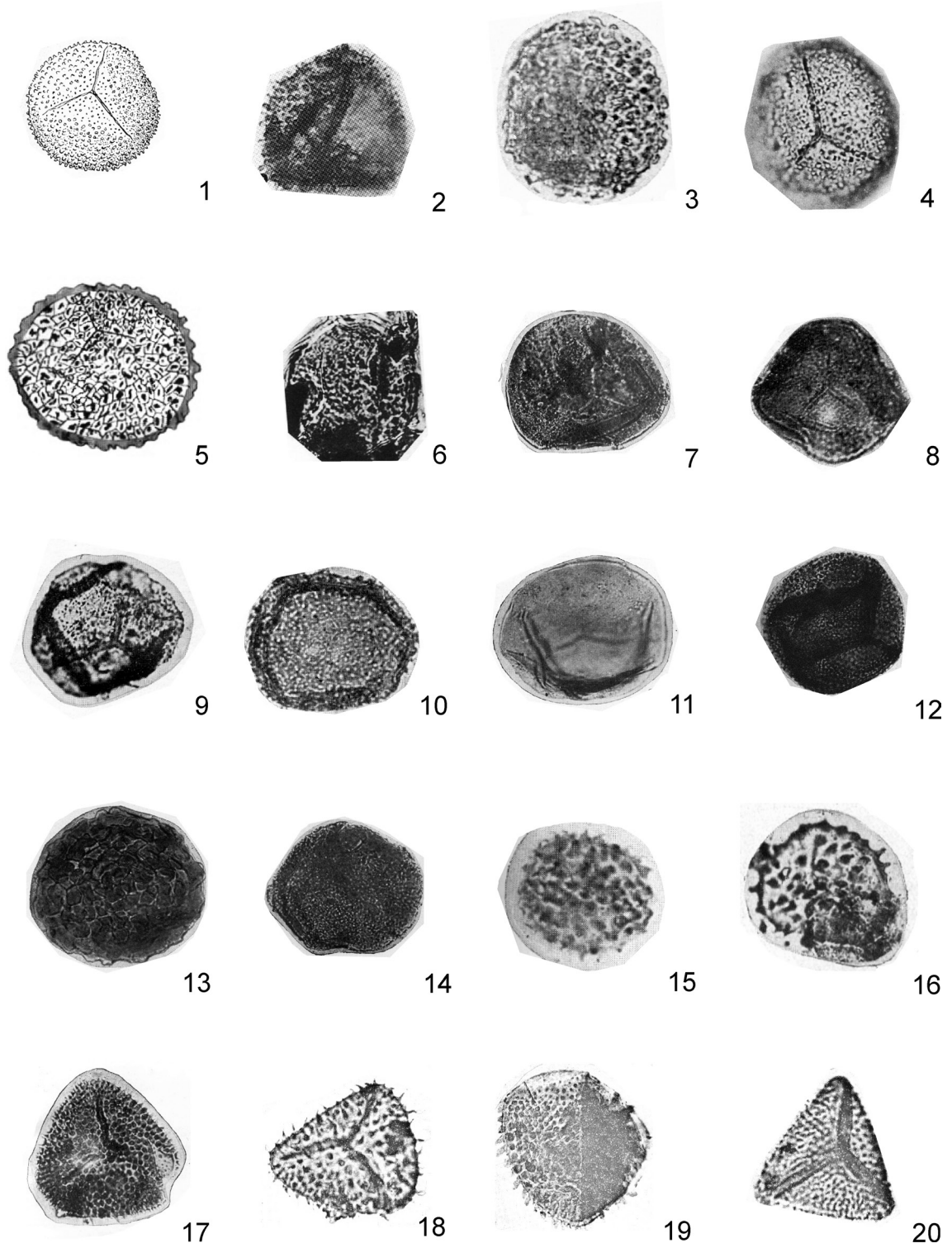


PLATE 7

Callumispora gretensis (Balme & Hennelly) Bharadwaj & Srivastava emend. Tiwari *et al.* 1989

Holotype: Balme & Hennelly, 1956; pl. 2, figs 11; size 110 μm .

Locality, Horizon & Age: Main Greta Seam, Hebburn No. 2 Colliery, Greta Coal Measures, NSW, Australia; Permian.

Salient features: Size 30–40 μm ; exine 4 μm thick, psilate or finely granulate.

Callumispora paliensis Tiwari & Ram–Awatar 1988

Holotype: Tiwari & Ram–Awatar 1988; pl. 1, fig. 5; size 58 μm .

Locality, Horizon & Age: Borecore JHL–25, 180–190 m, Birsinghpur–Pali, Johilla Coalfield, South Rewa Basin, Madhya Pradesh, India; Karharbari Formation, Early Permian.

Salient features: Size 58–70 μm ; trilete rays associated with folds; exine 3–4 μm thick, puncta uniformly distributed all over.

Callumispora saksenae Tiwari & Ram–Awatar 1988

Holotype: Tiwari & Ram–Awatar, 1988; pl. 1, fig. 3; size 66 μm .

Locality, Horizon & Age: Borecore JHL–25, 182–190 m, Birsinghpur–Pali, Johilla Coalfield, South Rewa Basin, Madhya Pradesh, India; Karharbari Formation, Early Permian.

Salient features: Size 52–82 μm ; trilete rays associated with folds, 10–20 μm wide in centre; exine 2–3 μm thick, distinctly and uniformly infra-micropunctate.

Genus: *Concavisporites* Plug emend. Delcourt & Sprumont 1955

Type species: *Concavisporites rugulatus* Plug in Thomson & Plug 1953.

Locality, Horizon & Age: Wehmingen, Antweiler Graben, Middle Europe; Palaeocene to early Eocene, Tertiary.

Salient features: Triangular with concave sides; trilete mark distinct, rays often undulated, accompanied with inter-radial thickening or kyrtome; exine smooth.

Concavisporites rugulatus Plug in Thomson & Plug 1953

Holotype: Plug in Thomson & Plug, 1953; pl. 1, fig. 22; size 32 μm . (ca)

Locality, Horizon & Age: Wehmingen, Antweiler Graben, Middle Europe; Palaeocene to early Eocene, Tertiary.

Salient features: Size 15–35 μm ; rays often wavy, kyrtome well developed; exine 1 μm thick, smooth.

Concavisporites bankolensis Bharadwaj & Salujha 1964

Holotype: Bharadwaj & Salujha 1964: pl. 1, fig. 2; size 42 μm .

Locality, Horizon & Age: Seam VIII, Raniganj Coalfield, Damodar Basin, West Bengal, India; Raniganj Formation, Late Permian.

Salient features: Size 30–45 μm , trilete rays up to 20 μm long, accompanied with 2–3 μm wide border all along the rays.

PLATE 8



Genus: *Imparitriletes* Tiwari & Singh 1981

1. *I. korbaensis* Tiwari & Singh 1981 (source of photograph: Tiwari & Singh, 1981)

Genus: *Jyantisporites* Lele & Makada 1972

2. *J. pseudozonatus* Lele & Makada 1972 (source of photograph: Lele & Makada, 1972)

3. *J. conatus* Lele & Makada 1972 (source of photograph: Lele & Makada, 1972)

4. *J. indicus* Lele & Makada 1972 (source of photograph: Lele & Makada, 1972)

5. *J. pseudozonatus* var. *minor* Chandra & Lele 1972 (source of photograph: Chandra & Lele, 1979)

Genus: *Lacinitriletes* Venkatachala & Kar emend. Tiwari & Singh 1981

6. *L. badamensis* Venkatachala & Kar emend. Tiwari & Singh 1981 (source of photograph: Venkatachala & Kar, 1965)

7. *L. minutus* Venkatachala & Kar emend. Tiwari & Singh 1981 (source of photograph: Venkatachala & Kar, 1968)

Genus: *Microbaculispota* Bharadwaj 1962

8. *M. gondwanensis* Bharadwaj 1962 (source of photograph: Bharadwaj, 1962)

9. *M. villosa* (Balme & Hennelly) Bharadwaj 1962 (source of photograph: Balme & Hennelly, 1956)

10. *M. tentula* Tiwari 1965 (source of photograph: Tiwari, 1965)

11. *M. indica* Tiwari emend. Tiwari & Singh 1981 (source of photograph: Tiwari, 1965)

12. *M. barakarensis* Tiwari emend. Tiwari & Singh 1981 (source of photograph: Bharadwaj & Tiwari, 1964)

Genus: *Microfoveolatispora* Bharadwaj 1962

13. *M. raniganjensis* Bharadwaj emend. Tiwari & Singh 1981 (source of photograph: Bharadwaj, 1962)

14. *M. bokaroensis* Tiwari 1965 (source of photograph: Tiwari, 1965)

15. *M. foveolata* Tiwari emend. Tiwari & Singh 1981 (source of photograph: Tiwari, 1965)

Genus: *Camptotriletes* (Naumova) Potonié & Kremp 1954

16. *C. corrugatus* Potonié & Kremp 1954 (source of photograph: Ibrahim, 1933)

17. *C. bellus* Venkatachala 1968 (source of photograph: Venkatachala & Kar, 1968)

Genus: *Cyclofoveolatispora* Venkatachala & Kar 1968

18. *C. caecus* Venkatachala & Kar 1968 (source of photograph: Venkatachala & Kar, 1968)

19. *C. plicatus* Venkatachala & Kar 1968 (source of photograph: Venkatachala & Kar, 1968)

20. *C. minutus* Venkatachala & Kar 1968 (source of photograph: Venkatachala & Kar, 1968)

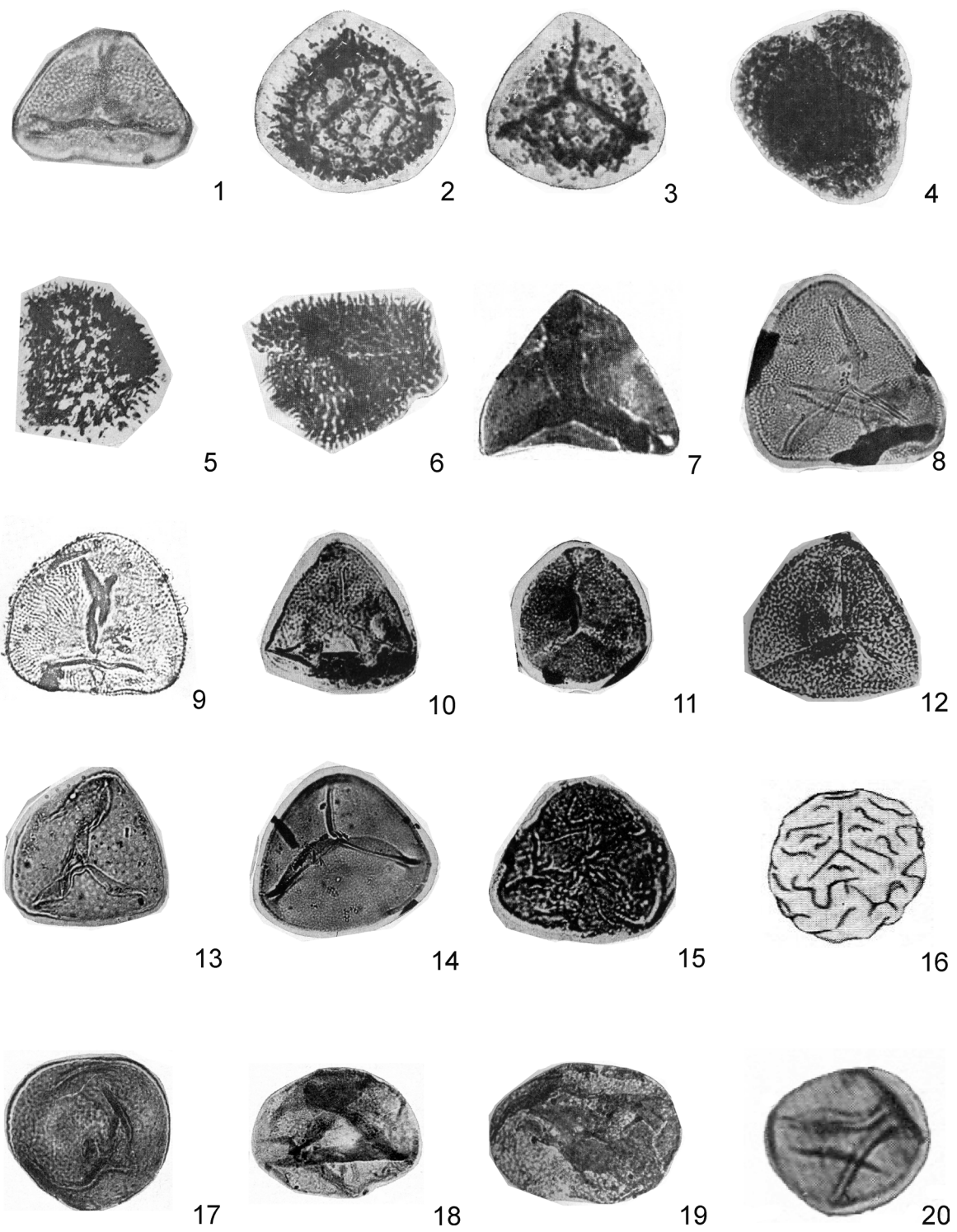


PLATE 8

Genus: *Eupunctisporites* Bharadwaj 1962

Type species: *Eupunctisporites poniatiensis* Bharadwaj 1962.

Locality, Horizon & Age: Poniati Seam, Raniganj Coal-field, Damodar Basin, West Bengal, India; Raniganj Formation, Late Permian.

Salient features: Circular to subcircular; trilete mark distinct, rays of equal length with abrupt ends; exine fairly thick, punctate, pits of various sizes.

Eupunctisporites poniatiensis Bharadwaj 1962

Holotype: Bharadwaj, 1962; pl. 1, fig. 4; size 90 µm.

Locality, Horizon & Age: Poniati Seam, Raniganj Coal-field, Damodar Basin, West Bengal, India; Raniganj Formation, Late Permian.

Salient features: Size 75–100 µm; trilete rays 33–39 µm long; exine 4–6 µm thick, bearing distinct, varied shaped, minute, roundish, elliptical or irregular puncta, ±1 µm across.

Eupunctisporites gravus Bharadwaj & Salujha 1964

Holotype: Bharadwaj & Salujha, 1964; pl. 1, fig. 6; size 78 µm.

Locality, Horizon & Age: Seam VIII, Raniganj Coalfield, Damodar Basin, West Bengal, India; Raniganj Formation, Late Permian.

Salient features: Size 60–95 µm; trilete rays extend ½ of radius; exine ±4 µm thick, bearing distinct, widely spaced broader puncta, more than 2 µm across.

Genus: *Hennellysporites* Tiwari 1968

Type species: *Hennellysporites diversiformis* (Balme & Hennelly) Tiwari 1968.

Locality, Horizon & Age: Main Greta Seam, Cessnock No. 1 Colliery, Greta Coal Measures, N.S.W, Australia; Permian.

Salient features: Broadly circular; trilete mark distinct, rays extend ½ of radius, contact area defined by incipient curvature; exine thick, psilate or faintly granulate, proximally thickening in inter-ray area.

Hennellysporites diversiformis (Balme & Hennelly) Tiwari 1968

Holotype: Balme & Hennelly, 1956; pl. 2, fig. 14; size 36 µm. (ca)

Locality, Horizon & Age: Main Greta Seam, Cessnock No. 1 Colliery, Greta Coal Measures, N.S.W, Australia; early Permian.

Salient features: Size 24–50 µm; subtriangular polar thickening in inter-ray area, 15–20 µm across; exine 1–2 µm thick, psilate or faintly granulate.

Hennellysporites indicus Tiwari 1968

Holotype: Bharadwaj & Tiwari, 1964; pl. 1, fig. 6; size 25 µm.

Locality, Horizon & Age: Korba Coalfield, South Rewa Basin, Madhya Pradesh, India; Barakar Formation, Early Permian.

Salient features: Size 25–50 µm; sharply defined polar thickening in inter-ray area; exine 1–2 µm thick, laevigate.

Genus: *Leiotriletes* (Naumova) Potonié & Kremp 1954

Type species: *Leiotriletes sphaerotriangulus* (Loose) Potonié & Kremp 1954.

Locality, Horizon & Age: Ruhrgebiet, Floz Bismarck, Westfal B, Late Carboniferous.

PLATE 9



- Genus: *Dictyotriletes* (Naumova) Potonié & Kremp 1954
1. *D. bireticulatus* (Ibrahim) Potonié & Kremp 1954 (source of photograph: Potonié & Kremp, 1955)
 2. *D. invisus* Bharadwaj & Salujha 1964 (source of photograph: Bharadwaj & Salujha, 1964)
- Genus: *Ghoshitriletes* D'Rozario & Banerjee 1987
3. *G. gondwanensis* D'Rozario & Banerjee 1987 (source of photograph: D'Rozario & Banerjee, 1987)
- Genus: *Plicatisporites* Lele & Makada 1972
4. *P. distinctus* Lele & Makada 1972 (source of photograph: Lele & Makada, 1972)
- Genus: *Pseudoreticulatispora* Bharadwaj & Srivastava 1969
5. *P. barakarensis* Bharadwaj & Srivastava 1969 (source of photograph: Bharadwaj & Srivastava, 1969)
- Genus: *Reticulatisporites* (Ibrahim) Potonié & Kremp 1954
6. *R. reticulatus* Ibrahim 1933 (source of photograph: Ibrahim, 1933)
- Genus: *Varireticulatus* Kar 1969
7. *V. varius* Kar 1969 (source of photograph: Kar, 1969)
- Genus: *Striasporis* Kar 1969
8. *S. striatus* Kar 1969 (source of photograph: Kar, 1969)
- Genus: *Valemisporites* Bharadwaj & Venkatachala 1968
9. *V. pukraensis* Venkatachala & Kar 1968 (source of photograph: Venkatachala & Kar, 1968)
- Genus: *Densosporites* (Berry) Potonié & Kremp 1954
10. *D. corensis* Berry 1937 (source of photograph: Potonié & Kremp, 1954)
 11. *D. splendens* Saksena 1971 (source of photograph: Saksena, 1971)
- Genus: *Dentatispora* Tiwari 1964
12. *D. indica* Tiwari 1964 (source of photograph: Tiwari, 1964)
 13. *D. crassa* Tiwari 1965 (source of photograph: Tiwari, 1965)
 14. *D. gondwanensis* Tiwari 1965 (source of photograph: Tiwari, 1965)
 15. *D. implicata* Tiwari 1965 (source of photograph: Tiwari, 1965)
 16. *D. lacunata* Tiwari 1965 (source of photograph: Tiwari, 1965)
 17. *D. mammoidea* Tiwari & Ram-Awatar 1988 (source of photograph: Tiwari & Ram-Awatar, 1988)
 18. *D. reticulata* Tiwari & Ram-Awatar 1988 (source of photograph: Tiwari & Ram-Awatar, 1988)

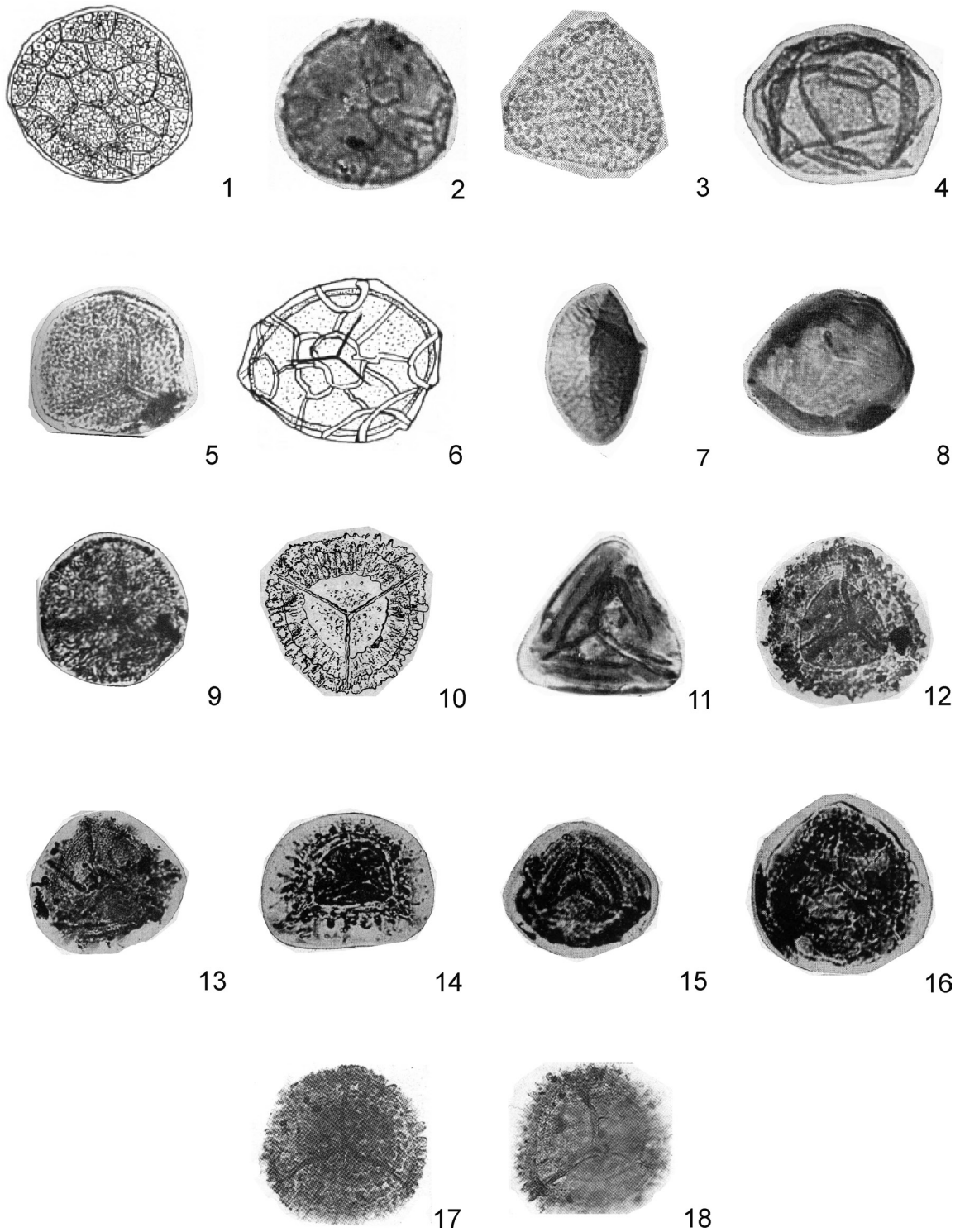


PLATE 9

Salient features: Triangular; trilete mark distinct, rays extend $\frac{1}{2}$ of radius; exine infra-punctate-faintly infra-reticulate.

Leiotriletes sphaerotriangulus (Loose) Potonié & Kremp
1954

Holotype: Loose in Potonié *et al.*, 1932; pl. 18, fig. 45; size 43.5 μm .

Locality, Horizon & Age: Ruhrgebiet, Floz Bismarck; Westfal B, Late Carboniferous.

Salient features: Size 40–60 μm ; exine $\pm 1 \mu\text{m}$ thick, faintly infra-punctate.

Leiotriletes virkkii Tiwari 1965

Holotype: Tiwari, 1965; pl. 1, fig. 2; size 72 μm .

Locality & Horizon: Borehole G-214, sample 1008 C, Korba Coalfield, South Rewa Basin, Chhattisgarh, India; Barakar Formation, Early Permian.

Salient features: Size 52–78 μm ; rays extend up to margin; exine 1–1.5 μm thick.

Leiotriletes erectus Kar 1968

Holotype: Kar 1968; pl. 1, fig. 1; size 33 μm .

Locality, Horizon & Age: Borehole No. J.K.5, Jharia Coalfield, Damodar Basin, Jharkhand, India; Barren Measures Formation, Late Permian.

Salient features: Size 25–33 μm ; exine less than 1 μm , laevigate, uniformly thick.

Leiotriletes conspicuus Saksena 1971

Holotype: Saksena, 1971; pl. 1, fig. 5; size 42 μm

Locality, Horizon & Age: Ganjra Nala beds, Johilla Coalfield, South Rewa Basin, Madhya Pradesh, India; Barakar Formation, Early Permian.

Salient features: Size 40–42 μm ; exine $\pm 1 \mu\text{m}$ thick.

Leiotriletes brevis Sinha 1972

Holotype: Sinha, 1972; pl. 1, fig. 1; size 25 μm

Locality, Horizon & Age: Borecore NCSJ-4, Sample No. 78, Jhingurdah Seam, Singrauli Coalfield, South Rewa Basin, Madhya Pradesh, India; Barakar Formation, Early Permian.

Salient features: Size 19–25 μm ; exine less than 1 μm .

Genus: *Psilalacinites* Kar 1969

Type species: *Psilacinites triangulus* Kar 1969.

Locality, Horizon & Age: Borecore K-2, 61.09–61.19 m, North Karanpura Coalfield, Damodar Basin, Jharkhand, India; Raniganj Formation, Late Permian.

Salient features: Triangular to sub triangular; trilete mark distinct, rays associated with lacinate folds; exine laevigate or finely microgranulose.

Remarks: This genus is placed under Genus *Lecinitriletes* in *Infraturma Varitriletes* in having lacinate folds and finely scabrate exine (See in Tiwari & Singh, 1981, p. 268).

Genus: *Punctatisporites* (Ibrahim) Potonié & Kremp 1954

Type species: *Punctatisporites punctatus* Ibrahim 1933.

Locality, Horizon & Age: Ruhrgebiet, Floz Agir, Germany; Westphalian B/C, Late Carboniferous.

Salient features: Circular; trilete mark distinct, rays extend up to $\frac{2}{3}$ of radius; exine proximally smooth, distally infrapunctate to infragranulose.

PLATE 10



Genus: *Cirratriradites* Wilson & Coe 1940

1. *C. maculates* Wilson & Coe 1940 (source of photograph: Wilson & Coe, 1940)

2. *C. gondwanensis* Tiwari 1965 (source of photograph: Tiwari, 1965)

Genus: *Gondisporites* Bharadwaj 1962

3. *G. raniganjensis* Bharadwaj 1962 (source of photograph: Bharadwaj, 1962)

4. *G. imbricatus* Segroves 1970 (source of photograph: Segroves, 1970)

5. *G. reticulatus* Tiwari & Ram-Awatar 1988 (source of photograph: Tiwari & Ram-Awatar, 1988)

Genus: *Indotriradites* Tiwari 1964

6. *I. korbaensis* Tiwari 1964 (source of photograph: Tiwari, 1964)

7. *I. sparsus* Tiwari 1965 (source of photograph: Tiwari, 1965)

8. *I. surangei* Tiwari 1965 (source of photograph: Tiwari, 1965)

9. *I. varius* Venkatachala & Kar 1968 (source of photograph: Venkatachala & Kar, 1968)

Genus: *Insignisporites* Bharadwaj & Dwivedi 1977

10. *I. barakarensis* Bharadwaj & Dwivedi 1977 (source of photograph: Bharadwaj & Dwivedi, 1977)

Genus: *Potoniétriradites* Bharadwaj & Sinha 1969

11. *P. barakarensis* Bharadwaj & Sinha 1969 (source of photograph: Bharadwaj & Sinha, 1969)

12. *P. tuberculatus* Sinha 1972 (source of photograph: Sinha, 1972)

13. *P. subtilis* Sinha 1972 (source of photograph: Sinha, 1972)

14. *P. angustus* (Bose & Kar) Bharadwaj & Dwivedi 1981 (source of photograph: Bharadwaj & Dwivedi, 1981)

15. *P. mercenierii* (Bose & Kar) Bharadwaj & Dwivedi 1981 (source of photograph: Bose & Kar, 1967)

16. *P. renierii* (Bose & Kar) Bharadwaj & Dwivedi 1981 (source of photograph: Bose & Kar, 1967)

Genus: *Indospora* Bharadwaj 1962

17. *I. clara* Bharadwaj 1962 (source of photograph: Bharadwaj, 1962)

18. *I. macula* Bharadwaj & Salujha 1964 (source of photograph: Bharadwaj & Salujha, 1964)

19. *I. laevigata* Bharadwaj & Salujha 1964 (source of photograph: Bharadwaj & Salujha, 1964)

Genus: *Lycospora* (Schopf *et al.*) Potonié & Kremp 1954

20. *Lycospora minuta* Saksena 1971 (source of photograph: Saksena, 1971)

Genus: *Triquitrites* Wilson & Coe 1940 emend. Potonié & Kremp, 1954

21. *T. valvetus* Saksena 1971 (source of photograph: Saksena, 1971)

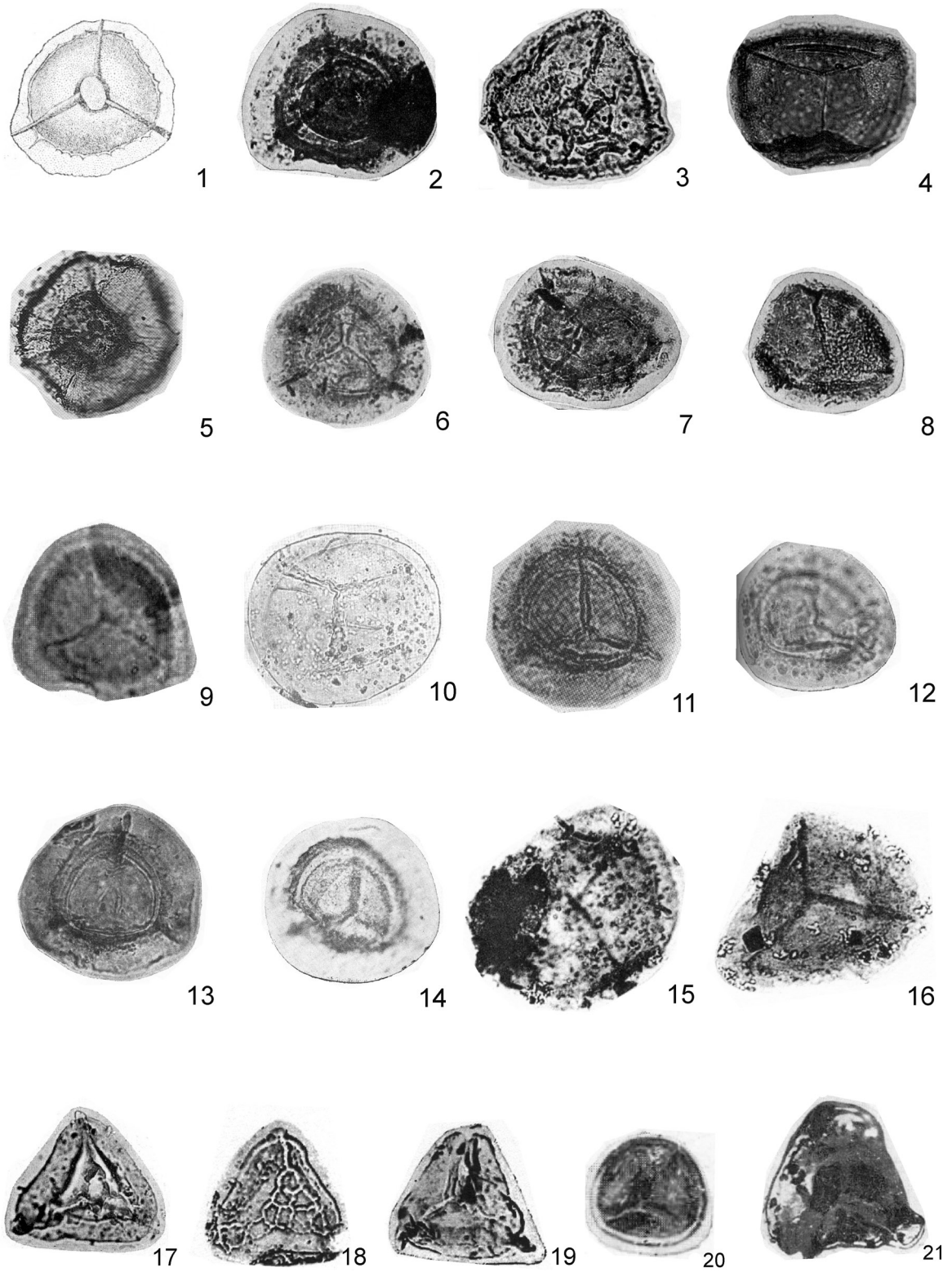


PLATE 10

Punctatisporites punctatus Ibrahim 1933

Holotype: Ibrahim, 1933; pl. 2, fig. 18; size 77 μm .

Locality, Horizon & Age: Ruhrgebiet, Floz Agir, Germany; Westphalian B/C, Late Carboniferous.

Salient features: Size 50–77 μm ; rays extend up to equator; exine 1–2 μm thick, proximally smooth, distally infrapunctate–infragranulose.

Punctatisporites minutus Kosanke 1950

Holotype: Kosanke 1950; pl. 16, fig. 3; size 29.4 x 28.7 μm .

Locality, Horizon & Age: Woodbury Coal Bed, Jasper County, Illinois, USA; Pennsylvanian, Carboniferous.

Salient features: Size 27.3–32.5 μm ; exine 1–1.5 μm thick, faintly micropunctate.

Punctatisporites gretensis Balme & Hennelly 1956

Remarks: Already transferred to genus *Callumispora*. For details see in Tiwari *et al.* 1989.

Punctatisporites priscus Bharadwaj & Salujha 1965

Holotype: Bharadwaj & Salujha, 1965; pl. 1, fig. 2; size 58 μm .

Locality, Horizon & Age: Bonbahal Seam, Raniganj Coalfield, Damodar Basin, West Bengal, India; Raniganj Formation, Early Permian.

Salient features: Size 42–74 μm ; exine less than 1 μm thick, smooth, finely infragranulose.

Punctatisporites reticulatus Pant & Srivastava 1965

Holotype: Pant & Srivastava 1965; pl. 1, figs. 14; size 74 μm .

Locality, Horizon & Age: Sample No. 1911, North of Rio Grande do Sul, near Candiota, Brazil, Early Permian.

Salient features: Size 66–102 μm ; exine 2.5–5 μm thick, granulose with fine reticulate texture.

Punctatisporites indicus Tiwari 1968

Holotype: Tiwari, 1968; pl. 1, fig. 6; size 33 μm .

Locality, Horizon & Age: IB River Coalfield, Mahanadi Basin, Orissa, India; Barakar Formation, Early Permian.

Salient features: Size 24–35 μm ; exine 1–1.5 μm thick, finely infra–micropunctate.

Punctatisporites ganjrensis Lele & Maithy 1969

Holotype: Lele & Maithy, 1969; pl. 1, fig. 2; size 60 μm .

Locality, Horizon & Age: Ganjra Nalla bed, Johilla Coalfield, South Rewa Basin, Madhya Pradesh, India; Karharbari Formation, Early Permian.

Salient features: Size 50–90 μm ; exine less than 1 μm thick.

Punctatisporites plicatus (Tiwari & Navale) Lele & Makada 1974

Holotype: Tiwari & Navale, 1967; pl. 1, fig. 2; size 100 x 110 μm .

Locality, Horizon & Age: Sample No. 1911, Rio Grande do Sul, Candiota, Santa Catrina Coalfield, Brazil; Permian.

Salient features: Size 96–120 μm ; exine 1–2 μm thick, finely infra–micropunctate, body surface heavily folded.

Genus: *Retusotriletes* Naumova 1953

Type species: *Retusotriletes simplex* Naumova 1953.

Locality, Horizon & Age: Kaluga–Gebiet, USSR; Givetien, Middle Devonian.

Salient features: Sub–triangular to circular; trilete mark distinct, ray–ends forming imperfect to complete curvature; exine schagrinate.

Retusotriletes simplex Naumova 1953

Holotype: Naumova, 1953; pl. 2, fig. 9; size 30 μm .

Locality, Horizon & Age: Kaluga–Gebiet, USSR; Givetien, Middle Devonian.

Salient features: Size 30–35 μm ; rays–ends join to form perfect curvature to contact area; exine \pm 1 μm thick, indistinctly structured.

Retusotriletes diversiformis (Balme & Hennelly) Bharadwaj 1962

Holotype: Balme & Hennelly, 1956; pl. 2, fig. 14; size 36 μm . (ca)

Locality, Horizon & Age: Main Greta Seam, Cessnock No. 1 Colliery, Greta Coal Measures, NSW, Australia; Permian.

Salient features: Size 24–53 μm ; contact area delimited by incipient curvature; exine \pm 2 μm thick, faintly granulate.

Remarks: This species had again been made new combination under genus *Hennellysporites* by Tiwari (1968).

Retusotriletes aridus Venkatachala & Kar 1968

Holotype: Venkatachala & Kar, 1968; pl. 1, fig. 1; size 92 x 92 μm .

Locality, Horizon & Age: Shale 25 ft. above Talchir Boulder bed, Kathwai Shales, Salt range, West Pakistan; Early Permian.

Salient features: Size range 59–92 x 69–92 μm ; exine \pm 2.5 μm thick, microverrucose.

Retusotriletes dejerseyi Venkatachala & Rawat 1978

Holotype: Venkatachala & Rawat, 1978; pl. 1, fig. 16; size 20 μm .

Locality, Horizon & Age: Purnea Well, Purnia, Bihar, India; Early Triassic.

Salient features: Size 25–28 μm ; trilete rays sinuous, extremities forming curvature; exine 1.5 μm thick, in contact area scabrate.

Genus: *Ricaspora* Bharadwaj & Salujha 1964

Type species: *Ricaspora granulata* Bharadwaj & Salujha 1964.

Locality, Horizon & Age: Seam III, Raniganj Coalfield, Damodar Basin, West Bengal, India; Raniganj Formation, Late Permian.

Salient features: Circular, enveloped by a perisporial membrane, appears thin flange; trilete mark prominent; exine thick, laevigate.

Ricaspora granulata Bharadwaj & Salujha 1964

Holotype: Bharadwaj & Salujha, 1964; pl. 1, fig. 10; size 80 μm .

Locality, Horizon & Age: Seam III, Raniganj Coalfield, Damodar Basin, West Bengal India; Raniganj Formation, Late Permian.

Salient features: Size 60–80 μm , trilete rays extend up to $\frac{3}{4}$ of the radius; exine \pm 1 μm thick, laevigate, perisporium 6–8 μm wide, finely granulose.

Infraturma: Apiculati (Bennie & Kidston) Potonié 1956

Genus: *Acanthotriletes* (Naumova) Potonié & Kremp 1954

Type species: *Acanthotriletes ciliatus* (Knox) Potonié & Kremp 1954.

Locality, Horizon & Age: Ruhrgebiet, Floz Loki, Zeche Brassert; Westfal C, Late Carboniferous.

Salient features: Broadly rounded; trilete mark simple, rays extend up to $\frac{1}{2}$ of radius; exine thin, covered with small spinules.

Acanthotriletes ciliatus (Knox) Potonié & Kremp 1954

Holotype: Potonié & Kremp, 1955; pl. 14, fig. 257; size 44 μm .

Locality, Horizon & Age: Ruhrgebiet, Floz Loki, Zeche Brassert; Westfal C, Late Carboniferous.

Salient features: Size 35–50 μm ; exine more or less 1 μm thick, all sides ornamented with tapering spinae, closely spaced, usually longer twice than broad, less than 0.5 μm at base.

Acanthotriletes filiformis (Balme & Hennelly) Tiwari 1965

Holotype: Balme & Hennelly, 1956; pl. 2, fig. 22; size 35 μm . (ca)

Locality, Horizon & Age: Borecore No. 5DDH, Seam at 688 ft, South Wallarah, NSW Australia; Permian.

Salient features: Size 26–46 μm ; exine up to 1–2 μm thick with aciculate or filiform processes, 2–5 μm long x 1–2 μm broad at base, densely placed.

Acanthotriletes jhariaensis Kar 1968

Holotype: Kar 1968; pl. 1, fig. 17; size 30 μm .

Locality, Horizon & Age: Borecore No. J.K. 5, Jharia Coalfield, Damodar Basin, Jharkhand, India; Barren Measures Formation, Late Permian.

Salient features: Size 28–30 μm ; exine 1 μm thick, spines 2.5–3.5 μm long with pointed or blunt ends, densely placed.

Genus: *Altitriletes* Venkatachala & Kar 1968

Type species: *Altitriletes densus* Venkatachala & Kar 1968.

Locality, Horizon & Age: Badam, North Karanpura Coalfield, Damodar Basin, Jharkhand, India; Barakar Formation, Early Permian.

Salient features: Circular to subcircular; trilete mark distinct, rays associated with thick lips; exine thick, proximally smooth, on distal face beset with coni, verrucae and warts.

Remarks: Based on these two exinal features—folds along trilete rays and differential nature of sculpture, this taxon is suggested to be placed in the Infraturma Varitriletes. Most probably under genus *Didecitriletes*.

Altitriletes densus Venkatachala & Kar 1968

Holotype: Venkatachala & Kar, 1968; pl. 2, figs. 38, & 39; size 64 x 55 μm .

Locality, Horizon & Age: Badam, North Karanpura Coalfield, Damodar Basin, Jharkhand, India; Barakar Formation, Early Permian.

Salient features: Size 46–59 x 61–64 μm ; trilete rays with 4 μm thick lips; exine 2–4 μm thick, beset with warts, 2–4 μm across, bacula, and few coni 1 x 1 μm , variable in size, irregular shape.

Genus: *Anapiculatisporites* Potonié & Kremp 1954

Type species: *Anapiculatisporites isselburgensis* Potonié & Kremp 1954.

Locality, Horizon & Age: Ruhrgebiet, Bohrung Isselburg, Germany; Westphalian, Late Carboniferous.

Salient features: Sub-rounded; trilete mark distinct, rays extend up to equator; exine proximally smooth, beset with coni on distal face and equator.

Remarks: Bharadwaj and Salujha (1965, p. 34) have commented about the folds along trilete rays in the specimens described under this taxon from the Permian successions in India. Henceforth, this species may probably be considered in the *Infraturma Varitriletes*.

Anapiculatisporites isselburgensis Potonié & Kremp 1954

Holotype: Potonié & Kremp 1954; pl. 20, fig. 97; size 56 µm.

Locality, Horizon & Age: Ruhrgebiet, Bohrung Isselburg, Germany; Westphalian, Late Carboniferous.

Salient features: Size 50–80 µm; exine more than 1 µm thick, coni–spinae 2–4 µm broad at base, up to 4–5 µm long, closely spaced.

Anapiculatisporites longispinosus Bharadwaj & Salujha 1965

Holotype: Bharadwaj & Salujha, 1965; pl. 1, fig. 13; size 70 µm.

Locality, Horizon & Age: Bon–Bahal Seam, Raniganj Coalfield, Damodar Basin, West Bengal, India; Raniganj Formation, Late Permian.

Salient features: Size 46–70 µm; exine less than 1 µm thick, spinae 3–5 µm long x 1.5–2 µm broad, sharp to blunt tipped.

Anapiculatisporites consonus Venkatachala & Kar 1968

Holotype: Venkatachala & Kar, 1968; pl. 1, fig. 11; size 28 µm.

Locality, Horizon & Age: Badam, North Karanpura Coalfield, Damodar Basin, Jharkhand, India; Barakar Formation, Early Permian.

Salient features: Size 28–42 µm; exine less than 1 µm, beset with coni or spines.

Anapiculatisporites veritas Venkatachala & Kar 1968

Holotype: Venkatachala & Kar, 1968; pl. 1, fig. 6; size 39 µm.

Locality, Horizon & Age: Badam, North Karanpura Coalfield, Damodar Basin, Jharkhand, India; Barakar Formation, Early Permian.

Salient features: Size 39–40 µm; exine less than 1 µm, beset with coni 1–1.5 µm high, equally broad, simulating vermiculate pattern.

Remarks: Suggested to be placed in *Granulatisporites*, acutely rounded apex.

Genus: *Apiculatisporis* Potonié & Kremp 1956

Type species: *Apiculatisporis aculeatus* (Ibrahim) Potonié & Kremp 1956.

Locality, Horizon & Age: Ruhrgebiet, Floz Agir, Germany; Westfal B/C, Late Carboniferous.

Salient features: Circular; trilete mark distinct, rays extend up to ½ of radius; exine thin, beset with coni.

Apiculatisporis aculeatus (Ibrahim) Potonié & Kremp 1956

Holotype: Ibrahim, 1933; pl. 6, fig. 57; size 53 µm.

Locality, Horizon & Age: Ruhrgebiet, Floz Agir, Germany; Westfal B/C, Late Carboniferous.

Salient features: Size 48–53 µm; exine 2 µm thick, coni 2–4 µm high x 1–2 µm wide.

Apiculatisporis grandis Salujha 1965

Holotype: Salujha, 1965; pl. 1, fig. 6; size 50 µm.

Locality, Horizon & Age: Upper Kajora Seam, Raniganj Coalfield, Damodar Basin, West Bengal, India; Raniganj Formation, Late Permian.

Salient features: Size 50–60 µm; exine thin, coni 1.5–3 µm high and ±1.5 µm broad, densely placed.

Apiculatisporis inconspicuus Salujha 1965

Holotype: Salujha, 1965; pl. 1, fig. 9; size 22 µm.

Locality, Horizon & Age: Upper Kajora Seam, Raniganj Coalfield, Damodar Basin, West Bengal, India; Raniganj Formation, Late Permian.

Salient features: Size 16–28 µm; exine less than 1 µm thick, beset with coni, ± 1 x 1 µm.

Apiculatisporis weylandii Bharadwaj & Salujha 1965

Holotype: Bharadwaj & Salujha, 1965; pl. 1, fig. 11; size 54 µm.

Locality, Horizon & Age: Jambad–Bowal Seam, Raniganj Coalfield, Damodar Basin, West Bengal, India; Raniganj Formation, Late Permian.

Salient features: Size 48–56 µm; exine ± 1 µm thick, coni 1.5–2.5 µm high and 1–1.5 µm broad, sharp to blunt tipped, sparsely arranged.

Apiculatisporis levis (Balme & Hennelly) Tiwari 1968

Holotype: Balme & Hennelly, 1956; pl. 2, fig. 20; size $\pm 30 \mu\text{m}$.

Locality, Horizon & Age: Main Seam, Proprietary Colliery, Collie, western Australia; Permian.

Salient features: Size 22–37 μm ; exine thin, beset with coni, blunt and pointed apex, 1–4 μm high x 1–4 μm broad.

Apiculatisporis secretus Venkatachala & Kar 1968

Holotype: Venkatachala & Kar, 1968; pl. 1, fig. 6; size 69 x 69 μm .

Locality, Horizon & Age: Shale 25 ft above Talchir Boulder Bed, Kathwai Shales, Salt Range, west Pakistan; Permian.

Salient features: Size 50–73 μm ; exine $\pm 1 \mu\text{m}$ thick, coni up to 1 μm high x 2 μm broad, closely spaced.

Genus: *Arasporites* Srivastava & Saxena 1984

Type species: *Arasporites crassus* Srivastava & Saxena 1984.

Locality, Horizon & Age: XIth Seam, Ara Block, West Bokaro Coalfield, Damodar Basin, Jharkhand, India; Barakar Formation, Early Permian.

Salient features: Broadly circular; trilete mark distinct, rays elevated; exine thick, ornamented with spines on both faces.

Remarks: In the nature of spines and trilete rays with folds, *Arasporites* is similar with *Didecitriletes*, a taxon in *Infraturma Varitriletes*.

Arasporites crassus Srivastava & Saxena 1984

Holotype: Srivastava & Saxena, 1984; pl. 1, fig. 2; size 60–86 μm .

Locality, Horizon & Age: XIth Seam, Ara Block, West Bokaro Coalfield, Jharkhand, India; Barakar Formation, Early Permian.

Salient features: Size 60–86 μm ; exine 2–6 μm thick, beset with spines, 1–5 μm long and 1–2 μm at base, sharply pointed to rounded apex.

Remarks: This species compares with *Didecitriletes horridus* Venkatachala and Kar (1965) in the nature of spines except exine thickness.

Genus: *Brijrajisporites* Tiwari 1968

Type species: *Brijrajisporites distinctus* Tiwari 1968.

Locality, Horizon & Age: Hingir–Rampur Seam, Ib–river Coalfield, Mahanadi Basin, Orissa, India; Barakar Formation, Early Permian.

Salient features: Spherical; trilete mark distinct; exine beset with bacula–pila like elements with blunt or obtuse apex, elements confluent like wavy ridges.

Brijrajisporites distinctus Tiwari 1968

Holotype: Tiwari, 1968; pl. 1, fig. 25; size 70 μm .

Locality, Horizon & Age: Hingir–Rampur Seam, Ib–river Coalfield, Mahanadi Basin, Orissa, India; Barakar Formation, Early Permian.

Salient features: Size 70–80 μm ; exine baculate, bacula blunt or curved tipped, 3–6 μm long, closely spaced, mostly confluent of their length, inter–spaces forming zig–zag canals.

Brijrajisporites fuscus Tiwari 1968

Holotype: Tiwari, 1968; pl. 1, fig. 27; size 65 μm .

Locality, Horizon & Age: Hingir–Rampur Seam, Ib–river Coalfield, Mahanadi Basin, Orissa, India; Barakar Formation, Early Permian.

Salient features: Size 65–80 μm ; exine baculate, bacula 1–3 μm long and broad, closely spaced.

Genus: *Cyclogranisporites* Potonié & Kremp 1954

Type species: *Cyclogranisporites leopoldii* (Kremp) Potonié & Kremp 1954

Locality, Horizon & Age: Ruhrgebiet, Floz Agir, Germany; Westphalian B/C, Late Carboniferous.

Salient features: Circular; trilete mark distinct; exine beset with grana all over.

Cyclogranisporites leopoldii (Kremp) Potonié & Kremp 1954

Holotype: Potonié & Kremp, 1954; pl. 20, fig. 103; size 33 μm

Locality, Horizon & Age: Ruhrgebiet, Floz Agir, Germany; Westphalian B/C, Late Carboniferous.

Salient features: Size 25–35 μm ; exine thin, grana less than 1 μm , closely placed on periphery.

Cyclogranisporites gondwanensis Bharadwaj & Salujha 1964

Holotype: Bharadwaj & Salujha, 1964; pl. 1, fig. 19; size 32 μm .

Locality, Horizon & Age: Seam VIII, Raniganj Coalfield, Damodar Basin, West Bengal, India; Raniganj Formation, Late Permian.

Salient features: Size 22–36 μm ; exine thin, matted with $\pm 1 \mu\text{m}$ wide grana.

Cyclogranisporites optimus Bharadwaj & Salujha 1965

Holotype: Bharadwaj & Salujha, 1964; pl. 1, fig. 23; size 65 μm .

Locality, Horizon & Age: Jambad–Bowal Seam, Raniganj Coalfield, Damodar Basin, West Bengal, India; Raniganj Formation, Late Permian.

Salient features: Size 58–66 μm ; exine thin, beset with grana, 1.5 μm high.

Cyclogranisporites barakarensis Srivastava 1970

Holotype: Srivastava, 1970; pl. 1, fig. 2; size 22 μm .

Locality, Horizon & Age: Gopalprasad Coal Bed, Talcher Coalfield, Mahanadi Basin, Orissa, India; Barakar Formation, Early Permian.

Salient features: Size 18–32 μm ; exine thin, grana less than 1 μm , closely set.

Cyclogranisporites triletus Kar 1970

Holotype: Kar, 1970; pl. 1, fig. 13; size 60 μm .

Locality, Horizon & Age: Borecore No. RE 9, depth 83 m, Raniganj Coalfield, West Bengal, India; Panchet Formation, Early Triassic.

Salient features: Size 45–70 μm ; exine 2.5 μm thick, grana ± 1 μm high, closely spaced.

Genus: *Cyclobaculisporites* Bharadwaj 1955

Type species: *Cyclobaculisporites grandiverrucosus* Bharadwaj 1955.

Locality, Horizon & Age: Saar Region, Germany; Stephanian C, Early Carboniferous.

Salient features: Circular; trilete mark distinct, rays extend less than 2/3 of radius; exine thin to thick, beset with bacula of uniform height but with wider width range, apex truncate or curvature, inter-bacular spaces irregular.

Cyclobaculisporites grandiverrucosus Bharadwaj 1955

Holotype: Bharadwaj, 1955; pl. 3, fig. 4; size 78 μm .

Locality, Horizon & Age: Saar Region, Germany; Stephanian C, Early Carboniferous.

Salient features: Size 70–90 μm ; exine 1–3 μm thick, bacula up to 3 μm long and broad with truncate apex.

Cyclobaculisporites minutus Bharadwaj & Salujha 1964

Holotype: Bharadwaj, 1962; pl. 2, fig. 47; size 94 μm .

Locality, Horizon & Age: Seam VIII, Raniganj Coalfield, Damodar Basin, West Bengal, India; Raniganj Formation, Late Permian.

Salient features: Size 42–80 μm ; exine thin, bacula 1.5 μm broad and closely placed.

Cyclobaculisporites indicus Bharadwaj & Salujha 1964

Holotype: Bharadwaj, 1962; pl. 2, fig. 37; size 70 μm .

Locality, Horizon & Age: Seam VIII, Raniganj Coalfield, Damodar Basin, West Bengal, India; Raniganj Formation, Late Permian.

Salient features: Size 94–120 μm ; exine less than 1 μm , bacula 2.5 μm broad and equally long.

Cyclobaculisporites bharadwajii Salujha 1965

Holotype: Salujha, 1965; pl. 1, fig. 15; size 78 μm .

Locality, Horizon & Age: Seam IX, Raniganj Coalfield, Damodar Basin, West Bengal, India; Raniganj Formation, Late Permian.

Salient features: Size 58–90 μm ; exine 2 μm thick, bacula 2–4 μm long and 1.5–2 μm broad with rounded apex.

Cyclobaculisporites proprius Bharadwaj & Salujha 1965

Holotype: Bharadwaj & Salujha, 1965; pl. 1, fig. 21; size 65 μm .

Locality, Horizon & Age: Jambad–Bowal Seam, Raniganj Coalfield, Damodar Basin, West Bengal, India; Raniganj Formation, Late Permian.

Salient features: Size 52–90 μm ; exine thin, bacula 2–3 μm high and broad, truncate tipped.

Cyclobaculisporites minimus Kar 1968

Holotype: Kar, 1968; pl. 1, fig. 19; size 27 μm .

Locality, Horizon & Age: Borecore No. J.K. 5, Jharia Coalfield, Damodar Basin, Jharkhand, India; Barren Measures Formation, Late Permian.

Salient features: Size 25–27 μm ; exine often folded, beset with bacula, less than 1 μm high as broad, closely spaced.

Genus: *Godavarisporites* Tiwari & Moiz 1971

Type species: *Godavarisporites indicus* Tiwari & Moiz 1971.

Locality, Horizon & Age: Mandamari–Somagudum Coalfield, Godavari Basin, Andhra Pradesh, India; Barakar Formation, Early Permian.

Salient features: Circular to roundly triangular; trilete mark distinct, contact area distinct delimited by arcuate rims, rays extend up to radius; exine beset with pointed or rounded apex coni on distal face and equator, reduced in contact area.

Godavarisporites indicus Tiwari & Moiz 1971

Holotype: Tiwari & Moiz, 1971; pl. 1, fig. 1; size 32 µm.

Locality, Horizon & Age: Mandamari–Somagudum Coalfield, Godavari Basin, Andhra Pradesh, India; Barakar Formation, Early Permian.

Salient features: Size 32–38 µm; exine thin, conic 2 x 2 µm, pointed to round apex.

Godavarisporites tentulus Tiwari & Moiz 1971

Holotype: Tiwari & Moiz, 1971; pl. 1, fig. 6; size 26 µm.

Locality, Horizon & Age: Mandamari–Somagudum Coalfield, Godavari Basin, Andhra Pradesh, India; Barakar Formation, Early Permian.

Salient features: Size 20–26 µm; conic 1 x 1 µm, closely placed, pointed to round apex.

Godavarisporites parmatus (Balme & Hennelly) Tiwari & Moiz 1971

Lecto–Holotype: Balme & Hennelly, 1956; pl. 5, figs 51, 52; size 44 x 50 µm.

Locality, Horizon & Age: Main Greta Seam, Cessnock No. 1 Colliery, Greta Coal Measures. N.S.W. Australia; Permian.

Salient features: Size 32–52 µm; exine less than 1 µm thick, beset with rounded verrucae or pustules, 2–5 µm broad, about 2 µm high, 3 µm apart, sometimes elements increased in size on distal pole.

Godavarisporites jamottei (Kar & Bose) Tiwari & Moiz 1971

Lecto–Holotype: Kar & Bose, 1967; pl. 1, fig. 12; size 25 µm.

Locality, Horizon & Age: Assise des schistes noirs de la Lukuga, Sondage 10; Early Permian.

Salient features: Size 22–30 µm; exine 1.5–2 µm thick, conic 1–1.5 µm across.

Remarks: Presence of contact area is observed in the photographs, not described by Kar and Bose (1961), as not visible originally due to heavy sculpture.

Genus: *Granulatisporites* Ibrahim emend. Potonié & Kremp 1954

Type species: *Granulatisporites granulatus* Ibrahim, 1933.

Locality, Horizon & Age: Ruhrgebiet, Floz Agir, Germany; Westphalian B/C, Late Carboniferous.

Salient features: Subtriangular; trilete mark distinct, rays extend 2/3 of radius; exine thin to thick, beset with grana.

Granulatisporites granulatus (Ibrahim) Potonié & Kremp 1954

Holotype: Ibrahim, 1933; pl. 6, fig. 51; size 30 x 31 µm.

Locality, Horizon & Age: Ruhrgebiet, Floz Agir, Germany; Westphalian B/C, Late Carboniferous.

Salient features: Size 25–34 µm; exine 2–3 µm thick, grana less than 1 µm, punctate on both faces.

Genus: *Horriditriletes* Bharadwaj & Salujha 1964

Type species: *Horriditriletes curvibaculosus* Bharadwaj & Salujha 1964.

Locality, Horizon & Age: Seam VIII, Raniganj Coalfield, Damodar Basin, West Bengal, India; Raniganj Formation, Late Permian.

Salient features: Triangular, straight to slightly curved sides and rounded angles, trilete mark distinct, rays extend 1/2 to 3/4 of radius; exine beset with bacula.

Horriditriletes curvibaculosus Bharadwaj & Salujha 1964

Holotype: Bharadwaj & Salujha, 1964; pl. 2, fig. 34; size ± 30 µm.

Locality, Horizon & Age: Seam VIII, Raniganj Coalfield, Damodar Basin, West Bengal, India; Raniganj Formation, Late Permian.

Salient features: Size 26–40 µm; exine 4 µm, bacula 3–4 µm long, curved, widely spaced.

Horriditriletes brevis Bharadwaj & Salujha 1964

Holotype: Bharadwaj & Salujha, 1964; pl. 2, fig. 41; size ± 20 µm.

Locality, Horizon & Age: Seam VIII, Raniganj Coalfield, Damodar Basin, West Bengal, India; Raniganj Formation, Late Permian.

Salient features: Size 20–24 µm; exine 2 µm, bacula 2 µm long and broad.

Horriditriletes ramosus (Balme & Hennelly) Bharadwaj & Salujha 1964

Holotype: Balme & Hennelly, 1956; pl. 3, fig. 39; size 36 µm.

Locality, Horizon & Age: Main Seam, Proprietary Colliery, Collie, western Australia; Early Permian.

Salient features: Size 26–45 µm; exine thin, beset with coarse spines or baculae, often bifurcated at tips and joined at their bases, 2–5 µm broad and 2–7 µm long.

Horriditriletes elegans Bharadwaj & Salujha 1965

Holotype: Bharadwaj & Salujha, 1965; pl. 1, fig. 14; size 40 μm .

Locality, Horizon & Age: Jambad–Bowal Seam, Raniganj Coalfield, Damodar Basin, West Bengal, India; Raniganj Formation, Late Permian.

Salient features: Size 34–42 μm ; exine less than 1 μm thick, bacula 3–5 μm long and 1.5–2 μm broad with blunt tip.

Horriditriletes splendidus Bharadwaj & Salujha 1965

Holotype: Bharadwaj & Salujha, 1965; pl. 1, fig. 17; size 60 μm .

Locality, Horizon & Age: Jambad–Bowal Seam, Raniganj Coalfield, Damodar Basin, West Bengal, India; Raniganj Formation, Late Permian.

Salient features: Size 50–60 μm ; exine \pm 1 μm , bacula 2.5 μm long and 2 μm broad.

Horriditriletes bulbosus Tiwari 1965

Holotype: Tiwari, 1965; pl. 1, fig. 27; size 45 μm .

Locality, Horizon & Age: Pindra Seam, West Bokaro Coalfield, Damodar Basin, Jharkhand, India; Barakar Formation, Early Permian.

Salient features: Size 40–50 μm ; exine \pm 1 μm thick, beset with bacula, 3–6 μm long, 2–4 μm broad, having blunt apex, bulbosus base.

Horriditriletes novus Tiwari 1965

Holotype: Tiwari, 1965; pl. 1, fig. 23; size 48 μm .

Locality, Horizon & Age: Topa Village Quarry, West Bokaro Coalfield, Damodar Basin, Jharkhand, India; Barakar Formation, Early Permian.

Salient features: Size 45–53 μm ; exine \pm 1 μm thick, beset with mixed elements–bacula, and coni, 2–3 μm long with blunt apex.

Horriditriletes unicus Tiwari 1965

Holotype: Tiwari, 1965; pl. 1, fig. 30; size 48 μm .

Locality, Horizon & Age: Borehole G–22, Sample 498 (D), Korba Coalfield, South Rewa Basin, Chhattisgarh, India; Barakar Formation, Early Permian.

Remarks: This species has already been placed under genus *Brevitriletes*.

Horriditriletes rampurensis Tiwari 1968

Holotype: Tiwari, 1968; pl. 1, fig. 17; size 29 μm .

Locality, Horizon & Age: IB River Coalfield, Mahanadi Basin, Orissa, India; Barakar Formation, Early Permian.

Salient features: Size 17 μm ; exine \pm 1 μm thick, bacula 1.5 μm long x 1 μm wide, rarely coni.

Horriditriletes pathakheraensis Anand–Prakash 1972

Holotype: Anand–Prakash, 1972; pl. 1, fig. 1; size 35 μm .

Locality, Horizon & Age: Borecore PK–82, sample 1574A (C) E, Pathakhera Coalfield, Satpura Basin, Madhya Pradesh, India; Barakar Formation, Early Permian.

Salient features: Size 34–44 μm ; exine thin, beset with blunt headed bacula, 1–2 μm high and wide.

Horriditriletes pseudoseptatus Sinha 1972

Holotype: Sinha, 1972; pl. 1, fig. 12; size 50 μm .

Locality, Horizon & Age: Borecore NCSJ–4, sample 82, Jhingurdah Seam, Singrauli Coalfield, South Rewa Basin, Madhya Pradesh, India; Raniganj Formation, Late Permian.

Salient features: Size 25–50 μm ; exine \pm 1 μm thick, beset with bacula 2.5 μm long and 2 μm broad, sparsely arranged.

Horriditriletes rajmahalensis D’Rozario & Banerjee 1987

Holotype: D’Rozario & Banerjee, 1987; pl. 2, fig. 7; size 39 μm .

Locality, Horizon & Age: Hura and Chuparbhita Coalfield, Rajmahal Basin, Jharkhand, India; Barakar Formation, Early Permian.

Salient features: Size 33–45 μm ; trilete rays extend up to $\frac{3}{4}$ of radius; exine beset with bacula, 2–3 μm long, confined at apical and inter–radial region.

Remarks: In this species, bacula are restricted in distribution, not uniformly present.

Infraturma: *Verrucati* Dyb. Jacho 1957**Genus**: *Lalmatiasporites* D’Rozario & Banerjee 1987

Type species: *Lalmatiasporites indicus* D’Rozario & Banerjee 1987.

Locality, Horizon & Age: Hura and Chuparbhita Coalfield, Rajmahal Basin, Jharkhand, India; Barakar Formation, Early Permian.

Salient features: Circular to subcircular; trilete mark distinct, rays extend up to $\frac{1}{2}$ to $\frac{3}{4}$ of radius, associated with verrucate–like thickening, ray–ends bifurcated forming bilobed or crescent shape structures; exine thick, laevigate and undulated, also beset with verrucae.

Lalmatiasporites indicus D’Rozario & Banerjee 1987

Holotype: D’Rozario & Banerjee, 1987; pl. 1, fig. 1; size \pm 72 μm .

Locality, Horizon & Age: Hura and Chuparbhita Coalfields, Rajmahal Basin, Jharkhand, India; Barakar Formation, Early Permian.

Salient features: Size 45–72 µm; rays associated with verrucate-like thickening; exine 1.5–3 µm thick, body folds present but no sculpture seen.

Lalmatiasporites barakarensis D’Rozario & Banerjee 1987

Holotype: D’Rozario & Banerjee, 1987; pl. 1, fig. 4; size ± 57.5 µm.

Locality, Horizon & Age: Hura and Chuparbhita Coalfields, Rajmahal Basin, Jharkhand, India; Barakar Formation, Early Permian.

Salient features: Size 45–66 µm; trilete rays associated with undulated thickening, bifurcated at ends forming lobe shape structures; exine 1.5–3 µm thick, beset with verrucae, 2–4 µm broad x 1–3 µm high.

Genus: *Lobatosporites* Tiwari & Moiz 1971

Type species: *Lobatosporites gondwanensis* Tiwari & Moiz 1971.

Locality, Horizon & Age: Ramagundam Coalfield, Godavari Basin, Andhra Pradesh, India; Barakar Formation, Early Permian.

Salient features: Triangular with concave inter-radial sides, broadly rounded angles; trilete mark distinct, rays extend $\frac{3}{4}$ of radius; exine beset with bacula, rarely mixed with coni on distal face and equator, reduced in contact area.

Lobatosporites gondwanensis Tiwari & Moiz 1971

Holotype: Tiwari & Moiz, 1971; pl. 1, fig. 9; size 30 µm.

Locality, Horizon & Age: Ramagundam Coalfield, Godavari Basin, Andhra Pradesh, India; Barakar Formation, Early Permian.

Salient features: Size 24–34 µm; exine less than 1 µm thick, beset with coni and bacula 1–2 µm broad and 2–4 µm high with blunt to round apex.

Lobatosporites brevibaculosus Tiwari & Moiz 1971

Holotype: Tiwari & Moiz, 1971; pl. 1, fig. 16; size 34 µm.

Locality, Horizon & Age: Ramagundam Coalfield, Godavari Basin, Andhra Pradesh, India; Barakar Formation, Early Permian.

Salient features: Size 28–44 µm; exine less than 1 µm thick, beset with coni and bacula, 1–2 µm broad and long with blunt to round apex, scanty; angle-lobes not more prominent.

Infraturma: *Apiculati* (Bennie & Kidston) Potonié 1956

Genus: *Lophotriletes* (Nauma) Potonié & Kremp 1954

Type species: *Lophotriletes gibbosus* (Ibrahim) Potonié & Kremp 1954.

Locality, Horizon & Age: Ruhrgebiet, Floz Agir; Westfal B/C, Late Carboniferous.

Salient features: Broadly triangular with concave sides; trilete mark distinct, rays extend $\frac{2}{3}$ of radius; exine thin, beset with coni of variable size.

Lophotriletes gibbosus (Ibrahim) Potonié & Kremp 1954

Holotype: Ibrahim, 1933; pl. 6, fig. 49; size 46 µm.

Locality, Horizon & Age: Ruhrgebiet, Floz Agir; Westfal B/C, Late Carboniferous.

Salient features: Size 40–50 µm; exine more or less 1 µm thick, coni ± 1 µm high and wide.

Lophotriletes rectus Bharadwaj & Salujha 1964

Holotype: Bharadwaj & Salujha, 1964; pl. 2, fig. 26; size 33 µm.

Locality, Horizon & Age: Seam VIII, Raniganj Coalfield, Damodar Basin, West Bengal, India; Raniganj Formation, Late Permian.

Salient features: Size 22–40 µm; exine thin, coni ± 2 µm high and 1–1.5 µm broad, blunt tipped.

Lophotriletes rarus Bharadwaj & Salujha 1964

Holotype: Bharadwaj & Salujha, 1964; pl. 2, fig. 30; size 36 µm.

Locality, Horizon & Age: Seam VIII, Raniganj Coalfield, Damodar Basin, West Bengal, India; Raniganj Formation, Late Permian.

Salient features: Size 30–42 µm; exine thin, coni ± 1.5 µm high, sparsely set.

Lophotriletes pseudogranus Bharadwaj & Salujha 1964

Holotype: Bharadwaj 1962; pl. 2, fig. 29; size 45 µm.

Locality, Horizon & Age: Seam VIII, Raniganj Coalfield, Damodar Basin, West Bengal, India; Raniganj Formation, Late Permian.

Salient features: Size 44–50 µm; Exine ± 1 µm, coni 2 µm high and 1–2 µm broad with sharp to blunted tip.

Lophotriletes frequens Tiwari 1965

Holotype: Tiwari, 1965; pl. 1, fig. 14; size ± 63 µm.

Locality, Horizon & Age: Pindra Seam, Datma Colliery, West Bokaro Coalfield, Damodar Basin, Jharkhand, India; Barakar Formation, Early Permian.

Salient features: Size 61–85 µm; exine ± 1 µm thick, coni 1–2 µm high and broad at base with pointed tip.

Lophotriletes minimus Salujha 1965

Holotype: Salujha, 1965; pl. 1, fig. 13; size 30 µm.

Locality, Horizon & Age: Seam IX, Raniganj Coalfield, Damodar Basin, West Bengal, India; Raniganj Formation, Late Permian.

Salient features: Size 26–34 µm; exine ± 1 µm, beset with less than 1 µm high and equally broad coni.

Lophotriletes novus Kar 1968

Holotype: Kar, 1968; pl. 1, fig. 13; size 30 µm.

Locality, Horizon & Age: Borehole No. J.K. 5, Jharia Coalfield, Damodar Basin, Jharkhand, India; Barren Measures Formation, Late Permian.

Salient features: Size 27–32 µm; exine thin, coni less than 1 µm, fairly distributed.

Lophotriletes latiangulatus Kar 1968

Holotype: Kar, 1968; pl. 1, fig. 11; size 41 µm.

Locality, Horizon & Age: Borehole No. J.K. 5, Jharia Coalfield, Damodar Basin, Jharkhand, India; Barren Measures Formation, Late Permian.

Salient features: Size 37–41 µm; exine thin, coni less than 0.5 µm, minute.

Genus: *Osmundacidites* Couper 1953

Type species: *Osmundacidites wellmanii* Couper 1953.

Locality, Horizon & Age: Ohika beds, L 12 (type), Garvey Greek Hawks Crag, Breccia, L 55, New Zealand; Jurassic.

Salient features: Sub-circular; trilete mark distinct, subduded due to sculptures, rays extend almost up to equator; exine thin, beset with mixed sculpture grana–papillae–bacula.

Osmundacidites wellmanii Couper 1953

Holotype: Couper, 1953; pl. 1, fig. 5; size 44 µm.

Locality, Horizon & Age: Ohika beds, L 12 (type), Garvey Greek Hawks Crag, Breccia, L 55, New Zealand; Jurassic.

Salient features: Size 40–63 µm; exine 1.5 µm thick, beset with grana–papillae, ± 1 µm across, reduced in inter-ray area.

Osmundacidites baculatus Tiwari & Ram–Awatar 1988

Holotype: Tiwari & Ram–Awatar, 1988; pl. 1, fig. 12; size 53 µm.

Locality, Horizon & Age: Johilla River Section near Dargaon Village, Johilla Coalfield, South Rewa Basin, Madhya Pradesh, India; Pali Formation, Permian–Triassic.

Salient features: Size 50–60 µm; exine ± 1 µm thick beset with finger-shaped bacula, 3.5 µm long x 1–1.5 µm broad, intermixed short coni and spines.

Osmundacidites pilatus Tiwari & Rana 1981

Holotype: Tiwari & Rana, 1981; pl. 2, fig. 30; size 48 x 49 µm.

Locality, Horizon & Age: Bore-hole RD–1, Sample No. 5 depth 600.58 m, Raniganj Coalfield, Damodar Basin, India; Upper Panchet Formation, Lower Triassic.

Salient features: Size 48 µm; exine 1 µm thick, Pila, 3.5 µm broad at base and up to 5 µm long and rounded head, intermixed with a few verrucae, closely placed all over the body.

Osmundacidites senectus (Balme) Bharadwaj & Tiwari 1977

Holotype: Balme, 1963; pl. 4, figs 1 & 2; size 58–79 µm.

Locality, Horizon & Age: Well point 217, Upper Greenough River area, western Australia; Kate shale, Lower Triassic.

Salient features: Size 72 µm; exine 1–2 µm cone, granz and sub-baculate, basal diameter 1–3 µm, height 1–2 µm.

Genus: *Verrucosisporites* Ibrahim emend. Smith 1971

Type species: *Verrucosisporites verrucosus* Ibrahim in Potonié, Ibrahim and Loose 1932.

Locality, Horizon & Age: Agir Seam, Wehofen Colliery, Ruhr Coalfield, Germany; Westfal B/C, Late Carboniferous.

Salient features: Circular to roundly triangular; trilete mark distinct, rays extend up to 2/3 of radius; exine beset with closely placed verrucae, may include rugulae, coni of variable size and shape.

Verrucosisporites verrucosus Ibrahim 1933

Holotype: Ibrahim in Potonié, Ibrahim and Loose 1932; pl. 15, fig. 17; size 65.5 x 77.5 µm.

Locality, Horizon & Age: Agir Seam, Wehofen Colliery, Ruhr Coalfield, Germany; Westfal B/C, Late Carboniferous.

Salient features: Size 58–108 µm; exine beset with warts, 2–4 µm in diameter.

Verrucosisporites donarii Potonié & Kremp 1955

Holotype: Potonié & Kremp 1955; pl. 4, fig. 1; size 65 µm.

Locality, Horizon & Age: Brassert Colliery, Ruhr Coalfield, Germany, Donan Seam; Lower Westphalian C.

Salient features: Size 65 µm; exine 2.3 µm, covered by discrete closely spaced verrucae length up to 6 µm.

Verrucosiporites distinctus Tiwari 1965

Holotype: Tiwari, 1965; pl. 1, fig. 10; size 95 µm.

Locality, Horizon & Age: Borecore G-26, 420(B) E, Korba Coalfield, South Rewa Basin, Chhattisgarh, India; Barakar Formation, Early Permian.

Salient features: Size 61–95 µm; exine 1–3 µm thick, verrucae densely placed, ± 1–2 µm across.

Verrucosiporites diversus Bharadwaj & Salujha 1965

Holotype: Bharadwaj & Salujha, 1965; pl. 1, fig. 9; size 70 µm.

Locality, Horizon & Age: Bon-Bahal Seam, Raniganj Coalfield, Damodar Basin, West Bengal, India; Raniganj Formation, Late Permian.

Salient features: Size 60–80 µm; trilete rays extend $\frac{1}{2}$ – $\frac{3}{4}$ of radius; labra along rays 2–3 µm thick, exine ± 1 µm thick, verrucae closely set, 2–3 broad and 1–2.5 µm high.

Verrucosiporites varius Maheshwari 1967

Holotype: Maheshwari, 1967; pl. 1, fig. 5; size 50 x 60 µm.

Locality, Horizon & Age: About $\frac{3}{4}$ mile South-east of Alubera, Bansloi River, Santhal Pargana, Rajmahal Basin, Jharkhand; Barakar Formation, Early Permian.

Salient features: Size 45–70 µm; exine less than 1 µm thick, verrucae 2–3 µm at base x 1–2 µm high.

Verrucosiporites ambiplicatus Kar 1968

Holotype: Kar, 1968; pl. 1, fig. 10; size 55 µm

Locality, Horizon & Age: Borehole No. J.K. 5, Jharia Coalfield, Damodar Basin, Jharkhand, India; Barren Measures Formation, Late Permian.

Salient features: Size 36–55 µm; exine 1 µm thick, verrucae fairly numerous, rounded to pointed tip, 2–2.5 µm high.

Verrucosiporites gondwanensis Srivastava 1970

Holotype: Srivastava, 1970; pl. 1, fig. 5; size 93 µm.

Locality, Horizon & Age: Dera Colliery, Talcher Coalfield, Mahanadi Basin, Orissa, India; Barakar Formation, Early Permian.

Salient features: Size 75–118 µm; exine 1–2 µm thick, verrucae 1 x 1 µm across, compactly arranged.

Verrucosiporites narmianus Balme 1970

Holotype: Balme, 1970; pl. 1, fig. 14; size 72 µm.

Locality, Horizon & Age: UWA 57761, Sample no. K12-6, Landa Pusha, Surghar Range, west Pakistan; Mianwali Formation, Early Triassic.

Salient features: Size 68–79 µm; exine 2–4 µm thick, verrucae 1–4 µm at base, 1–2 µm high, varied shape and size.

Verrucosiporites maiturensis Bharadwaj & Dwivedi 1981

Holotype: Bharadwaj & Tiwari, 1977; pl. 2, fig. 33; size 100 µm.

Locality, Horizon & Age: Borecore NCRD 6, depth 86 m, Raniganj Coalfield, Damodar Basin, West Bengal, India; Panchet Formation, Early Triassic.

Salient features: Size 70–140 µm; exine 2–3 µm thick, massive verrucae, 3–6 µm high x 8–12 µm broad.

Verrucosiporites raniganjensis Bharadwaj & Dwivedi 1981

Holotype: Bharadwaj & Tiwari, 1977; pl. 2, fig. 31; size 110 µm.

Locality, Horizon & Age: Borecore NCRD 6, depth 86 m, Raniganj Coalfield; Damodar Basin, West Bengal, India; Panchet Formation, Early Triassic.

Salient features: Size 65–88 µm; exine 3 µm thick, verrucae conically rounded 2–3 µm high and broad.

Infraturma: Varitriletes Venkatachala & Kar 1965

Spores subtriangular to subcircular; trilete rays associated with folds; exine sculptured with differential pattern of elements.

Genus: *Brevitriletes* Bharadwaj & Srivastava emend. Tiwari & Singh 1981

Type species: *Brevitriletes communis* Bharadwaj & Srivastava 1969.

Locality, Horizon & Age: South Belanda Colliery, Talcher Coalfield, Mahanadi Basin, Orissa, India; Barakar Formation, Early Permian.

Salient features: Subtriangular to subcircular; trilete mark distinct, rays associated with folds; exine beset with compound spines on distal face and equatorial region, absent in inter-ray area.

Brevitriletes communis Bharadwaj & Srivastava emend. Tiwari & Singh 1981

Holotype: Bharadwaj & Srivastava, 1969; pl. 1, fig. 12; size 37 µm.

Locality, Horizon & Age: South Belanda Colliery, Talcher Coalfield, Mahanadi Basin, Orissa, India; Barakar Formation, Early Permian.

Salient features: Size 25–44 μm ; trilete mark sometimes not visible due to compact arrangement of spines; exine up to 1–2 μm thick, spines with apical appendage, 1–3 μm long x 1–2 μm broad at base.

Brevitriletes unicus Bharadwaj & Srivastava emend. Tiwari & Singh 1981

Holotype: Bharadwaj & Srivastava, 1969; pl. 1, fig. 30; size 43 μm .

Locality, Horizon & Age: South Belanda Colliery, Talcher Coalfield, Mahanadi Basin, Orissa, India; Barakar Formation, Early Permian.

Salient features: Size 38–48 μm ; exine \pm 1–2 μm thick, spines constricted in middle part, broad base with rounded apex having curved appendage, 2–5 μm long x 1.5–3 μm broad at base.

Genus: *Didecitriletes* Venkatachala & Kar emend. Tiwari & Singh 1981

Type species: *Didecitriletes horridus* Venkatachala & Kar 1965.

Locality, Horizon & Age: Badam, North Karanpura Coalfield, Damodar Basin, Jharkhand, India; Barakar Formation, Early Permian.

Salient features: Triangular to subtriangular; trilete mark distinct, rays associated with folds, extend upto equator; exine thick, sculptured differentially, proximally sparsely granulose or conical, on distal face spines with bulbous base and blunt tips.

Didecitriletes horridus Venkatachala & Kar emend. Tiwari & Singh 1981

Holotype: Venkatachala & Kar, 1965; pl. 1, fig. 1; size 59 x 59 μm .

Locality, Horizon & Age: Badam, North Karanpura Coalfield, Damodar Basin, Jharkhand, Bengal, India; Barakar Formation, Early Permian.

Salient features: Size 50–59 x 55–64 μm ; exine \pm 2 μm thick, low and sparse conical on proximal face, dense spines with bulbous base and beak like apical appendage on distal face, 2–6 μm long and 2–3 μm broad at base.

Didecitriletes ericianus (Balme & Hennelly) Venkatachala & Kar 1965

Holotype: Balme & Hennelly, 1956; pl. 3, fig. 30; size 59 μm .

Locality, Horizon & Age: Lithgow Seam, Wallerawang Colliery, Western Coalfield, N.S.W. Australia; Permian.

Salient features: Size 39–84 μm ; exine 1–2 μm thick, with acicular or acuminate processes about 2 μm at base and up to 7 μm long, proximally psilate.

Didecitriletes dentatus (Balme & Hennelly) Venkatachala & Kar 1965

Holotype: Balme & Hennelly, 1956; pl. 3, fig. 34; size ca 100 μm .

Locality, Horizon & Age: Seam at 755 ft., Newston No. 2, D.D.H. Bore, upper part of New castle Stage, N.S.W. Australia; Permian.

Salient features: Size 78–114 μm ; exine about 2 μm thick, heavily closely packed conical process, 3–4 μm broad and 5–7 μm long.

Didecitriletes uncinatus (Balme & Hennelly) Venkatachala & Kar 1965

Holotype: Balme & Hennelly, 1956; pl. 3, fig. 35; size \pm 40 μm .

Locality, Horizon & Age: D.D.H. Bore, Seam at 688 ft., South Wallarah No.5, upper part of the New Castle Stage, N.S.W. Australia; Permian.

Salient features: Size 28–46 μm ; exine about 2 μm thick, echinate, 1–2 μm broad and 2–8 μm long.

Genus: *Imparitriletes* Tiwari & Singh 1981

Type species: *Imparitriletes korbaensis* Tiwari & Singh 1981.

Locality, Horizon & Age: Borecore NCKB–19, Sample No. 130, Korba Coalfield, South Rewa Basin, Chhattisgarh, India; Karharbari Formation, Early Permian.

Salient features: Triangular to subtriangular; trilete mark distinct, rays associated with folds and extend more or less up to equator; exine thin, proximally smooth, distally beset with rounded grana.

Imparitriletes korbaensis Tiwari & Singh 1981

Holotype: Tiwari & Singh 1981; pl. 10, fig. 85; size 46.5 μm .

Locality, Horizon & Age: Borecore NCKB–19, Sample No. 130, Korba Coalfield, South Rewa Basin, Chhattisgarh, India; Karharbari Formation, Early Permian.

Salient features: Size 26–60 μm ; exine \pm 1 μm thick, grana 0.5–1 μm high and wide.

Genus: *Jayantisporites* Lele & Makada 1972

Type species: *Jayantisporites pseudozonatus* Lele & Makada 1972.

Locality, Horizon & Age: Patharjore Nala, Jayanti Coal-field, Damodar Basin, Jharkhand, India; Talchir Formation, Early Permian.

Salient features: Triangular to sub-circular; trilete mark distinct, rays reaching up to margin, associated with thin folds; exine smooth proximally, compound process (bacula, spines, verrucae or coni in different combinations) on distal face and equator, basal parts confluence forming cristate ridges along equator, appear partial or complete pseudozonate.

Jayantisporites pseudozonatus Lele & Makada 1972

Holotype: Lele & Makada, 1972; pl. 1, fig. 6; size 80 x 95 μm .

Locality, Horizon & Age: Patharjore Nala, Jayanti Coal-field, Damodar Basin, Jharkhand, India; Talchir Formation, Early Permian.

Salient features: Size 70–80 x 80–95 μm ; exine beset with baculate to spinose processes, 7–10 μm long x 2–4 μm broad at base, fused to form cristate ridges.

Jayantisporites conatus Lele & Makada 1972

Holotype: Lele & Makada, 1972; pl. 1 fig. 17; size 60 x 62 μm .

Locality, Horizon & Age: Patharjore Nala, Jayanti Coal-field, Damodar Basin, Jharkhand, India; Talchir Formation; Early Permian.

Salient features: Size 55–70 x 50–70 μm ; exine beset with broad based conate to verrucose process, 3–5 μm long and 5–8 μm broad.

Jayantisporites indicus Lele & Makada 1972

Holotype: Lele & Makada, 1972; pl. 1, fig. 14; size 65 x 55 μm .

Locality, Horizon & Age: Patharjore Nala, Jayanti Coal-field, Damodar Basin, Jharkhand, India; Talchir Formation, Early Permian.

Salient features: Size 50–60 x 57–70 μm ; exine beset distally with small coni to baculate process, 4–6 μm long and 2–5 μm broad, confluence of elements not so prominent.

Jayantisporites pseudozonatus vari *minor* Chandra & Lele 1979

Holotype: Chandra & Lele, 1979; pl. 1, fig. 13; size 0–50 μm .

Locality, Horizon & Age: Barachada, Birsinghpur Pali Coalfield, South Rewa Basin, Madhya Pradesh, India; Talchir Formation, Early Permian.

Salient features: Size 35–56 x 40–60 μm ; exine beset with finger-like processes having apical spines, up to 2 μm broad and 10 μm long.

Remarks: Except the smaller size, this species is similar to *J. pseudozonatus*.

Genus: *Lacinitriletes* Venkatachala & Kar emend. Tiwari & Singh 1981

Type species: *Lacinitriletes badamensis* Venkatachala & Kar, 1968.

Locality, Horizon & Age: Badam, North Karanpura Coal-field, Damodar Basin, Jharkhand, India; Barakar Formation, Early Permian.

Salient features: Triangular to subtriangular; trilete mark distinct, rays extend almost up to equator, associated with folds; exine proximally smooth, on distal face very finely scabrate.

Lacinitriletes badamensis Venkatachala & Kar emend. Tiwari & Singh 1981

Holotype: Venkatachala & Kar, 1965; pl. 1, fig. 8; size 69 x 59 μm .

Locality, Horizon & Age: Badam, North Karanpura Coal-field, Damodar Basin, Jharkhand, India; Barakar Formation, Early Permian.

Salient features: Size 60–77 μm ; exine \pm 1 μm thick, proximally and distally laevigate.

Lacinitriletes minutus Venkatachala & Kar emend. Tiwari & Singh 1981

Holotype: Venkatachala & Kar, 1968; pl. 2, fig. 33; size 46 x 36 μm .

Locality, Horizon & Age: Badam, North Karanpura Coalfield, Damodar Basin, Bihar, India; Barakar Formation, Early Permian.

Salient features: Size 32–36 x 36–46 μm ; exine less than 1 μm , proximally and distally laevigate.

Genus: *Microbaculispora* Bharadwaj 1962

Type species: *Microbaculispora gondwanensis* Bharadwaj 1962.

Locality, Horizon & Age: Samla Seam, Raniganj Coal-field, Damodar Basin, West Bengal, India; Raniganj Formation, Late Permian.

Salient features: Triangular with broadly rounded angles; trilete mark distinct, rays associated with folds; exine thin, densely sculptured with uniformly spaced bacula all over, varied sized and shape except inter-ray area.

Microbaculispora gondwanensis Bharadwaj 1962

Holotype: Bharadwaj, 1962; pl. 2, fig. 33; size 94 μm .

Locality, Horizon & Age: Samla Seam, Raniganj Coalfield, Damodar Basin, West Bengal, India; Raniganj Formation, Late Permian.

Salient features: Size 70–90 µm; exine beset with bacula, 1 µm broad and 1.5–2 µm high.

Microbaculispora villosa (Balme & Hennelly) Bharadwaj 1962 emend. Tiwari & Singh 1981

Holotype: Balme & Hennelly, 1956; pl. 3, fig. 38; size ca 80 µm.

Locality, Horizon & Age: Lithgow Seam, Kandos Colliery, Western Coalfield, NSW, Australia; Permian.

Salient features: Size 68–98 µm; exine ± 2 µm thick, bacula closely placed, 1 µm broad and 2–3 µm high.

Microbaculispora tentula Tiwari 1965

Holotype: Tiwari, 1965; pl. 2; fig. 35; size 43 µm.

Locality, Horizon & Age: NS/ 165/ S, Borecore K–63, Korba Coalfield, South Rewa Basin, Chhattisgarh, India; Barakar Formation, Early Permian.

Salient features: Size 37–56 µm; exine ± 1 µm thick, bacula 1 x 1 µm high and broad.

Microbaculispora indica Tiwari emend. Tiwari & Singh 1981

Holotype: Tiwari, 1965; pl. 2, fig. 33; size 61 µm.

Locality, Horizon & Age: Borecore R–48, 200 (II Seam) E, Korba Coalfield, South Rewa Basin, Chhattisgarh, India; Barakar Formation, Early Permian.

Salient features: Size 44–72 µm; exine 1.5–2 µm thick, bacula ± 1 µm high and 1–1.5 µm broad with rounded apex.

Microbaculispora barakarensis Tiwari emend. Tiwari & Singh 1981

Holotype: Bharadwaj & Tiwari, 1964; pl. 1, fig. 8; size 76 µm.

Locality, Horizon & Age: Borecore G–2, 208 (II Seam) E, Korba Coalfield, South Rewa Basin, Chhattisgarh, India; Barakar Formation, Early Permian.

Salient features: Size 75–83 µm; exine ± 1.5–2 µm thick, bacula ± 2–4 µm high and 2.5–3 µm broad with truncate or dumb-bell shaped apex, on distal face and equator.

Genus: *Microfoveolatispora* Bharadwaj 1962

Type species: *Microfoveolatispora raniganjensis* Bharadwaj 1962.

Locality, Horizon & Age: Samla Seam, Raniganj Coalfield, Damodar Basin, West Bengal, India; Raniganj Formation, Late Permian.

Salient features: Triangular with broadly rounded angles and convex sides; trilete mark distinct, rays extend up to equator, associated with folds; exine thin to thick, beset with graded micro-foveolation from finest to biggest among the species.

Microfoveolatispora raniganjensis Bharadwaj 1962

Holotype: Bharadwaj, 1962, pl. 2, fig. 48; size 80 µm.

Locality, Horizon & Age: Samla Seam, Raniganj Coalfield, Damodar Basin, West Bengal, India; Raniganj Formation, Late Permian.

Salient features: Size range 35–90 µm; exine 1–2 µm thick, foveolae 2–3 µm across, muri up to 2 µm wide, medium size foveolae.

Microfoveolatispora bokaroensis Tiwari 1965

Holotype: Tiwari, 1965; pl. 2, fig. 44; size 106 µm.

Locality, Horizon & Age: Pindra Seam, Datma Colliery, West Bokaro Coalfield, Damodar Basin, Jharkhand, India; Barakar Formation, Early Permian.

Salient features: Size ranges 72–120 µm; exine ± 3 µm thick, foveolae 1–1.5 µm across, uniformly distributed.

Microfoveolatispora foveolata (Tiwari) Tiwari and Singh 1981

Holotype: Tiwari, 1965; pl. 2, fig. 40; size 55 µm.

Locality, Horizon & Age: Pindra Seam, Pindra–Ramgarh Colliery, West Bokaro Coalfield, Damodar Basin, Jharkhand, India; Barakar Formation, Early Permian.

Salient features: Size range 41–56 µm; exine ± 1 µm thick, foveolae 1–1.5 µm across, muri less than 1 µm broad and less than 1 µm high.

Infraturma: *Muornati* Potonié & Kremp 1954

Azonate spores; trilete; exine with more or less reticulum having muri and lumen.

Genus: *Camptotriletes* (Naumova) Potonié & Kremp 1954

Type species: *Camptotriletes corrugatus* (Ibrahim) Potonié & Kremp 1954.

Locality, Horizon & Age: Ruhrgebiet, Floz Agir, Westfal B/C, Late Carboniferous.

Salient features: Roundly triangular; trilete mark distinct, rays extend up to equator; exine thin, sculptured with irregular ridges of uneven height.

Camptotriletes corrugatus Potonié & Kremp 1955

Holotype: Ibrahim 1933; pl. 5, fig. 11; size 46 µm.

Locality, Horizon & Age: Ruhrgebiet, Floz Agir; Westfal B/C, Late Carboniferous

Salient features: Size 40–50 µm; exine with most irregular reticulum.

Camptotriletes bellus Venkatachala & Kar 1968

Holotype: Venkatachala & Kar 1968; pl. 1, fig. 3; size 73 x 70 µm.

Locality, Horizon & Age: Shale 25 ft. above the Talchir Boulder Bed, Kathwai Shale, Salt Range, west Pakistan; Permian.

Salient features: Size 65–110 µm; exine up to 2 µm thick, proximally laevigate, distally vermiculate with low set muri, less than 0.5 µm high and wide forming irregular ridges.

Genus: *Cyclofoveolatispora* Venkatachala & Kar 1968

Type species: *Cyclofoveolatispora caecus* Venkatachala & Kar 1968.

Locality, Horizon & Age: Shale 25 ft. above the Talchir Boulder Bed, Kathwai Shale, Salt Range, west Pakistan; Permian.

Salient features: Circular; trilete mark indistinct, rays restricted up to ½ of radius; exine proximally laevigate, infra-microfoveolate on distal face.

Remarks: This genus differs from *Microfoveolatispora* being circular in shape and discernible trilete mark.

Cyclofoveolatispora caecus Venkatachala & Kar 1968

Holotype: Venkatachala & Kar, 1968; pl. 1, fig. 10; size 78 x 60 µm.

Locality, Horizon & Age: Shale 25 ft. above the Talchir Boulder Bed, Kathwai Shale, Salt Range, west Pakistan; Permian.

Salient features: Size 60–80 µm; exine ± 1 µm thick, muri very fine, appear infra-microreticulate, lumen less than 0.5 µm.

Cyclofoveolatispora plicatus Venkatachala & Kar 1968

Holotype: Venkatachala & Kar, 1968; pl. 1, fig. 13; size 102 x 70 µm.

Locality, Horizon & Age: Shale 25 ft above the Talchir Boulder Bed, Kathwai Shale, Salt Range, west Pakistan; Permian.

Salient features: Size 64–115 µm; exine ± 1 µm thick, muri very fine, appear infra-microreticulate, lumen less than 0.5 µm.

Remarks: The two species *C. caecus* and *C. plicatus* are more or less similar, except size range.

Cyclofoveolatispora minutus Venkatachala & Kar 1968

Holotype: Venkatachala & Kar, 1968; pl. 1, fig. 8; size 30 µm.

Locality, Horizon & Age: Lungatoo, North Karanpura Basin, Jharkhand; Barakar Formation, Permian.

Salient features: Size 20–25 x 22–30 µm; exine 1–1.5 µm thick, foveolae ± 0.5 µm in diameter, closely and evenly distributed.

Genus: *Dictyotriletes* (Naumova) Potonié & Kremp 1955

Type species: *Dictyotriletes bireticulatus* (Ibrahim) Potonié & Kremp 1955.

Locality, Horizon & Age: Ruhrgebiet, Floz Agir, Germany; Westphalian B/C, Late Carboniferous.

Salient features: Broadly subtriangular to circular; trilete mark distinct, rays extend up to equator; exine smooth to scabrate, distally foveo-reticulate, encroaching equatorial region on proximal face, muri low.

Dictyotriletes bireticulatus (Ibrahim) Potonié & Kremp 1955

Holotype: Potonié & Kremp, 1955; pl. 16, fig. 296; size 57.5 µm.

Locality, Horizon & Age: Ruhrgebiet, Floz Agir, Germany; Westphalian B/C, Late Carboniferous.

Salient features: Size 40–60 µm; exine 1–1.5 µm thick, microreticulate, muri 1–1.5 µm wide, lumen 7–15 µm across.

Dictyotriletes invisus Bharadwaj & Salujha 1964

Holotype: Bharadwaj & Salujha, 1964; pl. 3, fig. 59; size 50 µm.

Locality, Horizon & Age: Seam VIII, Raniganj Coalfield, Damodar Basin, West Bengal; Raniganj Formation; Late Permian.

Salient features: Size 40–50 µm; exine covered with muri, about 2 µm high.

Genus: *Ghoshiatriletes* D'Rozario & Banerjee 1987

Type species: *Ghoshiatriletes gondwanensis* D'Rozario & Banerjee 1987.

Locality, Horizon & Age: Chuparbhitia Coalfield, Rajmahal Basin, Jharkhand, India; Barakar Formation, Early Permian.

Salient features: Triangular to subtriangular; trilete mark distinct, rays extend almost up to equator; exine thick, sculptured with rugulae on both faces, varied shape and size, free to united to form incomplete reticuloid pattern, decreased in inter-radial region.

Ghoshiatriletes gondwanensis D'Rozario & Banerjee 1987

Holotype: D'Rozario & Banerjee, 1987; pl. 2, fig. 1; size 30 µm.

Locality, Horizon & Age: Chuparbhitia Coalfield, Rajmahal Basin, Jharkhand, India; Barakar Formation, Early Permian.

Salient features: Size 36–45 µm; exine 1–1.5 µm thick, rugulae 3–4 µm long x 1.5–2 µm wide, straight or bent at apex.

Genus: *Plicatisporites* Lele & Makada 1972

Type species: *Plicatisporites distinctus* Lele & Makada 1972.

Locality, Horizon & Age: Patharjore Nala, Jayanti Coalfield, Damodar Basin, Jharkhand, India; Talchir Formation, Early Permian.

Salient features: Circular to sub-circular; trilete mark distinct, exine punctate to finely reticulate, variously folded.

Plicatisporites distinctus Lele & Makada 1972

Holotype: Lele & Makada, 1972; pl. 1, fig. 1; size 55 x 43 µm.

Locality, Horizon & Age: Patharjore Nala, Jayanti Coalfield, Damodar Basin, Jharkhand, India; Talchir Formation, Early Permian.

Salient features: Size 42–60 x 57–70 µm; exine punctate, puncta 1–2 µm across, closely spaced irregularly arranged semilunar to lenticular folds along the periphery.

Genus: *Pseudoreticulatispora* Bharadwaj & Srivastava 1969

Type species: *Pseudoreticulatispora barakarensis* Bharadwaj & Srivastava 1969.

Locality, Horizon & Age: Katkona Block, Sohagpur Coalfield, South Rewa Basin, Madhya Pradesh, India; Barakar Formation, Early Permian.

Salient features: Triangular; inter-radial sides convex; trilete mark distinct, rays with secondary folds, ends tapering, extend $\frac{3}{4}$ of radius; exine thick, sculptured with punctato-reticuloid, appearing pseudo-reticulum.

Remarks: This genus is similar with *Microfoveolatispora* in the nature of exinal sculpture.

Pseudoreticulatispora barakarensis Bharadwaj & Srivastava 1969

Holotype: Bharadwaj & Srivastava, 1969; pl. 1, fig. 21; size 70 µm.

Locality, Horizon & Age: Katkona Block, Sohagpur Coalfield, South Rewa Basin, Madhya Pradesh, India; Barakar Formation, Early Permian.

Salient features: Size 51–88 µm; exine 2–3 µm thick, puncta ± 1 µm in diameter, coalescing with each other, forming pseudo-reticulum.

Genus: *Reticulatisporites* Ibrahim emend. Potonié & Kremp 1954

Type species: *Reticulatisporites reticulatus* Ibrahim 1933.

Locality, Horizon & Age: Aegirhorizonts Ruhr–Rivers, Germany; Carboniferous.

Salient features: Broadly circular; trilete mark faint to distinct, rays extend $\frac{2}{3}$ of radius; exine thick, punctate, surface covered with reticulum, muri thick, lumen broad.

Reticulatisporites reticulatus Ibrahim 1933

Holotype: Ibrahim, 1933; pl. 1, fig. 3; size 73 x 81 µm.

Locality, Horizon & Age: Aegirhorizonts Ruhr–Rivers, Germany; Carboniferous.

Salient features: Size 73–100 µm; exine ± 4.00 µm thick, muri up to 3 µm wide enclosing broad lumen.

Genus: *Varireticulates* Kar 1969

Type species: *Varireticulates varius* Kar 1969.

Locality, Horizon & Age: Borecore K2, 61.09–61.19 m, North Karanpura Coalfield, Damodar Basin, Jharkhand, India; Raniganj Formation, Late Permian.

Salient features: Broadly triangular; trilete mark distinct, rays associated with folds; exine proximally reticulate, muri irregular in size and shape, distally laevigate.

Remarks: Only one specimen is illustrated, that too in lateral position, not exhibiting the exinal features in proximo-distal face. Hence, this genus might not hold a generic status.

Varireticulates varius Kar 1969

Holotype: Kar, 1969; pl. 1, figs 6–7; size 73 x 69 µm.

Locality, Horizon & Age: Borecore K2, 61.09–61.19 m, North Karanpura Coalfield, Damodar Basin, Bihar, India; Raniganj Formation, Late Permian.

Salient features: Size 50–85 x 40–80 µm; exine upto 3 µm thick, muri raised forming square to rectangular lumen.

Infraturma: *Striasporiti* Kar 1969

Spores azonate, triangular to circular; trilete; exine striated on one or both faces.

Genus: *Striasporis* Kar 1969

Type species: *Striasporis striatus* Kar 1969.

Locality, Horizon & Age: Borecore K2, 342.64–342.74 m, North Karanpura Coalfield, Damodar Basin, Jharkhand, India; Raniganj Formation, Late Permian.

Salient features: Subcircular to circular; trilete mark distinct; exine striated proximally in inter–radial area, inter–striated area micro–verrucose to granulose.

Remarks: Only one specimen is illustrated that too does not exhibit regular features. Circular exinal folds seen along equator in some specimens, but not described.

Striasporis striatus Kar 1969

Holotype: Kar, 1969; pl. 1, fig. 5; size 55 x 46 μm .

Locality, Horizon & Age: Borecore K2, 342.64–342.74 m, North Karanpura Coalfield, Damodar Basin, Jharkhand, India; Raniganj Formation, Late Permian.

Salient features: Size 45–65 x 40–55 μm ; exine \pm 3 μm thick, striations absent in contact area, in inter–radial area striations parallel, occasionally inter–connected vertically, may join at ends.

Infraturma: Perinotrileti Erdtman 1947

Genus: *Velamispurites* Bharadwaj & Venkatachala 1961

Type species: *Velamispurites rugosus* Bharadwaj & Venkatachala 1961.

Locality, Horizon & Age: Pyramidenberg, Spitzbergen, Lower Carboniferous.

Salient features: Circular, oval–roundly triangular; prominent trilete mark; exine laevigate, thick–walled and covered over by a granulose perine, wrinkled on the surface giving a corrugated and pseudoreticulate appearance.

Velamispurites pukraensis Venkatachala & Kar 1968

Holotype: Venkatachala & Kar 1968; pl. 1, fig. 4; size 40 μm .

Locality, Horizon & Age: Lungatoo, North Karanpura Basin, Bihar; Barakar Stage, Permian.

Salient features: Size 68–82 μm ; exine about 2 μm thick, laevigate.

Turma: Zonales (Bennie & Kidston) Potonié 1956

Subturma: Zonotriletes Waltz 1935

Infraturma: Cingulati Potonié & Klaus 1954

Genus: *Densosporites* Berry emend. Potonié & Kremp 1954

Type species: *Densosporites covensis* Berry 1937.

Locality, Horizon & Age: Rhea County, Tennessee, USA; Penington Kohle.

Salient features: Cingulate, broadly triangular; trilete mark distinct, rays extend up to cingulum; exine thickness vary from pole towards equator; cingulum massive, partly thinning divides in two zones.

Densosporites covensis Berry 1937

Holotype: Potonié & Kremp, 1954; fig. 57; size 32.5 μm .

Locality, Horizon & Age: Rhea County, Tennessee, USA; Penington Kohle.

Salient features: Size 30–35 μm ; cingulum tapering into narrow zona.

Densosporites splendens Saksena 1971

Holotype: Saksena, 1971; pl. 2, fig. 24; size 50 μm .

Locality, Horizon & Age: Ganjra Nalla Beds, Johilla Coalfield, South Rewa Basin, Madhya Pradesh, India; Barakar Formation, Early Permian.

Salient features: Size 50 μm ; margin thickened along equator forming cingulum, \pm 10 μm wide.

Genus: *Dentatispora* Tiwari 1964

Type species: *Dentatispora indica* Tiwari, 1964.

Locality, Horizon & Age: Borecore G–101, Sample 511(D), Korba Coalfield, South Rewa Basin, Chhattisgarh, India; Barakar Formation, Early Permian.

Salient features: Broadly subtriangular; trilete mark distinct, rays extend up to cingulum; exine proximally micro–punctate, on distal face conical or verrucate of varied shape and size, partially confluent; cingulum more or less thick unevenly with smooth or tuberculate to spinose margin; inner body generally present.

Dentatispora indica Tiwari 1964

Holotype: Tiwari, 1964; pl. 1, fig. 1; size 73 μm .

Locality, Horizon & Age: Borecore G–101, Sample 511(D), Korba Coalfield, South Rewa Basin, Chhattisgarh, India; Barakar Formation, Early Permian.

Salient features: Size 58–75 μm ; exine \pm 1 μm thick, 2–8 μm long x 2–8 μm broad conical processes; cingulum 8–12 μm wide, dentate margin.

Dentatispora crassa Tiwari 1965

Holotype: Tiwari, 1965; pl. 2, fig. 52; size 83 μm .

Locality, Horizon & Age: Borehole G–110, Sample 703 (C2–C3), Korba Coalfield, South Rewa Basin, Chhattisgarh, India; Barakar Formation, Early Permian.

Salient features: Size 60–117 μm ; exine 2 μm thick, on distal face 3–8 μm x 2–8 μm , blunt or round-tipped apex conical processes; cingulum 8–16 μm wide, beset with blunt conical processes on margin.

Dentatispora gondwanensis Tiwari 1965

Holotype: Tiwari, 1965; pl. 2, fig. 48; size 66 μm .

Locality, Horizon & Age: Borehole G–150, Sample 763(C), Korba Coalfield, South Rewa Basin, Chhattisgarh, India; Barakar Formation, Early Permian.

Salient features: Size 41–55 μm ; exine \pm 1 μm thick, on distal face processes small, cingulum beset with 4–9 μm long x 3–9 μm broad, blunt spines.

Dentatispora implicata Tiwari 1965

Holotype: Tiwari, 1965; pl. 2, fig. 47; size 43 μm .

Locality, Horizon & Age: Borehole G–103, Sample 570(C), Korba Coalfield, South Rewa Basin, Chhattisgarh, India; Barakar Formation, Early Permian.

Salient features: Size 40–66 μm ; exine \pm 1 μm , on distal face, small bacula 2 x 2 μm , densely placed, partially fused.

Dentatispora lacunata Tiwari 1965

Holotype: Tiwari, 1965; pl. 2, fig. 50; size 48 μm .

Locality, Horizon & Age: Borehole G–150, Sample 763(C), Korba Coalfield, South Rewa Basin, Chhattisgarh, India; Barakar Formation, Early Permian.

Salient features: Size 41–58 μm ; exine distal face covered with broader, round tipped bacula; 2–7 μm high x 2–6 μm broad, cingulum narrow, uneven, 3–5 μm wide.

Dentatispora mammoida Tiwari & Ram–Awatar 1988

Holotype: Tiwari & Ram–Awatar 1988; pl. 1, fig. 9; size 60 x 62 μm .

Locality, Horizon & Age: Borecore JHL–24, 212.00–213.50 m, 10 km west from Birsinghpur–Pali, Johilla Coalfield, Madhya Pradesh, India; Barakar Formation, Early Permian.

Salient features: Size 60–72 μm ; exine up to 2 μm thick, beset with nipple like spines mixed conical, 4.5 μm high and 3–4 μm broad at base, cingulum 5–10 μm wide.

Dentatispora reticulata Tiwari & Ram–Awatar 1988

Holotype: Tiwari & Ram–Awatar 1988; pl. 1, fig. 1; size 70 μm .

Locality, Horizon & Age: Borehole JHL–24, 213.00–213.50 m, 10 km west from Birsinghpur–Pali, Johilla Coalfield, Madhya Pradesh, India; Barakar Formation, Early Permian.

Salient features: Size 65–70 μm ; exine 4 μm thick, beset with 5–7 μm long x 4–5 μm broad spines; cingulum 5–10 μm wide.

Infraturma: Zonati Potonié & Klaus 1954

Genus: *Cirratriradites* Wilson & Coe 1940

Type species: *Cirratriradites maculatus* Wilson & Coe 1940.

Locality, Horizon & Age: Ruhrgebiet, Floz Agir; Westfal B/C, Late Carboniferous.

Salient features: Broadly triangular; equatorial flange present; trilete mark distinct, rays extend up to outer margin of flange; exine mediumly thick, faint striations, rods, or fringe-like layer often seen on inner edge of flange.

Cirratriradites maculatus Wilson & Coe 1940

Holotype: Wilson & Coe, 1940; pl. 1, fig. 7; size 70 μm .

Locality, Horizon & Age: Ruhrgebiet, Floz Agir; Westfal B/C, Late Carboniferous.

Salient features: Size 70–100 μm ; equatorial region around central body densely granulate, a concentric ridge seen on distal pole.

Cirratriradites gondwanensis Tiwari 1965

Holotype: Tiwari, 1965; pl. 3, fig. 55; size 79 μm .

Locality, Horizon & Age: Datma Seam, West Bokaro Coalfield, Damodar Basin, Jharkhand, India; Barakar Formation, Early Permian.

Salient features: Size 58–94 μm ; exine thin, infra-micropunctate; 4–6 μm wide denser equatorial zone around body; flange 8–17 μm broad.

Genus: *Gondisporites* Bharadwaj 1962

Type species: *Gondisporites raniganjensis* Bharadwaj 1962.

Locality, Horizon & Age: Samla Seam, East Raniganj Coalfield, Damodar Basin, India; Raniganj Formation, Late Permian.

Salient features: Zonate roundly triangular–subcircular; trilete mark distinct, rays extending up to margin of zona or ridge, exine uniformly granulose as well as sparsely spinulate or baculate.

Gondisporites raniganjensis Bharadwaj 1962

Holotype: Bharadwaj, 1962; pl. 4, fig. 67; size 106 x 110 μm .

Locality, Horizon & Age: Samla Seam, East Raniganj Coalfield, Damodar Basin, India; Raniganj Formation, Late Permian.

Salient features: Size 90–115 µm; trilete rays associated with 2–4 µm broad labra, reaching up to the zona; exine 1–2 µm thick, finely granulose all over with sparsely inter-spaced bacula, 2–3 µm broad; zona membranous, 6–8 µm wide.

Gondisporites imbricatus Segrooves 1970

Holotype: Segrooves 1970; pl. 8, fig. A; size 67 µm.

Locality, Horizon & Age: Wicherina bore x 49, 367–373 feet, Wicherina District, Perth Basin, western Australia; Upper Permian.

Salient features: Size 60–104 µm; exine ± 1 µm thick; zona 5 µm wide, margin denticulate, distal surface bearing coni and spines, 1–3 µm high, about 1–1.5 µm in basal diameter.

Gondisporites reticulatus Tiwari & Ram–Awatar 1988

Holotype: Tiwari & Ram–Awatar, 1988; pl. 1, fig. 6; size 90 x 95 µm.

Locality, Horizon & Age: Near Dargaon Village, Johilla River Section, Johilla Coalfield, South Rewa Basin, Madhya Pradesh, India; Pali Formation, Late Permian.

Salient features: Size 90–95 µm; exine coarsely intrareticulate, muri ± 1 µm wide, lumen 2–4 µm across; zona thin, denticulate ridge, densely covered with spinules, less than 1 µm.

Genus: *Indotriradites* Tiwari 1964

Type species: *Indotriradites korbaensis* Tiwari 1964.

Locality, Horizon & Age: Borecore G–2, 208 (II Seam) E, Korba Coalfield, South Rewa Basin, Chhattisgarh, India; Barakar Formation, Early Permian.

Salient features: Zonate, roundly triangular; trilete mark well defined, rays extend into flange, associated with folds; exine thin, distinct inner body, coni or spines on distal face.

Indotriradites korbaensis Tiwari 1964

Holotype: Tiwari, 1964; pl. 1, fig. 4; size 71 µm.

Locality, Horizon & Age: Borecore G–2, 208 (II Seam) E, Korba Coalfield, South Rewa Basin, Chhattisgarh, India; Barakar Formation, Early Permian.

Salient features: Size 42–77 µm; flange 7–13 µm wide with 2–4 µm thicker regions, distally on body surface 2–6 µm long and broad based spines and coni closely set.

Indotriradites sparsus Tiwari 1965

Holotype: Tiwari, 1965; pl. 3, fig. 59; size 75 µm.

Locality, Horizon & Age: Borehole G–2, 208 (II Seam) E, Korba Coalfield, South Rewa Basin, Chhattisgarh, India; Barakar Formation, Early Permian.

Salient features: Size 61–95 µm; exine conical process 3–8 µm long x 2.5 µm broad base, surface minutely granulose, flange 7–12 µm wide.

Indotriradites surangei Tiwari 1965

Holotype: Tiwari, 1965; pl. 3, fig. 57; size 63 µm.

Locality, Horizon & Age: Borehole G–1, 207 (II Seam) Korba Coalfield, South Rewa Basin, Chhattisgarh, India; Barakar Formation, Early Permian.

Salient features: Size 48–66 µm; exine 2–3 µm thick, coni 1–3 x 1–2 µm, flange 5–10 µm wide.

Indotriradites varius Venkatachala & Kar 1968

Holotype: Venkatachala & Kar 1968; pl. 1, fig. 14; size 55 x 50 µm.

Locality, Horizon & Age: Shale 25 ft above the Talchir Boulder Bed, Kathwai Shale, west Pakistan; Permian.

Salient features: Size 41–55 µm; exine up to 3 µm thick, coni 1–1.5 µm closely spaced, flange ± 6 µm wide.

Genus: *Insignisporites* Bharadwaj & Dwivedi 1977

Type species: *Insignisporites barakarensis* Bharadwaj & Dwivedi 1977.

Locality, Horizon & Age: South Karanpura Coalfield, Damodar Basin, Bihar, India; Barakar Formation, Early Permian.

Salient features: Circular to sub-circular; trilete mark distinct, rays having fold, reaching $\frac{1}{2}$ – $\frac{3}{4}$ body radius; exine thin or thick, sculptured with grana and pila.

Insignisporites barakarensis Bharadwaj & Dwivedi 1977

Holotype: Bharadwaj & Dwivedi 1977; pl. 1, figs. 1, 2; size 100 µm.

Locality, Horizon & Age: South Karanpura Coalfield, Damodar Basin, Bihar, India; Barakar Formation, Early Permian.

Salient features: Size 75–110 µm, exine ± 0.5 µm thick exine granulose and pilate, densely on distal face, 1–4 µm across and 2–5 µm high, sometimes coalescing.

Genus: *Potonieitiradites* Bharadwaj & Sinha 1969

Type species: *Potonieitiradites barakarensis* Bharadwaj & Sinha 1969.

Locality, Horizon & Age: Jhingurdah Seam, Singrauli Coalfield, South Rewa Basin; Madhya Pradesh, India; Barakar Formation, Early Permian.

Salient features: Broadly triangular; trilete mark distinct, rays extending up to margin of zona, labra thick, raised; central

body distinct; exine on distal face coarsely micro-granulose to tuberculate; zona thin, margin microdentate, thickened along zone of attachment.

Potonieitradites barakarensis Bharadwaj & Sinha 1969

Holotype: Bharadwaj & Sinha, 1969; pl. 1, fig. 1; size 74 μm .

Locality, Horizon & Age: Borecore NCSJ-4, Sample 62, Jhingurdah Seam, Singrauli Coalfield, South Rewa Basin, Madhya Pradesh, India; Barakar Formation, Early Permian.

Salient features: Size 62–95 μm ; central body 35–66 μm ; on distal face exine coarsely granulose to verrucose; 8–15 μm wide equatorial thickening, zona microgranulose to verrucose.

Potonieitradites tuberculatus Sinha 1972

Holotype: Sinha 1972; pl. 1, fig. 25; size 83 μm .

Locality, Horizon & Age: Borecore NCSJ-4, Sample No. 62, Jhingurdah Seam, Singrauli Coalfield, South Rewa Basin, Madhya Pradesh, India; Raniganj Formation, Late Permian.

Salient features: Size 56–90 μm ; central body 36–55 μm ; exine on distal face beset with warty processes, 2–3 μm across, sometimes coalescing; zona 10–15 μm wide, having 3–6 μm wide equatorial thickening along central body.

Potonieitradites subtilis Sinha 1972

Holotype: Sinha, 1972; pl. 1, fig. 25; size 80 μm .

Locality, Horizon & Age: Borecore NCSJ-4, Sample No. 62, Jhingurdah Seam, Singrauli Coalfield, South Rewa Basin, Madhya Pradesh, India; Raniganj Formation, Late Permian.

Salient features: Size 65–102 μm ; exine zona thin, 8–15 μm wide, margin dentate, at inner margin 3–6 μm wide equatorial thickening.

Potonieitradites angustus Bharadwaj & Dwivedi 1981

Holotype: Bharadwaj & Dwivedi, 1981; pl. 2, fig. 15–17; size 85 μm .

Locality, Horizon & Age: Argada Seam, South Karanpura Coalfield, Damodar Basin, Bihar, India; Barakar Formation, Early Permian.

Salient features: Size 67.5–92.5 μm ; exine distally finely punctate and verrucose, zona 15.0–22.5 μm wide.

Potonieitradites mercenierii (Bose & Kar) Bharadwaj & Dwivedi 1981

Holotype: Bose & Kar, 1967; pl. 2, fig. 16; size 60 μm .

Locality, Horizon & Age: Assise des schistes noirs de la Lukuga Sondage 10, South Africa; Lukuga Series; Permian.

Salient features: Size 50–70 μm ; exine verrucae 1.5–2.5 μm , zona thin, 4–10 μm wide.

Potonieitradites renierii (Bose & Kar) Bharadwaj & Dwivedi 1981

Holotype: Bose & Kar, 1967; pl. 2, fig. 18; size 60 μm .

Locality, Horizon & Age: Assise des schistes noirs de la Lukuga Sondage 10, South Africa; Lukuga Series; Permian.

Salient features: Size 48–60 μm ; Exine 2 μm thick, distally finely granulose to verrucose, \pm 5 μm across flange 5–10 μm wide.

Subturma: Auritotriletes Potonié & Kremp 1954

Infraturma: Auriculati (Schopf) Potonié & Kremp 1954

Genus: *Indospora* Bharadwaj 1962

Type species: *Indospora clara* Bharadwaj 1962.

Locality, Horizon & Age: Salma Seam, Salma–Kendra Colliery, Raniganj Coalfield, Damodar Basin, West Bengal, India; Raniganj Formation, Late Permian.

Salient features: Triangular with broad roundly angles; trilete mark distinct, rays extending almost up to equator; exine thin, verrucose or baculate, on distal face three high muri meet in a triradiate manner forming circular to polygonal meshes.

Remarks: The three species differ from each other in the nature and number of polygonal meshes on distal face.

Indospora clara Bharadwaj 1962

Holotype: Bharadwaj 1962; pl. 3, fig. 54; size 60 μm .

Locality, Horizon & Age: Salma Seam, Raniganj Coalfield, Damodar Basin, West Bengal, India; Raniganj Formation, Late Permian.

Salient features: Size 49–64 μm ; exine thin, sparsely verrucose, 2–4 μm long bacula with truncate, smooth or dissected apex; on distal face muri 4–10 μm high, peaked, joining to form none to 4 polygonal meshes.

Indospora macula Bharadwaj & Salujha 1964

Holotype: Bharadwaj & Salujha, 1964; pl. 2, fig. 54; size 44 μm .

Locality, Horizon & Age: Seam VIII, Raniganj Coalfield, Damodar Basin, West Bengal, India; Raniganj Formation, Late Permian.

Salient features: Size 44–60 μm ; exine sparsely beset with few grana and bacula, distal muri 2–3 μm broad, form 6–10 polygonal meshes.

Indospora laevigata Bharadwaj & Salujha 1964

Holotype: Bharadwaj & Salujha 1964; pl. 2, fig. 51; size 48 μm .

Locality, Horizon & Age: Seam VIII, Raniganj Coalfield, Damodar Basin, West Bengal, India; Raniganj Formation, Late Permian.

Salient features: Size 40–54 µm; exine laevigate, on distal face muri 2 µm wide, projecting at apex, forming none or one polygonal mesh.

Genus: *Lycospora* Schopf *et al.* emend. Potonié & Kremp 1954

Type species: *Lycospora (Cirratriradites) micropapillatus* Schopf *et al.* 1944.

Locality, Horizon & Age: What Cheer, Keokuk County, Iowa, USA; Des Moines Series, Westfal, Carboniferous.

Salient features: Cingulate, subcircular; trilete mark distinct, rays extend up to flange; exine two layered, granulose to infra-granulose.

Lycospora (Cirratriradites) micropapillatus Schopf *et al.* 1944

Holotype: Schopf *et al.* 1944; pl. 1, fig. 6; size 15 µm.

Locality, Horizon & Age: What Cheer, Keokuk County, Iowa, USA; Des Moines Series, Westfal, Carboniferous.

Salient features: Size 15–16 µm; no frills on equatorial flange; exine micropapillate.

Lycospora minuta Saksena 1971

Holotype: Saksena, 1971; pl. 2, fig. 23; size 20 µm.

Locality, Horizon & Age: Ganjra Nalla Beds, Johilla Coalfield, South Rewa Basin; Madhya Pradesh, India; Barakar Formation, Early Permian.

Salient features: Size 24–35 µm; trilete rays short; exine smooth with uniform cingulum.

Genus: *Triquitrites* Wilson & Coe emend. Potonié & Kremp 1954

Type species: *Triquitrites arcuatus* Wilson & Coe 1940.

Locality, Horizon & Age: Des Moines Series, Iowa, USA; Pennsylvanian Coals, Carboniferous.

Salient features: Broadly triangular, apices thickened, rounded or truncate, inter-connected by a narrow equatorial flange; trilete mark distinct, rays extend up to inner body; exine thin, translucent, sculpture finely granulose or verrucose, more prominent at apices.

Triquitrites arcuatus Wilson & Coe 1940

Holotype: Wilson & Coe, 1940; pl. 1, fig. 8; size ± 40 µm.

Locality, Horizon & Age: Des Moines Series, Iowa, USA; Pennsylvanian Coals, Carboniferous.

Salient features: Size 40–49 µm; exine thin, smooth ± 2 µm wide equatorial flange at apices.

Triquitrites valvaetus Saksena 1971

Holotype: Saksena 1971; pl. 2, fig. 22; size 35 µm.

Locality, Horizon & Age: Ganjra Nalla Beds, Johilla Coalfield, South Rewa Basin, Madhya Pradesh, India; Barakar Formation, Early Permian.

Salient features: Size 22 µm; auriculate shape in between apex.

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