

Orientation pattern of striations in the genus *Schizaeoisporites* Potonié 1951

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The objective of this paper is to elucidate characteristic patterns in the emergence and orientation of striations in the genus *Schizaeoisporites* Potonié 1951 in order to understand the specific characteristic of this genus. This lead to emend the generic diagnosis of the genus to include spores having oblique emergence and orientation of striations. It also necessitated re-description of *S. grandiformis* Ramanujam 1972 and proposal of two new species—*S. proximobliques* and *S. obliques*.

Key-words—Palynology, Schizaeaceae, *Schizaeoisporites*, Striations, Neyveli Lignitefield (India).

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सारांश

शाइजिओस्पोराइटिस पोतेनिये 1951 प्रजाति में विद्यमान धारीयों का दिक्विन्यास

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प्रस्तुत शोध-पत्र का उद्देश्य शाइजिओस्पोराइटिस पोतेनिये 1951 नामक प्रजाति में पाई जाने वाली धारीयों के दिक्विन्यास एवं उत्पत्ति के लाक्षणिक स्वरूप को स्पष्ट करना है जिससे इस प्रजाति के जातीय लक्षणों का बोध हो सके। उक्त अध्ययन के आधार पर इस प्रजाति के निदान में संशोधन किया गया है तथा इसमें तिर्यक धारीयों वाले बीजाणुओं को सम्मिलित किया गया है। इसी विशेष अध्ययन के आधार पर शा० ग्रेन्डिफॉर्मिस रामानुजम 1972 नामक जाति में संशोधन की आवश्यकता का अनुभव किया गया है तथा शा० प्रोक्सिमोब्लिक्स एवं शा० ऑब्लीक नामक दो जातियाँ प्रस्तावित की गई हैं।

SCHIZAEOISPORITES was instituted as a form genus for monolete, striate spores (Potonié, 1951) having affinity with the family Schizaeaceae. Later, the generic diagnosis was extended by Delcourt and Sprumont (1955). The genus is commonly reported from the Tertiary (Palaeocene-Miocene) sediments of India (Ramanujam, 1966-67, 1972; Dutta & Sah, 1970; Sah & Kar, 1974; Rao & Ramanujam, 1976; Naskar & Baksi, 1976).

Schizaeoisporites recovered from the core samples of Mine III, Neyveli Lignite Field, south India are characterized by longitudinal as well as oblique pattern (emergence and orientation) of striations. Slides of extant spores of the family Schizaeaceae (available in B.S.I.P. Herbarium) are examined to verify the oblique pattern. In order to classify the spores having characteristic oblique pattern, a thorough study of the published literature

on the genus is made. The spores recovered from the Neyveli lignite could not be referred to any of the known species, because most of the morphological features (shape, size, exine thickness, nature of laesura, etc.) which were utilized for specific delimitation are overlapping in various species (Table 1). Also, the oblique orientation of striations is only vaguely described and no credence is given to its emergence.

SPECIATION SCHEME

A study on *Schizaeoisporites* spores leads to opine that emergence and orientation of striations should be considered as the most important characters for specific delimitations. Whereas, shape and size of spores, thickness of exine, ridges, grooves and number of ridges should be considered

Table 1—Morphological features of various *Schizaeoisporites* species having oblique striations or ridges

Species	Shape	Size (μm)	Exine (μm)	Laesura	Surface
<i>S. ghosbi</i> Ramanujam 1966	Plano-convex; oblong	50.55 × 20.26	2.5-4.5	Broad, extending up to equatorial axis, ends pointed, surrounded by a ridge	Prominently striated; striae longitudinally oblique, parallel, few in number, widely spaced, ridges broad, simple or bifurcating, grooves much narrower than ridges
<i>S. sinulata</i> Ramanujam 1966	Plano-convex; oval	50 × 37	2.5	Narrow, long, faint, tenuimarginate	Longitudinal and slightly obliquely striated; striae sinulate; ridges broader than grooves, rounded deeper areas represent original pits which fuse to form grooves
<i>S. crassimurus</i> Dutta & Sah 1970	Bean to ovoid elongated	30-40	thin, 1.5	Long (30-32 μm), about 3/4 the longer axis, bordered by slightly raised ridges	Ridges thick (2.4 μm), few (7-12), oriented obliquely to the laesura but parallel to one another, intervening space 1-1.5 μm wide
<i>S. grandistriatus</i> Ramanujam 1972	Plano-to concavo-convex; oval-elliptical	20-28.5 × 18-24	2	Long, almost reaching ends, margin thick-walled and slightly raised, ends pointed	Coarsely striated; ridges straight to slightly slanting, seldom fork, 3-4.5 μm thick, few in number (5-7), widely spaced, grooves 2.5-5 μm
<i>S. multistriatus</i> Rao & Ramanujam 1976	Plano-convex	41.50 × 25.30	1.5	Long, reaching ends, margin slightly thickened, ends pointed to blunt	With many longitudinal striae formed of extremely fine grooves, striae simple, straight to locally slanting
<i>S. perforatus</i> Naskar & Baksi 1976	Concavo-convex	30.33 × 24.26	1	Long, slender with pointed end	Striated; striae closely spaced, longitudinally oblique, pitted; pits distributed uniformly throughout the surface; ridges thin, grooves comparatively thicker (1.5 μm) than the ridges
<i>S. sarnuensis</i> Naskar & Baksi 1976	Plano-convex; oval	28.30 × 40.46	1.5	Long, extending almost end to end, slender with pointed ends	Prominently striated; striae widely spaced, 14-16 in number, longitudinally oblique, ridges and grooves are more or less uniformly thick (2-2.5 μm)

as the secondary parameters for further speciation. Besides, biodegradational effects on the spores which cause pits and punctation (secondary character) should also be considered. In extreme

case, outer layer of the exine peels off and the spore remains no more the *Schizaeoisporites*.

On the basis of the emergence of striations, the spores are divided into two broad categories (1st

PLATE 1

(All specimens studied on Leitz Ortholux Microscope, magnification as stated)

1. Specimen in fig. 2 focussed on longitudinal pattern of striations. Film no. 36/19, Slide no. BSIP 10506, S42/2 × 750.
- 2, 5. *Schizaeoisporites grandiformis* Ramanujam 1972. Film nos. 36/20, 36/7, Slide nos. BSIP 10506, S42/2 × 750; 10503 J43/1 × 500.
3. *S. proximobliques* sp. nov. (Holotype) showing oblique emergence of striations. Film no. 36/29, Slide no. BSIP 10501, J59/2 × 500.
4. Specimen in fig. 3 illustrated to show longitudinal orientation of striations. Film no. 36/30 × 500.
6. *S. proximobliques* sp. nov. showing oblique emergence of

- striations. Film no. 36/26, Slide no. BSIP 10502, N68/3 × 750.
7. Specimen in fig. 6 reveals longitudinal orientation of striations at distal side. Film no. 36/27 × 750.
8. Specimen in fig. 10 showing oblique emergence of striations. Film no. 37/2 × 750.
9. Specimen in fig. 10 illustrated to show oblique orientation of striations at distal side. Film no. 37/6 × 750.
10. *S. obliques* sp. nov. (Holotype). Film no. 37/4, Slide no. BSIP 10504, X58/1 × 750.
- 11, 12, 13, 14. Other specimens of *S. obliques* sp. nov. illustrated to show oblique emergence and orientation of striations. Film nos. 38/6, 38/8; 36/31, 36/32, Slide nos. BSIP 10505, X31/1 × 750; 10503, N39/2 × 500.

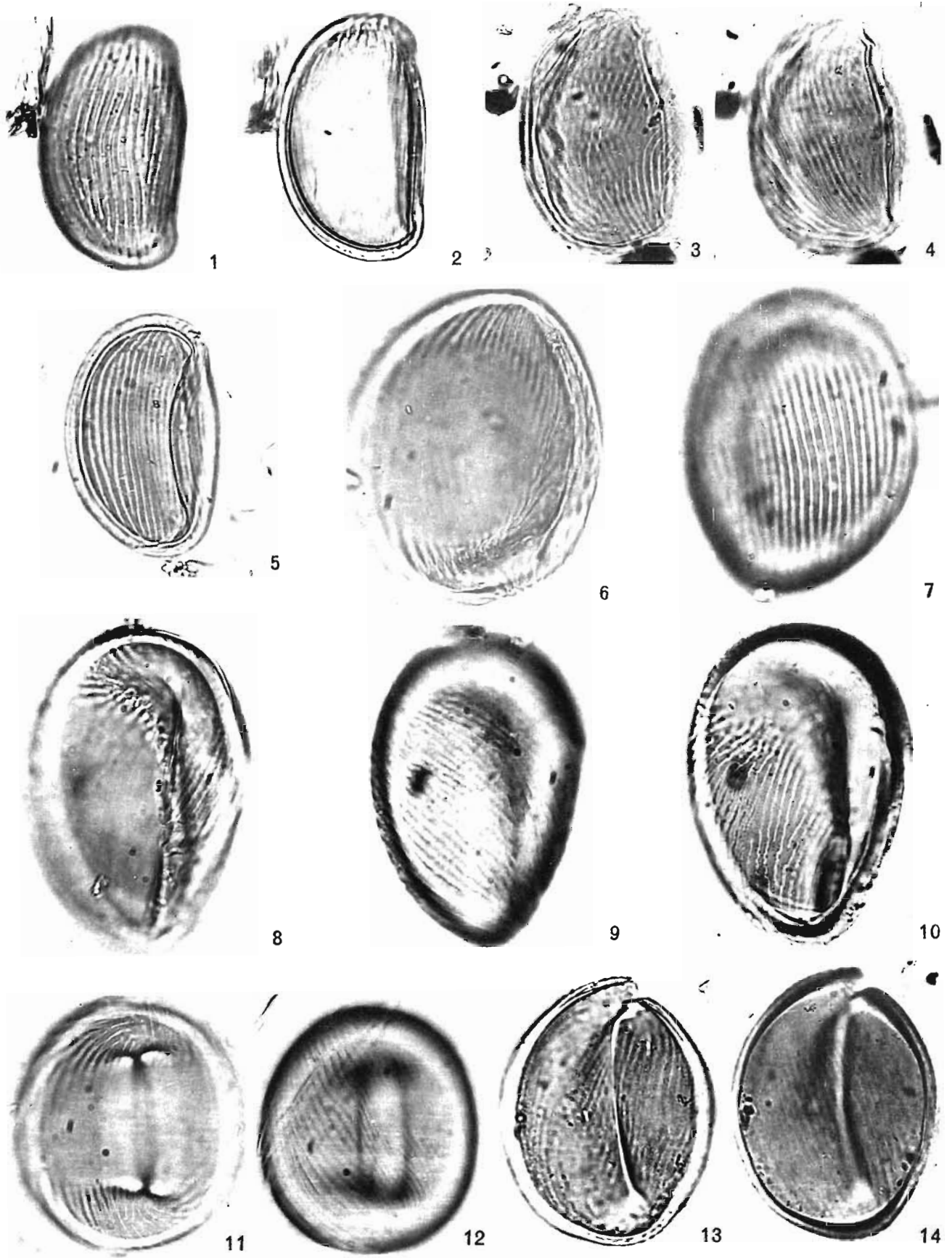
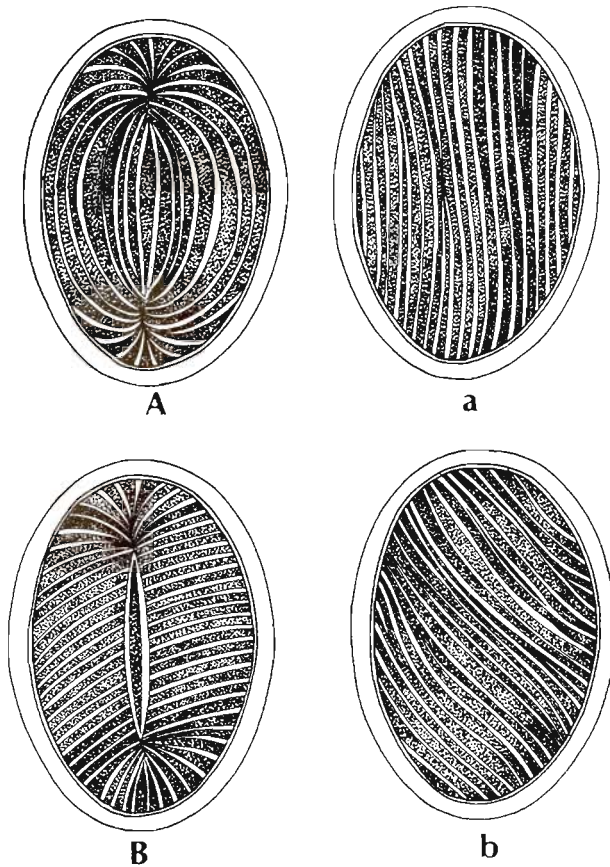


PLATE 1



Text-figure 1—Diagrammatic sketch of *Schizaeoisporites* spore showing emergence of striations from: **A.** ends of the laesura, and **B.** entire length of the laesura. Figures **a, b.** show longitudinal and oblique orientation of striations at distal side.

order division)—

1. spores with striations emerging from the ends of the laesura (Text-fig. 1A), and

2. spores with striations emerging obliquely from the entire length of the laesura (Text-fig. 1B). Orientation pattern of striations at distal side subdivides each of the two broad categories into two (2nd order division)—

- i. longitudinal (Text-fig. 1a), and
- ii. oblique (Text-fig. 1b).

The classification scheme (Table 2) proposes four sets of morphological features, i.e., spores having: (i) longitudinal emergence and orientation, (ii) longitudinal emergence and oblique orientation, (iii) oblique emergence and longitudinal orientation, and (iv) oblique emergence and orientation. These may further be classified according to spore size and shape, thickness of exine, ridges, grooves, number of ridges and nature of laesura, etc.

Lack of detailed information on striation pattern (emergence in particular) made it impossible to categorize some of the known species (Table 1) according to the known classification concept. Also, these species could not be re-examined because their type slides are not available in the B.S.I.P. repository.

MORPHOTAXONOMY

Genus—*Schizaeoisporites* (Potonié) ex. Delcourt & Sprumont 1955 emended

Type species—*Schizaeoisporites eocenicus* (Selling) Potonié 1956 (Synopsis I, p. 81).

Original generic diagnosis—Monolete microspores; exine cicatricose to canaliculate (i.e., closely placed, regular, parallel ridges, mutually separated by canali or grooves); monolete mark enclosed by ridges; ridges converge at the two, narrow ends, may spiral to some degree (after Potonié, 1956, I.C.).

Emended generic diagnosis—Spores bean-shaped or plano-convex in lateral and oval or elliptical in proximal/distal views; heteropolar, monolete; laesura slit-like, simple or raised, occasionally thickened; exine two layered, canaliculate or cicatricose; striations simple, bifurcating or coalescing, occasionally wavy also; striations emerge either from ends of the laesura or obliquely from entire length; orientation of

Table 2—A classification scheme for *Schizaeoisporites* spore

STRIATIONS		Species	Remarks
Emergence	Orientation		
From ends of the laesura (longitudinal, diverging)	1. longitudinal, parallel	<i>S. grandiformis</i>	Further classification on the basis of: —exine thickness —thickness of ridges —thickness of grooves —number of ridges —size of spore —nature of laesura
	2. oblique, parallel		
From entire length of the laesura (oblique, parallel)	1. longitudinal, parallel	<i>S. proximobliquus</i> sp. nov.	
	2. oblique, parallel	<i>S. obliquus</i> sp. nov.	

striations longitudinal or horizontal/oblique at distal side (in relation to longer axis of spores).

Remarks—The diagnosis of the genus has been emended to incorporate monolete spores having oblique pattern of striations (emergence, orientation). The oblique pattern has been observed in *Schizaeosporites* spores from Neyveli samples and also from slides of extant spore.

Schizaeosporites grandiformis Ramanujam 1972 emend.

Pl. 1, figs 1, 2, 5

Holotype—Ramanujam, 1972; pl. 10, fig. 10, p. 251; size $35 \times 62.5 \mu\text{m}$.

Type locality—Warkalli lignite, Kerala.

Horizon & age—Tertiary horizon, Miocene.

Re-description—Spores bean-shaped, plano-convex in lateral and oval, elliptical in polar views; heteropolar, $30\text{--}60 \times 60\text{--}108 \mu\text{m}$, monolete; laesura simple, short to long; exine two layered, canalicate, $3\text{--}6 \mu\text{m}$ thick; ridges $1\text{--}2 \mu\text{m}$ thick, separated by $<$ up to $1 \mu\text{m}$ thick grooves, emerge from ends of the laesura encircling the latter, parallel, bifurcating or coalescing locally; longitudinally oriented at distal side.

Comparison—The species resembles *S. multistriatus* Rao & Ramanujam 1976 but differs from it in having large spores with thicker exine.

Remarks—The species is re-described to accommodate similar spores of larger dimension and thicker exine from Neyveli assemblage of Mine III.

Schizaeosporites proximobliquus sp. nov.

Pl. 1, figs 3, 4, 6, 7

Holotype—Pl. 1, fig. 3; size $54 \times 90 \mu\text{m}$.

Type locality—Neyveli Lignite Field, South Arcot District, Tamil Nadu.

Horizon & age—Cuddalore Formation, Miocene.

Description—Spores plano-convex, bean-shaped in lateral and oval, elliptical in proximal/distal views; heteropolar, $36\text{--}62 \times 65\text{--}90 \mu\text{m}$, monolete; laesura simple, short to long; exine two layered, canalicate, $3\text{--}4 \mu\text{m}$; ridges $1\text{--}2 \mu\text{m}$ thick, parallel, bifurcating or coalescing locally, separated by $\pm 1 \mu\text{m}$ thick grooves, emergence of striations oblique, parallel; orientation longitudinal at distal side.

Comparison—This species closely compares with *S. obliquus* sp. nov. in oblique, parallel emergence of striations but differs in having longitudinal orientation of striations at distal side.

Derivation of name—After oblique pattern (emergence) of striations at the proximal side.

Schizaeosporites obliquus sp. nov.

Pl. 1, figs 8-14

Holotype—Pl. 1, fig. 10; size $52 \times 75 \mu\text{m}$.

Type locality—Neyveli Lignite Field, South Arcot District, Tamil Nadu.

Horizon & age—Cuddalore Formation, Miocene.

Description—Spores bean-shaped, plano-convex in lateral and oval, elliptical in polar views; heteropolar, $45\text{--}75 \times 75\text{--}100 \mu\text{m}$, monolete; laesura simple, short to long; exine two layered, $3\text{--}5 \mu\text{m}$ thick, canalicate; ridges $\pm 2 \mu\text{m}$ broad, occasionally bifurcating and coalescing, parallel, separated by $\pm 1 \mu\text{m}$ thick grooves; emergence of striations oblique, parallel; orientation oblique at distal side.

Comparison—The species resembles *S. proximobliquus* sp. nov. but has oblique emergence and orientation of striations. It also differs from various other species (Table 1) in having large spore size and thicker exine.

Derivation of name—After oblique emergence and orientation of striations.

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