

MORPHOLOGICAL STUDY OF THE RETIALETES COMPLEX FROM INDIAN TERTIARIES

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ABSTRACT

The Palaeogene sediments of India abound in inaperturate, reticulate pollen grains. These pollen grains, by various authors, have been described under different genera viz., *Monosulcites*, *Nonaperturipites*, *Potamogetonaceapites*, *Microreticulatipites*, *Reticulatasporites*, *Retialetes*, *Schizosporis*, *Nymphaeoidipollis*, *Proxapertites* and *Inaperturopollenites*. The present paper deals with the taxonomic reassessment of these genera. In this connection three new genera viz., *Assamiapollenites*, *Sahiapollis* and *Assamiales* have been instituted for the precise placement of these pollen grains. The entire complex of these pollen grains has been dealt under the term *Retialetes Complex*.

INTRODUCTION

The record of inaperturate pollen grains of reticulate-varied ornamentation from the Tertiary sediments of India dates back to late forties when SAHNI, SITHOLEY AND PURI (1947) described some spores and pollen grains from the Tertiary succession of Assam. They differentiated four palynological assemblages, characterizing Barail, Surma, Tipam and Dhekiajuli sediments. One of their specimen (Pl. 16, fig. 43) is described to possess an oval to ellipsoidal shape and reticulate ornamentation. The pollen approximates $100 \times 60 \mu$ in size. They considered this specimen to be a marker form for the Tipam Group. From the illustration, however, it appears to be a monocolpate pollen of liliaceous affinity. The possibility of its being an acolpate form should not also be overlooked. SEN (1948) while describing plant microfossils from the Laitryngew Coalfield distinguished 11 classes of spores and pollen grains. His type H of class 4 is very much similar to the figure 43 in Pl. 16 of SAHNI, SITHOLEY AND PURI (1947). He stated that this grain had not been observed to dehisce along any regular plane. Sen's this observation further strengthens the doubt concerning the inaperturate nature of these specimens. The other pollen grains, viz., type N and O recorded by SEN (1948) are, however, small and psilate but exhibit a similar organization.

CHITALEY (1951, p. 376) recorded two forms, *Monosulcites (Palmidites) minima* and *M. (Palmidites) media*, from the Intertrappean beds of Mohgaon Kalan, Madhya Pradesh. These grains which according to her are psilate, seem to be separable along an equatorial plane. BISWAS (1962) while dealing with the stratigraphy of Mahadeo, Langpar, Cherra and Tura formations of Assam recorded two genera, viz., *Nonaperturipites* and *Potamogetonaceapites*. The former taxon is ornamented with tubercles, warts and pila of varied characters and shows a negative reticulum while the latter is a truly reticulate form. Similarly, the genus *Microreticulatipites* described by BAKSI, (1962), Pl. 2, fig. 20) from the Simsang river Tertiaries is nothing but a circular to subcircular reticulate pollen grain. RAMANUJAM (1966, p. 156, Pl. 1, fig. 5) described an inaperturate reticulate pollen as *Reticulatasporites* sp. from the Miocene Lignite of South Arcot. In 1972, DEB, recorded another species *Reticulatasporites arcotense* from the Neyveli Lignite. SAH AND DUTTA (1966, 1968) and DUTTA AND SAH (1970) during their extensive palynostratigraphic investi-

gations of the sedimentary formations of Assam described grains with a similar reticulate ornamentation under the genera *Retialetes* Sah & Dutta (1966) and *Schizosporis* Cookson & Dettmann (1959). In their latest publication SAH AND DUTTA (1974, p. 50) transferred the species *Schizosporis crassimurus* and *S. assamicus* to the genus *Nymphaeipollis* established by VENKATACHALA AND KAR (1969) from the Laki sediments of Kutch, Western India. It is worth mentioning here that the genus *Nymphaeipollis* Venkatachala & Kar (1969) perfectly resembles the genus *Proxapertites* Van der Hammen (1956). The difference that VENKATACHALA AND KAR (1969) have advocated for *Proxapertites* is the "dyad" nature of the grains. According to MULLER (1968), the dyad character of *Proxapertites* is not a consistent feature, hence the difference cited by VENKATACHALA AND KAR (1969) is not tenable. This makes the genus *Nymphaeipollis* Venkatachala and Kar (1969), a junior synonym of the genus *Proxapertites* Van der Hammen (1956). It has now been observed that the grains resembling *Nymphaeipollis marginatus* Venkatachala & Kar (1969) have also been described as *Proxapertites hammenii* by Venkatachala & Rawat (1972) from the Palaeocene-Eocene sediments of the Cauvery Basin.

The palynological data from the subsurface sediments of the Bengal basin are known only from the work of BAKSI (1972). He (1972, p. 195, text-fig. 2) has recorded *Retialetes emendatus* Sah & DUTTA (1966) and *Schizosporis crassimurus* Sah & Dutta (1966) from his palynological zone II comprising Jalangi Formation. Regarding the taxonomic status of these forms, he opined that the above taxa should be grouped under the well recognized genus *Proxapertites*. On the contrary, SALUJHA, KINDRA AND REHMAN (1972) described such reticulate grains under the genus *Inaperturopollenites* from the Palaeogene sediments of the Garo Hills. SAH AND KAR (1972) while evaluating the Lower Eocene palynological assemblages of India considered *Retialetes emendatus* and *Schizosporis crassimurus* as the marker species.

Recently, the palynology of the Barmer Sandstone of Rajasthan has been worked out by JAIN, KAR AND SAH (1973) who have grouped pollen grains similar to *Schizosporis assamicus* Sah & Dutta (1966) under *Proxapertites scabratus* (p. 154, Pl. 1, figs. 18-19 & 28).

Thus, it is obvious that taxonomic chaos and morphographic confusion are involved concerning these so-called inaperturate, reticulate pollen grains. These grains up till now have been described under the following genera:

Monosulcites Cookson, 1947 (in CHITALEY, 1951)

Nonaperturipites Biswas, 1962

Potamogetonaceapites Biswas, 1962

Microreticulatipites Baksi, 1962

Reticulatasporites Leschik, 1955 (in RAMANUJAM, 1955; Deb, 1972)

Retialetes Sah & Dutta, 1966

Schizosporis Cookson & Dettmann, 1959 (in SAH & DUTTA, 1966)

Nymphaeipollis Venkatachala & Kar, 1969

Proxapertites Van der Hammen 1956, (in VENKATACHALA & RAWAT, 1972 and JAIN, KAR & SAH, 1973)

Inaperturopollenites Potonić, 1958 (in SALUJHA, KINDRA & REHMAN, 1972).

The present taxonomic status of the Indian forms assigned to each of the above genera is discussed as follows:

MONOSULCITES

The generic diagnosis of the form genus *Monosulcites* as given by COUPER (1953, p. 65) is as follows—"Free, isopolar bilateral, monosulcate, grains elongate to subcircular. Exine

variable in thickness and sculpture." The pollen grains described by CHITALEY (1951) are, however, spheroidal and seem to bear an equatorial sulcus. Her *Monosulcites (Palmidites) media* (p. 376, Pl. 13, fig. 10) shows two distinct white scars, representing the reminiscent of single equatorial sulcus, which are clearly observable on either side of the pollen grains. Her *Monosulcites (Palmidites) minima* (p. 376, Pl. 13, fig. 9) is nothing but a lateral view of the same sulcus along an equatorial plane. Therefore, Chitaley's placement of these grains under the genus *Monosulcites* does not seem to be appropriate. The correct allocation of these grains is given in the later part of this paper.

NONAPERTURIPITES

Pollen grains described under the genus *Nonaperturipites* Biswas (1962) are non-aperturate, circular to subcircular, mostly ornamented with tubercles and warts. He has also included grains with psilate to granulose ornamentation under the same genus. PIERCE (1961) had earlier instituted the genus *Verruinaferturites* having same characters as *Nonaperturipites* Biswas (1962) but his genus has been opined to be invalid by POTONIÉ (1966, p. 147) as the morphology of this form is not well understood. BISWAS (1962) has also neither given a generic diagnosis nor designated a type species for his genus *Nonaperturipites*, hence this also becomes invalid according to I.C.B.N. (STAFLEU 1972, article 41). I, therefore, propose a new name *Assamiapollenites* to accommodate all ornamented pollen grains described, so far, under the above two genera.

POTAMOGETONACEAEPITES/MICRORETICULATIPITES/NYMPHAEOIPOLLIS/ PROXAPERTITES

The genera *Potamogetonaceapites* Biswas (1962), *Microreticulatipites* Baksi (1962) and *Nymphaeoiipollis* Venkatachala & Kar (1969) are morphologically identical to *Proxapertites* Van der Hammen (1956) and are thus junior synonyms of the genus *Proxapertites*. *Weylandiipollis* instituted by TAKAHASHI (1964) from the Mesozoic sediments of Japan also appears to be a morphological variant of *Proxapertites*.

INAPERTUROPOLLENITES

Inaperturopollenites (Thompson & Pflug) Potonié (1958) is a circular and infrapunctate pollen with thin exine having many secondary folds. None of these characters are met with in *Inaperturopollenites* sp. described by SALUJHA *et al.* (1972) from the South Shillong Front. Therefore, this species may be referred to the genus *Proxapertites*.

RETICULATASPORITES

The genus *Reticulatasporites* established by LESCHIK (1955, p. 29) from the Triassic sediments of Basel is inaperturate, reticulate form with coarse to fine meshes. The meshes of the reticulum are incomplete and irregularly built presenting a "lock arrangement". The genotype *Reticulatasporites densus* (p. 29, Pl. 3, fig. 24) is oval to circular in shape, provided with a thin perinal layer which is strongly folded in a vermiculate pattern. The main body of the spore is, however, punctate (in sense of small reticulation). Often the muri of this reticulum do not enclose the polygonal luminae. His other species *R. aduncus* shows a rough sculpture over which lies a reticulum of irregularly arranged lacunae. Thus, it appears (in terms of LESCHIK, 1955, p. 29) that the genus *Reticulatasporites* is an inaperturate, reticulate

to scabrate surfaced spore usually provided with a perinal layer. Since *Reticulatasporites* sp. (RAMANUJAM, 1966, p. 156, Pl. 1, fig. 5) and *R. arcotense* (DEB, 1972, p. 221, figs. 1 & 2) are devoid of a perinal layer, the placement of these grains under this genus is not justified. The occurrence of similar reticulate grains in Tertiary sediments of Assam, *Reticulatasporites* sp. of RAMANUJAM (1966) appears in every likelihood a new form of *Proxapertites*. In *Reticulatasporites arcotense* Deb (1972) the pollen grains are inaperturate. One surface of the grain is ornamented with coarse irregular reticulum whereas the other is provided with distinct fine striations. As this form can not be accommodated in any of the known genera, a new name *Sahiapollis* is proposed to encompass the aforesaid characteristic pollen grains.

RETIALETES

The generic name *Retialetes* instituted by SAH AND DUTTA (1966, p. 76) is illegitimate being a later homonym of the genus *Retialetes* Staplin (1960) (under Article 64 of ICBN). *Retiatetes* Staplin is a genus of reticulate, alete spores having ellipsoidal outline and fine grooves oriented parallel to the long axis of the grain (STAPLIN, 1960, p. 6, figs. 2 & 3). A new substitute name *Assamiales* is, therefore, proposed here for *Retialetes* Sah & Dutta (1966) (non STAPLIN, 1960).

SCHIZOSPORIS

Schizosporis assamicus Sah & Dutta (1966) and *S. crassimurus* Sah & Dutta (1966) which were later described as *Nymphaeoipollis assamicus* and *N. crassimurus* by the same authors in 1974 are definitely tectate grains. The taxonomic placement of these grains under the genus *Proxapertites* has already been advocated by BAKSI (1972, p. 195) and MULLER (1974, p. 50).

SYSTEMATIC REALLOCATIONS

Genus—**Proxapertites** Van der Hammen, 1956 emend.

Type species: Proxapertites operculatus v. d. Hammen, 1956.

Locality: Rio Lebrjga, Columbia.

Horizon: Lisama Formation, (Palaeocene).

1962 *Potamogetonaceapites* Biswas, p. 48.

1962 *Microreticulatipites* Baksi, p. 17.

1964 *Weylandipollis* Takahashi, p. 17.

1969 *Nymphaeoipollis* Venkatachala & Kar, p. 163.

Emended diagnosis: Pollen grains circular to subcircular in shape, zonisulcate, sulcus \pm parallel to margin, resulting into breaking of the pollen into \pm two equal halves. Size range 20—70 \times 25—50 μ . Exine tectate, variable in ornamentation and sculpture generally ranging from punctate, psilate, granulose to microfoveolate and reticulate.

Other known species of the genus:

Proxapertites minima (Chitaley) comb. nov. (= *Monosulcites* (*Palmidites*) *minima*, Chitaley, 1951, p. 376, Pl. 13, fig. 9.)

Proxapertites media (Chitaley) comb. nov. (= *Monosulcites* (*Palmidites*) *media* Chitaley, 1951, p. 376, Pl. 13, fig. 10).

Proxapertites pramathi (Biswas) comb. nov. (= *Potamogetonaceapites pramathi* Biswas, 1962, p. 48, Pl. 13, fig. 41.)

- Proxapertites intecta* (Baksi) comb. nov. (= *Microreticulatipites intecta* Baksi, 1962, p. 17, Pl. 2, fig. 20).
- Proxapertites crassimurus* (Sah & Dutta) comb. nov. (= *Schizosporis crassimurus* Sah & Dutta 1966, p. 78, Pl. 1, fig. 18).
- Proxapertites asamicus* (Sah & Dutta) comb. nov. (= *Schizosporis assamicus* Sah & Dutta, 1966, p. 79, Pl. 1, fig. 20).
- Proxapertites marginatus* (Venkatachala & Kar) comb. nov. (= *Nymphaeopollis marginatus* Venkatachala & Kar 1969, p. 163, Pl. 2, figs. 24-25).
- Proxapertites granulatus* Singh (MS).
- Diagnosis*: Pollen grains, subcircular to circular, 46—50 μ , zonisulcate, exine granulose.
- Proxapertites* sp. A. Singh (MS).
- Description*: Pollen grain circular, 48 μ , zonisulcate, sulcus not distinct. Exine 2—2.5 μ thick, stratification not clear, surface ornamentation microreticulate.
- Proxapertites* sp. B. (=Sahni, Sitholey & Puri, 1947, Pl. 16, fig. 43; Type H, Sen, 1948, p. 5).
- Proxapertites* sp. C. (=Type O, Sen, 1948, p. 5).
- Proxapertites* sp. D. (= *Nonaperturipites* sp. Biswas, 1962, p. 46, Pl. 11, fig. 28).
- Proxapertites* sp. E. (= *Nonaperturipites* Biswas, 1962, p. 46, Pl. 11, fig. 21).
- Proxapertites* sp. F. (= *Nonaperturipites*, Biswas, 1962, p. 44, Pl. 10, fig. 10).
- Proxapertites* sp. G. (= *Nonaperturipites* sp. Biswas, 1962, p. 38, Pl. 5, fig. 15).
- Proxapertites* sp. H. (= *Reticulatasporites* sp. Ramanujam, 1966, p. 156, Pl. 1, fig. 5).
- Proxapertites* sp. I. (= *Reticulanopites* Banerjee, 1966, p. 210, Pl. 1, fig. 27).
- Proxapertites* sp. J. (= *Inapertites* sp. Banerjee, 1968, p. 172, Pl. 1, fig. 9).
- Proxapertites* sp. K. (= *Nymphaeopollis* sp. Venkatachala & Kar, 1969, p. 163, Pl. 2, fig. 26).
- Proxapertites* sp. L. (= *Inaperturopollenites* sp. Salujha *et al.*, 1972, p. 277, Pl. 2, fig. 49).

Genus **Assamiapollenites** gen. nov.

1961 *Verruinaperturites* Pierce, p. 45

1962 *Nonaperturipites* Biswas, p. 38

Genotype—*Assamiapollenites* (*Nonaperturipites*) *browni* (Biswas, 1962) comb. nov.

Diagnosis—Pollen grains subcircular to circular in outline, nonaperturate, medium sized. Exine thick ornamented with pila, bacula, grana or some other thick projections forming a reticulum. Lumina of the reticulum quite big rounded to polygonal. Extreme lineamenta \pm rounded and sometimes possesses a shallow depression near the equator.

Comparison—*Proxapertites* v. d. Hammen (1956) is differentiated from the present genus in its zonisulcate nature. *Sahiapollis* gen. nov., though a nonaperturate pollen grain but bears prominent striations on the other half. *Assamialetes* gen. nov. is a tectate grain and possesses a true reticulum.

Assamiapollenites browni (Biswas, 1962) comb. nov.

1962—*Nonaperturipites browni* Biswas, p. 42, Pl. 7, fig. 40.

Diagnosis—See Biswas 1962, p. 42.

Locality—Garo Hills, Meghalaya.

Horizon—Tura Formation (Palaeocene).

Other known species of the genus:

Assamiapollenites thiergarti (Biswas) comb. nov. (= *Nonaperturipites thiergarti* Biswas, 1962, p. 41, Pl. 17, fig. 36).

Assamiapollenites berryi (Biswas) comb. nov. (= *Nonaperturipites berryi* Biswas, 1962, p. 41, Pl. 7, fig. 38).

Assamiapollenites chanderi (Biswas) comb. nov. (= *Nonaperturipites chanderi* Biswas, 1962, p. 43, Pl. 9, fig. 49).

Assamiapollenites evansi (Biswas) comb. nov. (= *Nonaperturipites evansi* Biswas, 1962, p. 46, Pl. 11, fig. 22).

Assamiapollenites sp. A. (= *Nonaperturipites* sp. Biswas, 1962, p. 38, Pl. 5, fig. 6).

Assamiapollenites sp. B. (= *Nonaperturipites* sp. Biswas, 1962, p. 46, Pl. 11, fig. 21).

Assamiapollenites sp. C. (= *Nonaperturipites* sp. Biswas, 1962, p. 46, Pl. 11, fig. 28).

Genus—**Sahiapollis** gen. nov.

Genotype—*Sahiapollis* (*Reticulatasporites*) *arcotense* (Deb, 1972) comb. nov.

Diagnosis—Pollen grains spheroidal to oval in shape, nonaperturate, medium sized. Exine tectate, thickness variable. Ornamented on one surface with a distinct reticulum, the other surface either psilate or provided with variable ornamentation and sculpture.

Comparison—*Reticulatasporites* Leschik (1955) is differentiated from the present genus by a reticulate, ornamentation on both the surfaces. Besides this, genus is also covered by wrinkled perinal layer. *Assamialetes* nom. Subt. nov. is uniformly reticulate all over the surface. *Proxapertites* v. d. Hammen (1956) is distinguished from *Sahiapollis* gen. nov. in having an equatorial sulcus.

Derivation of Name—Dr. S. C. D. Sah, Assistant Director, Birbal Sahni Institute of Palaeobotany, Lucknow, India is well known for his extensive contribution towards the Palyno-stratigraphy of Assam. It gives me a great pleasure in naming the genus after him. *Sahiapollis arcotense* (Deb, 1972) comb. nov.

1972—*Reticulatasporites arcotense* Deb. p. 221, Pl. 1, figs. 1 & 2.

Diagnosis—See Deb, 1972, p. 221.

Locality—Neyveli, South Arcot, Tamil Nadu.

Horizon—Eocene.

Genus—**Assamialetes** nom. Subst. nov.

Genotype—*Assamialetes* (*Retialetes*) *emendatus* (Sah & Dutta, 1966) comb. nov.

Diagnosis—Pollen grains subcircular to circular in outline, nonaperturate, medium sized. Exine ornamented with perfect reticulum on both surfaces lumina of the reticulum fairly large, rounded to polygonal. Equatorial outline wavy.

Comparison—*Proxapertites* Van der Hammen (1956) resembles the present genus in shape and reticulate ornamentation but differs from the latter in having an equatorial sulcus. *Reticulatasporites* Leschik (1955) is differentiated from this genus by its wrinkled perinal layer. Similarly *Sahiapollis* gen. nov. is reticulate only on one surface.

Assamialetes emendatus (Sah & Dutta) comb. nov.

1972—*Retialetes emendatus* Sah & Dutta 1966, p. 63, pl. 1, fig. 16.

Locality—Mawkma, South Shillong Plateau, Assam, India.

Horizon—Cherra Formation (Palaeocene).

Diagnosis—See Sah and Dutta 1965, p. 63.

Other known species of the genus: Assamialetes dubius (Sah & Dutta) comb. nov.-

Retialetes dubius Sah & Dutta, 1968, p. 187, Pl. 1, fig. 22).

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