

PALYNOLOGY OF THE UMIA PLANT BEDS OF KUTCH, W. INDIA — 2. BHUJ EXPOSURES NEAR WALKAMATA, KUTCH DISTRICT, GUJARAT STATE — SYSTEMATIC PALYNOLOGY

B. S. VENKATACHALA*

Birbal Sahni Institute of Palaeobotany, Lucknow

ABSTRACT

The dispersed spore-pollen genera recovered from the Bhuj exposures near Walkamata are referred to 42 spore-pollen genera and 59 species. Microforaminifera and Hystrichosphaerids recovered from the sediments have been figured. The geological distributions of the species are also tabulated in the present paper.

INTRODUCTION

THE present paper deals with the systematics of spores and pollen recovered from the exposures near Walkamata on the bank of the Bhuki nala (rivulet) (For description of locality and other details of section investigated — see VENKATACHALA, 1966, 1967). Microforaminifera and Hystrichosphaerids figured in the report will be described later. The material investigated belongs to the Bhuj stage of the Umia series considered as Lower Cretaceous (Necomian-Aptian) in age.

SYSTEMATIC PALYNOLOGY

Anteturma — *Sporites* H. Pot. 1893
Turma — *Triletes* (Rein) Pot. & Kr. 1954
Subturma — *Azonotriletes* Lub. 1935
Infraturma — *Laevigati* (Benn. & Kid.)
Pot. 1958

Deltoidospora Min. 1935

Type Species — *Deltoidospora hallii* Min. 1935.

Deltoidospora rhytisma Rouse, 1956.

Pl. 1, Fig. 1

Lectotype — Rouse, 1956; pl. 1, fig. 30 herein designated.

Remarks — Roundly triangular, 38 μ . Y-Mark distinct, open, rays reaching upto 2/3 equator. Exine infragranulose.

Stereisporites (= *Sphagnumsporites*) and certain species of *Deltoidospora* are closely comparable. Placement of several spore types under different genera may appear not correct under different circumstances, overlap to a great extent is inevitable because of lack of more evidence about their parent plants.

Distribution — Jurassic (Kootenay formation) of British Columbia.

Cyathidites Coup. 1953

Cyathidites cf. *C. minor* Coup. 1953

Pl. 1, Fig. 3

Remarks — Up to 60 μ . Slightly bigger than *C. minor*.

Stereisporites Pf. 1953

Type Species — *Stereisporites stereoides* (Pot. & Ven.) Pf. 1953.

Stereisporites sp.

Pl. 1, Fig. 7

Description — Trilete miospore, biconvex, equatorial outline subcircular with convex sides, 22 μ . Trilete distinct, almost reaching up to the margin. Exine laevigate-infragranulose, marginal thickening appears to be present.

Remarks — In the present study only few badly preserved specimens have been recorded and hence they have been referred to as *Stereisporites* sp.

*Present address — Palynology Laboratory, Research and Training Institute, Oil and Natural Gas Commission, Dehra Dun.

Biretisporites (Delc. & Spr.) Delc. et al. 1963

Type Species — *Biretisporites poloniaei*
Delc. & Sprum. 1955.

Biretisporites sp.

Pl. 1, Fig. 4

Description — Roundly triangular microspore, with almost straight to slightly concave sides and rounded angles, 44 μ . Trilete mark reaching up to the equator, labra thick, $\pm 2 \mu$ along the suture, slightly elevated. Exine $\pm 2 \mu$ thick.

Remarks — The specimen illustrated here is not well preserved, hence assignment to any known species is difficult.

The slight mottled appearance or unevenness of the exine is due to bad preservation.

Dictyophyllidites Coup. 1958

Type Species — *Dictyophyllidites harrisii*,
Coup. 1958.

Dictyophyllidites sp.

P. 1, Fig. 5

Description — Roundly triangular; 42 μ , sides slightly concave, apices rounded. Y-mark distinct, wavy, almost reaching 2/3 radius, slightly elevated. Kyrtoemic thickening present bordering the trilete rays. Exine $\pm 2 \mu$ thick.

Appendicisporites Weyl. & Krieg. 1953? *Appendicisporites* sp.

Pl. 1, Fig. 24

Description — Triangular with convex sides and pointed bulbous, projecting tips in equatorial outline. Y-mark present, open (in the specimen illustrated here). Muri occupying the interradial contour and joining the three angular projections. Exine infragranulose.

Distribution — The genus is known only from Cretaceous sediments (Pocock, 1964).

Infraturma — Apiculati (Benn. & Kids.) Pot. 1956**Leptolepidites Cup. 1953**

Type Species — *Leptolepidites verrucatus*
Coup. 1953.

Leptolepidites sp.

Pl. 1, Fig. 6

Description — Roundly triangular with straight to convex sides, 42 μ . Y-Mark indistinct, faintly visible. Exine proximally smooth, distally verrucose, verrucae irregular in distribution, broad, 3-5 μ high and 4-7 μ wide.

Comparison — *L. verrucatus* Coup. and *L. major* Coup. differ in possessing uniform verrucae for its ornamentation.

Distribution — The genus is distributed in Upper Jurassic-Lower Cretaceous sediments (COUP. 1953; COOKS. & DETTM. 1959; DETTM. 1959 & 1963; LANTZ, 1958; DE JERSEY, 1959).

Osmundacidites Coup. 1958

Type Species — *Osmundacidites wellmanii*
Coup. 1958.

Remarks — Dettmann (1963) differentiates *Osmundacidites* from *Baculatisporites* on the nature of exine ornamentation, the former possessing grana and the latter bacula or pila. The same practice is followed here.

Osmundacidites wellmanii Couper, 1958

Pl. 1, Fig. 10

Distribution — Known geological range Liassic-Middle Senonian (COUP. 1960).

Osmundacidites indicus Singh et al. 1964

Pl. 1, Fig. 9

Distribution — Lower Cretaceous (SINGH et al., 1964).

Baculatisporites Thom. & Pf. 1953

Type Species — *Baculatisporites primarius*
(Wolf) Thoms. & Pfl. 1953.

Baculatisporites comaumensis (Cooks.)

Pot. 1956

Pl. 1, Fig. 11

Remarks — The ornamentation in the specimens studied here show a wide range of variation from bacula, pila, spines and irregular warts. Their distribution is also not uniform.

Distribution — Upper Triassic (KL., 1960) — Lower Cretaceous (BALME, 1957; DETTM., 1959).

Neoraistrickia Pot. 1956

Type Species — *Neoraistrickia truncatus* (Cooks.) Pot. 1956.

Neoraistrickia truncatus (Cooks.) Pot. 1956

Pl. 1, Fig. 8

Remarks — The specimens figured here are smaller in size as compared to the ones figured earlier.

Distribution — The species is widely distributed in Middle Jurassic — Lower Cretaceous (BALME, 1957; COOKSON, 1953; COOKSON & DETTMANN, 1958, 1959; DETTMANN, 1959, 1963).

Ceratosporites Cooks. & Dettm. 1958

Type Species — *Ceratosporites equalis* Cooks. & Dettm. 1958.

Ceratosporites kutchensis sp. nov.

Pl. 1, Fig. 19

Holotype — Pl. 1, Fig. 19.

Type locality — Walkamata, Bhuj series, Kutch.

Description — Roundly triangular in equatorial compressions, distal surface convex, proximal surface pyramidal, 26-30 μ . Y-mark distinct, rays straight, elevated, up to the margins. Proximally smooth, distally ornamented with slender up to 4 μ long processes; processes generally with bulbous base and flattened tips, sometimes they are as broad as long.

Comparison — *C. equalis* is larger in size.

Distribution — The genus *Ceratosporites* is widely distributed in Upper Mesozoic sediments, (COOKS. & DETTM. 1958, 1959; DETTM., 1959, 1963; C. SINGH, 1964).

Pilosisorites Delc. & Sprum. 1955

Type Species — *Pilosisorites trichopilosus* (Thierg.) Delc. & Sprum. 1955.

Pilosisorites notensis Cooks. & Dettm. 1958

Pl. 1, Fig. 35

Distribution — Known from the Upper Mesozoic sediments (COOKS. & DETTM., 1958, 1959; DETTM. 1959, 1963).

Infraturma — Murornati Pot. & Kr. 1954

Lycopodiumsporites Thierg. ex Delc. & Sprum. 1955

Type Species — *Lycopodiumsporites agathoecus* (Pot.) Thierg. 1938.

Lycopodiumsporites sp.

Pl. 1, Fig. 18

Description — Roundly triangular, proximal surface pyramidal, distal surface convex, 20 μ ; Y-mark distinct, 3/4 radius, raised; apex and vertex high. Exine proximally smooth, distally reticulate, muri up to 2 μ thick and lumina up to 2 μ wide forming fine meshes, membranous, forming a thin equatorial expanse. Equatorial margin dentate due to projecting muri.

Comparison — *L. eminus* is closely comparable but differs in possessing larger meshes.

Klukisporites Coup. 1958

Type Species — *Klukisporites variegatus* Coup. 1958.

Klukisporites cf. *K. scaberis* (Cooks. & Dettm.) Dettm. 1963

Pl. 1, Fig. 27

Remarks — Trilete, Y-Mark distinct. Exine covered by muri; muri up to 5 μ high, projecting on the equatorial contour, 4-5 μ broad enclosing 8-10 μ wide lumina.

Comparison — *K. scaberis* Dettm. has distinct verrucae on the proximal surface. *K. variegatus* Coup. has more or less flat broad muri in contrast to narrow projecting muri as seen here.

Distribution — Lower Cretaceous sediments (COOKSON & DETTMANN, 1958, 1959; DETTMANN, 1959, 1963).

Subturma — Zonotriletes Waltz, 1935

Infraturma — Cingulati (Pot. & Kl.) Dettm. 1963

Foraminisporis Krtz. 1957

Type Species — *Foraminisporis foraminis* Krutz. 1959.

Foraminisporis sp.

Pl. 2, Fig. 43

Description — Subtriangular, biconvex 56 μ . Y-mark faint, hardly perceptible. Exine ornamented with warts of $\pm 2 \mu$

thick. Ornamentation prominent on distal side. Equatorial thickening in the form of a crassitude present.

Distribution — The genus is distributed in the Lower Cretaceous sediments (KRUTZSCH, 1959; DETTMANN, 1963).

***Polycingulatisporites* Simonc. & Ked. 1962**

Syn. — *Taurocusporites* Stov. 1962.

Type Species — *Polycingulatisporites circulus* Simonc. & Ked. 1962.

Polycingulatisporites reduncus (Bolkhov.)
comb. nov.

Pl. 1, Fig. 21

Syn. — *Chomotriletes reduncus* Bolkhov. 1953 — *Taurocusporites reduncus* Stov. 1962.

***Contignisporites* Dettm. 1963**

Type Species — *Contignisporites glebulentus* Dettm. 1963.

Contignisporites cf. *C. cooksonii*

Pl. 1, Fig. 34

Remarks — The specimens are smaller as compared to *C. cooksonii* (Balme) Dettm. Figured specimen measures 36 μ .

Contignisporites sp.

Pl. 1, Fig. 36

Description — Microspores roundly triangular in equatorial compressions, 62 μ . Cingulate, cingulum lobate, up to 8 μ wide. Distal surface cicatricose sculptured with 10 parallel muri, muri up to 6 μ wide, lumina in between muri up to 3 μ wide and anastomose with the inner margin of the cingulum.

The studied specimen is flattened with distal side up and hence proximal feature can not be studied, Y-mark perceptible.

Remarks — The lobate cingulum differentiates this species from the known species. The specimen is not well preserved.

Turma — *Monoletes* Ibr. 1933

Subturma — *Azonomonoletes* Lub. 1935

Infraturma — *Laevigatomonoleti* Dyb. Jach. 1957

***Laevigatosporites* (Ibr.) Pot. & Kr. 1954**

Type Species — *Laevigatosporites vulgaris* Ibr. 1933.

***Laevigatosporites* sp.**

Pl. 2, Fig. 47

Description — Oval, 30 μ . Monolete, exine infragranulose.

Infraturma — *Sculptatomonoleti* Dyb. & Jach. 1957

***Thymospora* Wils. & Venkat. 1962**

Type Species — *Thymospora pseudotheisinii* (Kos.) Wils. & Venkata. 1962.

Thymospora sp.

Pl. 2, Fig. 48

Description — Bean shaped, 30-35 μ long and 14-20 μ broad. Monolete mark less than 1/2 length of spore. Exine ornamented with irregular ± 2 μ wide verrucae which anastomose to form a rugulate pattern.

Turma — *Hilates* Dettm. 1963

Remarks — The development of a polar aperture (hilum) is significant as it marks a step ahead of the normal aperture pattern met so far in monolete-trilete groups of spores and is of a great evolutionary significance. This tendency of a distal aperture seen in *Aequitriradites* is already differentiated in the Palaeozoic spore genus *Cirratriradites* Schopf, Wils. & Bent.

***Aequitriradites* (Delc. & Sprum.) Cooks. & Dettm. 1961**

Type Species — *Aequitriradites dubius* Delc. & Sprum. 1963.

Aequitriradites sp.

Pl. 2, Figs. 44-46

Description — Roundly triangular, zonate, 55-65 μ (including zona). Zona up to 20 μ wide, membranous, infragranulose irregular in outline, in the specimens described here not preserved or torn during maceration. Spore body roundly triangular, 40-50 μ ; ornamented with irregular 2-5 μ wide warts, ornamentation dense towards the pole, perhaps indicating distal fovea. Crassitudo like ridge seen in most of the specimens studied.

Comparison — *Aequitriradites spinulosus* described by Cookson and Dettmann (1961) is closely comparable to the species described here; since the Bhuj specimens are

not well preserved they have not been assigned to any known species.

Anteturma — *Pollenites* Pot. 1931
Turma — *Saccites* Erdt. 1947
Subturma — *Disaccites* Cooks. 1947

***Alisporites* Daugherty, 1941**

Type Species — *Alisporites opii* Daugherty, 1941.

Alisporites similis Balme, (1957) comb. nov.

Pl. 2, Fig. 60

Holotype — Balme, 1957; pl. 10, fig. 108.

Distribution — Upper Jurassic and Lower Cretaceous (BALME, 1957).

Alisporites grandis (Cookson) Dettmann, 1963

Pl. 2, Fig. 59

***Podocarpidites* Cooks. ex Coup. 1953**

Type Species — *Podocarpidites ellipticus* Cooks. 1947.

Podocarpidites cf. *P. ellipticus* Cooks. 1947

Pl. 2, Fig. 64

Remarks — Similar pollen grains have been figured by Dettmann (1963).

Distribution — Jurassic — Lower Cretaceous (BALME, 1957, DETTMANN, 1963).

Podocarpidites cf. *P. multesimus* (Bolkhov.) Poc. 1962

Pl. 2, Fig. 65

Remarks — Similar pollen grains have been recorded by Dettmann, 1963.

Distribution — Cretaceous (BOLKHOVITINA, 1956; DETTMANN, 1963; POCKOCK, 1962; ROUSE, 1957).

Subturma — *Polysaccites* Cooks. 1947

***Microcachyridites* Cooks. ex Coup. 1953**

Type Species — *Microcachyridites antarcticus* Cooks. 1947.

Microcachyridites antarcticus Cooks. 1947

Pl. 2, Figs. 66 & 69

Distribution — The genus is widely distributed in Mesozoic and Tertiary strata.

***Microcachyridites* sp.**

Pl. 2, Fig. 67

Description — Bisaccate, 42 μ , pollen body 42 μ , sacci 12 μ . Body exine \pm smooth or infragranulose, sacci infrareticulate, with closed meshes.

***Podosporites* Rao, 1943**

Type Species — *Podosporites tripakshi* Rao, 1943.

Remarks — *Trisaccites* Cookson & Pike, 1954 is a junior synonym of *Podosporites*.

Podosporites microsaccatus (Coup.) Dettm. 1963

Pl. 2, Fig. 68

Distribution — Upper Mesozoic and Lower Tertiary (BALME, 1957; COOKS. & PIKE, 1954; COUP. 1953, 1960; DETTM. 1963).

Turma — *Plicates* Naum. 1939

Subturma — *Monocolpates* Iver. & Tr.-Sm. 1950

***Gynkgaletes* Lub. 1955**

Type Species — *Gynkgaletes retroflexus* (Lub. 1938) Lub., 1955.

Gynkgaletes sp.

Pl. 2, Fig. 72

Description — Longitudinally oval, 40 \times 24 μ , sides concave, poles broadly rounded. Colpus \pm 8 μ wide, extending almost through the entire length of the pollen, uniformly wide. Exine smooth, without conspicuous folds.

Remarks — The colpus in *Gynkgocycadophytus* is funnel shaped while in *Gynkgaletes* it is uniformly broad.

***Cycadopites* Wodeh. ex Wils. & Webs. 1946**

Type Species — *Cycadopites follicularis* Wils. & Webs. 1946.

Cycadopites sp.

Pl. 2, Fig. 73

Description — Pollen grains 22 \times 10 μ , boatshaped, broadly oval, with sharp tips and convex sides, sulcus narrow funnel shaped at the tips, wide. Exine smooth.

Comparison — Comparable to *Cycadopites* sp. described by Singh et al.

Turma — *Poroses* (Naum.) Pot. 1960
Subturma — *Monoporines* Naum. 1939
Infraturma — *Operculati* Venkat. & Goc. 1963

***Classopollis* (Pf.) Pock. & Jans. 1961**

Type Species — *Classopollis classoides* (Pf.) Poc. and Jans. 1961.

Classopollis obidoensis Groot & Groot, 1962
 Pl. 2, Figs., 74-75

Remarks — In the specimens studied here the equatorial striations forming the ring tenuitas are obscured due to bad preservation; however, in some specimen the striations are perceptible.

Distribution — Cenomanian (GROOT & GROOT, 1962).

Turma — *Aletes* Ibr. 1933
Subturma — *Azonoletes* (Lub.) Pot. & Kr. 1954

***Araucariacites* Cooks, 1947**

Type Species — *Araucariacites australis* Cooks. 1947.

Araucariacites australis Cooks. 1947
 Pl. 2, Fig. 54

Distribution — Originally described from the Lower Tertiary lignites of Kerguelan archipelago (COOKSON, 1947) widely reported from Mesozoic & Tertiary sediments (DETTMANN, 1963).

INCERTAE SEDIS

***Schizosporis* Cooks. & Dettm. 1959**

Type Species — *Schizosporis reticulatus* Cooks. & Dettm. 1959.

Schizosporis sp.
 Pl. 2, Fig. 76

Description — Elliptical to fusiform 24 × 70 μ; ends pointed and rounded.

Exine rugulate, muri irregularly anastomosing. Equatorial longitudinal split seen in the illustrated specimen in the form of a cleft.

Comparison — *Schizosporis parvus* Cooks. & Dettm. (1959) is comparable in shape but differs in its smooth exine. The other species are not comparable.

Distribution — *Schizosporis* is widely distributed in the Upper Mesozoic sediments (DETTMANN, 1963; COOKSON & DETTMANN, 1959; POCKOCK, 1962).

The following species are also present in the assemblage:

Cyathidites minor Coup.
Todisporites minor Coup.
Foveosporites canalis Balme
Lycopodiumsporites eminulus Dettm.
Lycopodiumsporites austroclavatidites (Cooks.) Pot.

Lycopodiumsporites facetus Dettm.
Microreticulatisporites lacunosus (Ibr.) Knox
Cicatricosisporites australiensis (Cooks.) Pot.

Cicatricosisporites ludbrookii Dettm.
Cicatricosisporites sp. 1 & sp. 2
Trilobosporites trioreticulosus Cooks. & Dettm.

Gleicheniidites senonicus Ross.
Sestrosporites pseudoalveolatus (Coup.) Dettm.

Coronatispora perforata Dettm.
Coronatispora telata (Balme) Dettm.
Staplinisporites caminus (Balme) Poc.
Annulispora folliculosa (Rogal.) d. Jers.
Contignisporites cooksonii (Balme) Dettm.
Contignisporites fornicatus Dettm.
Applanopsis trilobatus (Balme)
A. dampieri (Balme)
A. triletus (Singh et al.) Venkat. & Kar.
A. sp. Venkat.

Vitreisporites pallidus (Reis.) Nils.
Ginkgocycadophytus nitidus (Balme) d. Jers.

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EXPLANATION OF PLATES

(All photo-micrographs are enlarged $\times 500$. The slides are preserved at the museum of the Birbal Sahni Institute of Palaeobotany, Lucknow, India)

Plate 1

1. *Deltoidospora rhytisma*.
2. *Cyathidites minor*.
3. *Cyathidites* cf. *C. minor*.

4. *Biretisporites* sp.
5. *Dictyophyllidites* sp.
6. *Leptolepidites* sp.
7. *Stereisporites* sp.
8. *Neoraistrickia truncatus*.

9. *Osmundacidites indicus*.
10. *Osmundacidites wellmanii*.
11. *Baculatisporites comaumensis*.
12. *Todisporites minor*.
13. *Foveosporites canalis*.
14. *Lycopodiumsporites facetus*.
15. *L. circolumensus*.
16. *L. austroclavatiidites*.
17. *L. eminulus*.
18. *L. sp.*
19. *Ceratospurites kutchensis*.
20. *Annulispora foliculosa*.
21. *Polycingulatisporites reduncus*.
22. *Staplinisporites caminus*.
23. *Sestrosporites pseudoalveolatus*.
24. ? *Appendicisporites sp.*
25. *Gleicheniidites senonicus*.
26. *Microreticulatisporites uniformis*.
27. *Klukisporites cf. K. scaberis*.
28. *Cicatricosporites sp.*
29. *Contignisporites fornicatus*.
30. *C. fornicatus*.
31. *Cicatricosporites australiensis*.
32. *C. ludbrookii*.
33. *Contignisporites cooksonii*.
34. *C. cf. cooksonii*.
35. *Pilosisporites notensis*.
36. *Contignisporites sp.*
37. *Coronatispora perforata*.
38. *Coronatispora telata*.
39. Microforaminifera.
- 40-41. Hystrichosphaerid types 1 & 2.
42. *Cicatricosporites sp.*
43. *Foraminisporis sp.*
- 44-46. *Aequitriradites sp.*
47. *Laevigatosporites sp.*
48. *Thymospora sp.*
- 49-50. *Applanopsis trilobatus*.
51. *A. triletus*.
52. *A. dampieri*.
53. *A. sp.*
54. *Araucariacites australis*.
55. Hystrichosphaerid Type 3.
56. Hystrichosphaerid Type 2.
57. Fungal spore.
58. Fungal spore.
59. *Alisporites grandis*.
60. *Alisporites similis*.
61. *Trilobosporites trioreticulosus*.
- 62-63. *Vitreisporites pallidus*.
64. *Podocarpidites cf. P. ellipticus*.
65. *P. cf. P. multesimus*.
66. *Microcachryidites antacticus*.
67. *M. sp.*
68. *Podosporites microsaccatus*.
69. *Microcachryidites antacticus*.
- 70-71. *Ginkgocycadophytus nitidus*.
72. *Gynkgaletes sp.*
73. *Cycadopites sp.*
- 74-75. *Classopollis obidoensis*.
76. *Schizosporis sp.*



