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Palynological Investigation of the Sediment Cores from the Arabian Sea. 1. Fungal Spores

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ABSTRACT

The paper deals with the systematic study of the fungal spores recovered from five sediment cores from the Arabian Sea. The fungal spore assemblage recorded here includes 12 genera viz., *Inapertisporites*, *Dicellaesporites*, *Multicellaesporites*, *Staphlosporonites*, *Polycellaesporonites*, *Monoporisporites*, *Lacrimasporonites*, *Basidiosporites*, *Didymoporisporonites*, *Pluricellaesporites*, *Diporisporites* and *Diporicellaesporites* and 42 species. Of these, one genus viz. *Polycellaesporonites* and 25 species are new to the record. *Inapertisporites* is represented in all the samples and is the most common element of the assemblage. The distribution of various fungal spore genera and species in each core has been discussed.

INTRODUCTION

The present work represents part of the palynological investigation of five sediment Cores from the Arabian Sea collected by the R/V *Oceanographer* during June 13-23, 1967. One of us (Setty) was a participant to this cruise and shared these samples with the U. S. Environmental Science Administration. The assemblages obtained from these samples consist of spores (fungal and pteridophytic), pollen, microplanktons and a few microfossils of unknown affinity. The present paper deals with the fungal spores only. The study of other microfossils is in progreess and will be published elsewhere.

The fungal spores described here are assignable to 12 form genera and 42 form species. Of these, 1 genus and 25 species are proposed as new. The new genus and species have been described in detail while previously described species have simply been recorded. Additional remarks on the known fungal spore species have also been made wherever necessary. All fungal spores have been described as form genera and form species. Efforts have, however, been made to trace their affinity with the modern forms wherever possible.

MATERIAL

The material for the present study has been obtained from five sediment Cores from the Arabian Sea. Data concerning their location, water depth, Core length, lithology, mineral contents, organic matter etc. have already been published (Setty, 1972, a, b). Cores no. 3, 4 and 5 at stations 66,73 and 146 respectively were collected from the continental shelf. Core no. 1 at station 29 was collected from the slope and Core no. 2 at station 43 from the basin. Core no. 5 is located nearest, Core no. 2 farthest from the shore. The maximum Core length is

2·35 m (cores no. 5) and the minimum 0·50 m (core no 4). 9 samples were taken from three sections of Core no. 1, 12 samples from four sections of Core no. 2, 9 samples from three sections of Core no. 3, 3 samples from one section of Core no. 4 and 12 samples from four sections of Core no 5. Thus a total of 45 Core samples were studied. The age of two samples i. e. the top sample no. 7 of Core no. 2 has been determined as 9830 ± 180 years and 20940 ± 450 years respectively by radio-carbon dating method (Rajagopalan *et al.*, 1978). Considering the rate of deposition as normal, the age of the oldest sample of these Cores may be estimated in the range of 0·1 million years or even more. In general, a late Quaternary age may be safely assigned to these samples.

SYSTEMATIC PALYNOLOGY

Genus — *Inapertisporites* van der Hammen, 1954 ex Rouse, 1959 emend. Sheffy and Dilcher 1971

Inapertisporites minutus van der Hammen, 1954.

Remarks— The size of the spores described under this species by van der Hammen (1954) is 14 μm while size range of our specimens is 13-20 μm.

Occurrence : Cores no. 3 and 4.

Inapertisporites kedvesii Elsik, 1968

Remarks : Elsik (1968, pl. 5, fig. 8) proposed *Inapertisporites kedvesii* for spherical, psilate, inaperturate and folded thin-walled fungal spores ranging from 28 to 38 μm in size. Kar and Saxena (1976, p. 10, pl.3, fig. 23, pl. 4, fig. 47) described similar but larger (27-72 μm) spores from the Matanomadh Formation (Palaeocene) of Kutch. In the present preparation similar fungal spores with the size range of 14-88 μm have been observed.

Occurrence- Cores no. 1, 2, 3, 4 and 5.

Inapertisporites vulgaris Sheffy and Dilcher 1971

Remarks : The upper limit of the size range of Sheffy and Dilher's specimens is 14·5 μm while in the present preparation spores as large as 22 μm have also been recorded.

Occurrence- Core no. 1, 2, 3, 4 and 5.

Inapertisporites ovalis Sheffy and Dilcher, 1971

Remarks : The present specimens are slightly larger (15—34 × 6—18 μm) than those described by Sheffy and Dilcher (1971) from the Puryear Clay Pit, Henry County, Tennessee.

Occurrence : Cores no. 1, 2, 3, 4 and 5.

Inapertisporites subcapsularis : Sheffyand Dilcher, 1971

Remarks : In the present preparation, size of the spores is larger (15—42 × 10—32 μm) than that of the spores described by Sheffy and Dilcher (1971) from Puryear Clay Pit, Henry County, Tennessee.

Occurrence : Cores no 1, 2, 4 and 5.

Inapertisporites subovoideus : Sheffy and Dilcher, 1971

Occurrence : Core no 2.

Inapertisporites scabridus Sheffy and Dilcher, 1971

Remarks : Sheffy and Dilcher (1971) instituted *I. scabridus* for spherical, pitted fungal spores having a small spherical projection. In the present preparation similar spores without spherical projection have also been recorded.

Occurrence : Core no. 2.

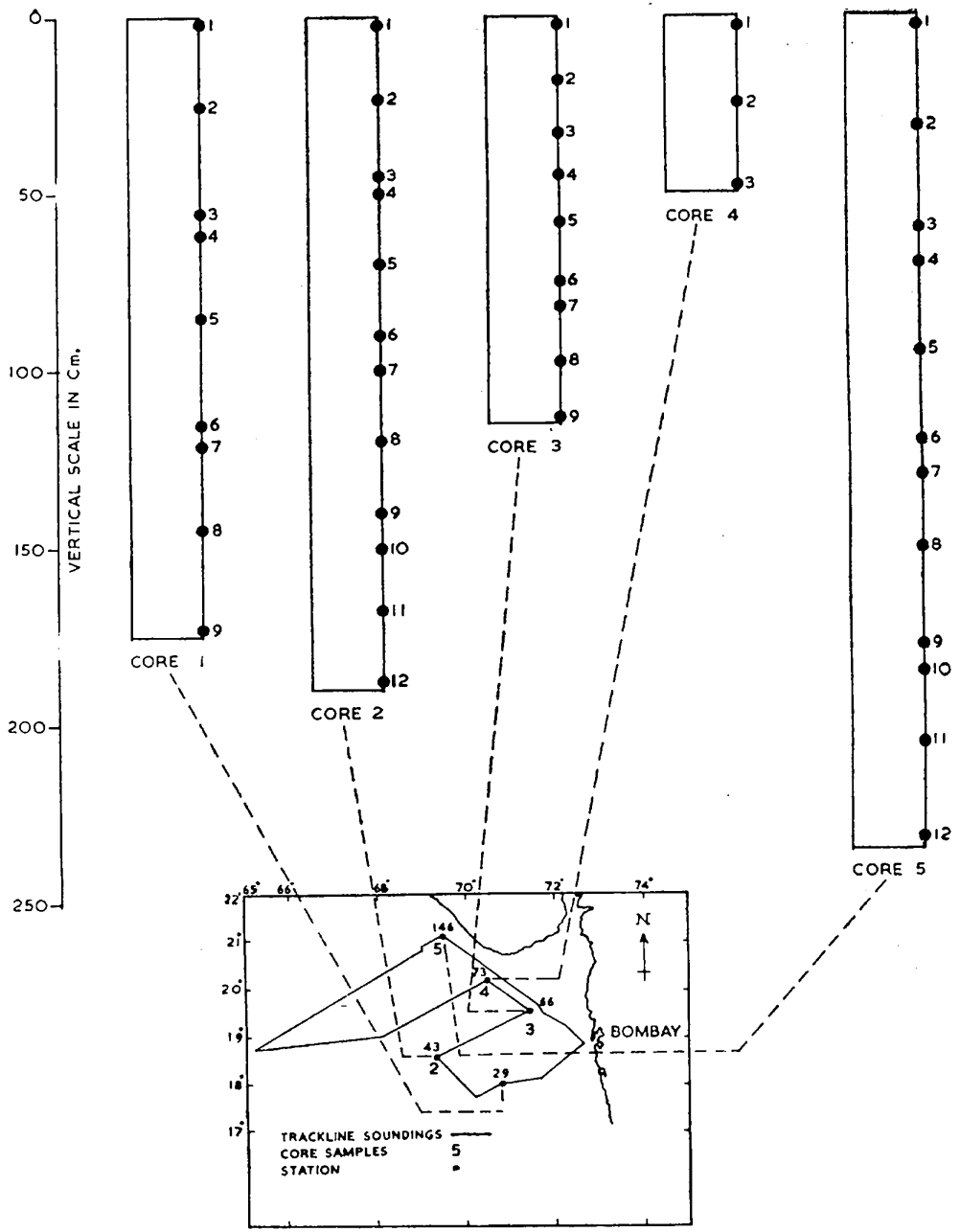

Fig. 1 Map showing the stations from where the sediment cores were collected in the Arabian sea (Setty, 1972a), including the length of the cores.

Inapertisporites ellipticus : sp. nov.

Pl. II, fig. 1

Holotype : Pl. II, fig. 1, size 55 × 28 μm : Slide no. BSIP 6298/5.

Type Locality : Arabian Sea, 17°57·9' : 70°46·0', Core no. 1.

Diagnosis : Oval-elliptical fungal spores, size range 27-127 × 17-98 μm, unicellate, inaperturate; spore wall psilate, upto 1·5 μm thick, irregularly folded.

Comparison : The present species is closely comparable with *I. kedvesii* Elsik (1968) in having folded spore wall but can be distinguished by its oval-elliptical shape. *I. maximus* Singh and Saxena (1981) can be differentiated by larger size range. From other species of *Inapertisporites*, the present species differs by its species folded spore wall.

Occurrence : Core no. 1, 2, 3, 4 and 5.

Inapertisporites cephalu sp. nov.

Pl. II, fig. 2

Holotype : Pl. II, fig. 2, size 25 μm; Slide no. BSIP 6296/4.

Type Locality : Arabian Sea, 17°57·9' : 70°46·0', Core no. 1

Diagnosis: Spherical to oval fungal spores; size range 24-57 × 23-55 μm; unicellate, inaperturate; spore wall upto 1·0 μm; thick, psilate, ± intrapunctate, pigment light.

Comparison : The present species can be differentiated from *I. kedvesii* Elsik (1968) and *I. elliptcus* sp. nov. in having an unfolded spore wall. *I. vulgaris* Sheffy and Dilcher (1971) is smaller in size. Other species of *Inapertisporites* can be distinguished by having different shape, size or spore wall ornamentation.

Occurrence : Cores no. 1, 2, 4 and 5.

Inapertisporites punctatus : sp. nov. Pl. II fig. 3

Holotype : Pl. II, fig. 3, size 45 × 30 μm; Slide no. BSIP 6297/3.

Type Locality : Arabian Sea, 19°32.8':71° 21·5', Core no.3.

Diagnosis: Subspherical to oval fungal spores; size range 21-90 × 21 – 76 μm; unicellate, inaperturate; spore wall 0·5μm thick, punctate, puncta fine, closely placed and uniformly distributed all over the spore wall, irregularly folded.

Comparison : The present species resembles *I. kedvesii* Elsik (1968) and *I. ellipticus* sp. nov. in having folded spore wall but differs in being punctate.

Occurrence : Cores no. 1, 2, 3 and 5.

Inapertisporitesdilcheri sp. nov.

Pl. II, fig. 4

Holotype : Pl. II, fig. 4, size 55 × 18μm; Slide no. BSIP 6303/7.

Type Locality : Arabian Sea, 17°57·9' : 70°46·0' Core no. 1.

Diagnosis : Biconvex, lanceolate fungal spores with both apices pointed, size range 33—55 × 17—22 μm; unicellate, inaperturate, spore wall 0·5 μm thick, psilate.

Comparison : The present species is comparable with *I. reticulatus* Sheffy and Dilcher (1971) in having almost similar shape and size. However, latter is easily distinguishable by its reticulate spore wall. *I. ellipticus* sp. nov. differs by having folded spore wall. From the other species of *Inapertisporites*, *I. dilcheri* can be differentiated by its characteristic biconvex shape.

Occurrence : Cores no. 1, 2, 3 and 5.

Derivation of name : The present species is named is honour of Dr. D. L. Dilcher of the Department of Botany, Indiana University, Bloomington, Indiana.

Inapertisporites quadrangularis sp. nov.

Pl. II, fig. 5

Holotype : Pl. II fig. 5, size 10 μm; Slide no. BSIP 6336/11.

Type Locality : Arabian Sea, 20°10·0' : 70°26·9,' Core no. 4.

Diagnosis : Quadrangular fungal spores size 10 μm, unicellate, inaperturate; spore wall psilate, pigment medium to light.

Comparison : The present species can easily be differentiated from other species of *Inapertisporites* by its quadrangular shape.

Occurrence : Core no. 4

Inapertisporites hammenii sp. nov.

Pl. II, figs. 6, 7

Holotype : Pl, II, fig. 6, size 13 × 9 μm; Slide no BSIP 6337/11

Type Locality : Arabian Sea, 20°10·0' : 70°26·9', Core no. 4.

Diagnosis : Oval fungal spores; size range 13-18 × 9-16 μm; unicellate, inaperturate, spore wall about 1 μm thick, ornamented with very fine reticulum.

Comparison : The present species closely resembles *I. reticulatus* Sheffy and Dilcher (1971) in having a reticulate spore wall but can be distinguished by its oval shape and smaller size while the latter is oblong and larger in size (48·4 × 12·6 μm). From other species of *Inapertisporites* it can be differentiated by its reticulate spore wall.

Occurrence : Core no. 4.

Derivation of name : This species is named after T. van der Hammen, who has made commendable contribution to the Tertiary Palynology.

Inapertisporites granulosus : sp. nov.

Pl. II, fig. 8

Holotype : Pl. II, fig. 8, size 38 × 22μm; Slide no. BSIP 6338/3.

Type Locality : Arabian Sea, 20°04·5' : 69°26·0' Core no. 5.

Diagnosis : Oval fungal spores; size range 20-39 × 14-29 μm; unicellate, inaperturate; spore wall upto 1 μm thick, occasionally slightcy folded, granulose, grana prominent, 1 μm in size, sometimes larger importing a verrucose appearance, uniformly distributed.

Comparison : The present species is comparable with *I. typicus* and *I. minutus* both described by van der Hammen (1954), in spore wall sculpture but is easily differentiated by its larger size and oval shape. From other species of *Inapertisporites* the present species differs in having a granulose spore wall.

Occurrence : Core no. 5.

Inapertisporites sp. cf. *I. nodulus* Sheffy and Dilcher, 1971

Pl_1. II, Fig. 9.

Description : Circular fungal spore with ± wavy margin and a small, about 2 μm long protuberance, main body of the spore 6·5 μm in diameter (excluding protuberance) unicellate, inaperturate; spore wall psilate, pigment solid, dark.

Comparison : The present species closely resembles *I. nodulus* Sheffy and Dilcher (1971) in having a projection attached to the main body of spore. However, it can be differentiated by its wavy outline, smaller size and comparatively large and dark pigmented projection. *I. scabridus* Sheffy and Dilcher (1971) is also comparable to the present species in having a projection but is distinguished by its coarsely pitted spore wall. Other species of *Inapertisporites* do not possess any

Occurrence : Core no. 4.

Inapertisporites sp.

Pl. II, fig. 10

Description : Triangularly oval fungal spore with two protuberances, main body of the spore 28 × 19 μm in size, outgrowths each 5μm long and 2·5 μm wide; unicellate, inaperturate, spore wall 1·5 μm thick, psilate.

Comparison : The present species can be differentiated from *Inapertisporites* sp. cf. *I. nodulus* Sheffy and Dilcher (1971) described above in having two outgrowths and smooth outline. *I. nodulus. I. irregularis* and *I. scabridus* Sheffy and Dilcher (1971) differ in having only one projection and smaller size. Other species of *Inapertisporites* do not bear any protuberance.

Occurrence : Core no. 1.

Genus *Dicellaesparites* Elsik, 1968 emend. Sheffy and Dilcher, 1971

Dicellaesporites sp. 1

Pl. II, fig. 11

Description : Fusiform fungal spore; size 85 × 60 μm; dicellate, two cells of the spore dissimilar in shape and size, apex of one cell is angular while that of the other rounded; uniseptate, septa clearly discernible but not very thick; no aperture traceable; spore wall 1 μm twick, psilate to weakly structured.

Comparison : The present species can be differentiated from *D. popovii* Elsik (1968) and *D. levis, D. aculeolatus, D. fusiformis, D. disphaericus* and *D. fragilis* all described by Sheffy and Dilcher (1971) by its larger size range. *D. granuliformis* Sheffy and Dilcher (1971) differs by having granulose spore wall while *D. appendiculatus* Sheffy and Dilcher (1971) has a flat basal attachment.

Occurrence : Core no. 1.

Dicellaesporites sp. 2

Pl. II. fig. 12

Description : Capsular fungal spore, slightly constricted in the middle; size 17 × 9 μm, dicellate, both cells almost equal in size and shape; uniseptate, septa biconvex thicker than spore wall; inaperturate; spore wall about 1·0 μm thick, psilate, pigment medium.

Comparison : The present species differs from *D. popovii* Elsik (1968) by its smaller size. *D. levis* Sheffy and Dilcher (1971) differs by having two unequal cells. *D. aculeolatus* and *D. fusiformis* both described by Sheffy and Dilcher (1971) are different from the present species in their shape. *D. granuliformis* and *D. fragilis* both described by Sheffy and Dilcher (1971), have granulose and scabrate spore walls respectively. *D. appendiculatus* Sheffy and Dilcher (1971) has a flat basal attachment and thus easily distinguishable. *D. sminutus* Kar and Saxena (1976) in larger in size.

Occurrence : Core no.

Possible affinity : *Cladosporium* sp.

Genus *Multicellaespgrites* Elsik, 1968 emend. Sheffy and Dilcher, 1971

Multicellaesporites didymus Sheffy and Dilcher, 1971.

Remarks : The spore wall in the specimens described by Sheffy and Dilcher (1971) is 0·5 μm thick while in the present material it is *ca.* 1·5 μm thick

Occurrence : Core no. 5.

Possible affinity : *Sarcinella* sp.

Multicellaesporites karii sp. nov.

Pl. II, fig. 13

Holotype : Pl. II, fig. 13, size 18 × 17 μm Slide No. BSIP 6316/9.

Type Locality : Arabian Sea, 18°35·2 : 69°17·2', Core no. 2.

Diagnosis : Spindle shaped fungal spore size 18 × 17 μm; tricellate, middle cell much larger than the terminal ones; inaperturate, biseptate, septa slightly thicker than the spore wall; spore wall about 1·0 μm thick, psilate, pigment light.

Comparison : *M. nortonii* Elsik (1968), the type species of the genus, differs from the present species in having 5 cells, larger size and fusiform shape. *M. irregularis*, *M. ovatus*. *M. pandus*, *M. elongatus*. *M. attenuatus*, *M. ellipticus*, *M. fusiformis*, *M. didymus*, *M. sacciformis* and *M. bigeminatus* all described by Sheffy and Dilcher (1971) differ from the present species in having four or more cells. *M. simplicissimus* and *M. capsularis* both described by Sheffy and Dilcher (1971) resemble *M. karii* sp. nov. in being tricellate. However, the present species can readily be distinguished from them by its spindle shaped structure.

Occurrence : Core no. 2.

Derivation of name : The species is named after Dr. R. C. Kar of the Birbal Sahni Institute of Palaeobotany, Lucknow.

Multicellaesporites confusus sp. nov.

Pl. II, fig. 14

Holotype : Pl. II, fig. 14, size 88 × 15 μm; Slide no. BSIP 6332/5.

Type Locality : Arabian Sea, 20°10.0' : 70°26·9', Core no. 4.

Diagnosis : Ribbon-shaped fungal spore, size 88 × 15 μm, multicellate, number of cells nine, all cells ± equal in shape and size, individual cell squarish-elongated in shape; inaperturate, 8 septa present, septa upto 2 μm thick, sometimes incomplete or broken; spore wall less than 1·0 μm thick, psilate.

Comparison : The present species differs from *M. nortonii* Elsik (1968) and *M. simplicissimus*,, *M. fusiformis*. *M. ovatus*, *M. pandus*, *M. capsularis*, *M. ellipticus*, *M grandiusculus*, *M. allomorphus* and *M. sacciformis* etc. described by Sheffy and Dilcher (1971) by having more number (9) of cells.

Occurrence : Core no. 4.

Multicellaesporites tricellatus sp. nov.

Pl. II, fig. 15

Holotype : Pl. II, fig. 15, size 21 × 6 μm; Slide no. BSIP 6347/1.

Type Locality : Arabian Sea, 20°04.5' : Arabian Sea, 20°04.5' : 69°26·0', Core no. 5.

Diagnosis : Elongated rod-shaped fungal spore; size 21 × 6 μm, tricellate, two cells slightly larger than the third one, inaperturate, biseptate, septa thicker than spore wall; spore wall less than 1·0 μm thick, psilate.

Comparison : The present species is comparable to *M. simplicissimus* and *M. capsularis* both described by Sheffy and Dilcher (1971) in being tricellate and having psilate spore wall. However, the latter ones can be differentiated by their much thicker septa. *M. karii* sp. nov. is also tricellate but differs by its spindle shaped structure. *M. nortonii* Elsik (1968), *M. irregularis*, *M. ovatus*, *M. pandus*, *M. elongatus*, *M. attenuatus*, *M. ellipticus*, *M. fusiformis*, *M. grandiusculus*, *M. allomorphus*, *M. didymus*, *M. sacciformis* and *M. bigeminatus*, all proposed by Sheffy and Dilcher (1971) and *M. elsikii* Kar and Saxena (1976) differ from the present species by having more than three cells.

Occurrence : Core no. 5

Multicellaesporites sp.

Pl. II, fig. 16

Description : Elliptical fungal spore; size 28 × 10 μm; tetracellate, triseptate, inaperturate; spore wall about 1 μm thick, psilate

Remarks : The present specimen is closely comparable to *M. ellipticus* Sheffy and Dilcher (1971) in having four cells and elliptical shape but differs in being slightly larger in size.

Occurrence : Core no. 1.

Possible Affinity : Curvularia sp.

Genus—*Staphlosporonites* **Sheffy and Dilcher, *Staphlosporonites subcircularis* sp. nov. Pl. II, fig. 17, 18.**

Holotype : Pl. II, fig. 17, size 15×13 μm; Slide no. BSIP 6314/2.

Type locality : Arabian Sea, 18°35·2':69° 17·2', Core no. 2.

Diagnosis : Subcircular to oval fungal spores having eight or more, polygonal, irregularly arranged cells; size range 15-42 ×13-30μm; inaperturate; septa thicker than spore wall; spore wall 1·0 μm thick; psilate, pigment medium to dark.

Comparison : S. conoideus Sheffy and Dilcher (1971) compares with the present spcies in number of cells but the cells are arranged in a conical body. In *S. tristratosus* Sheffty and Dilcher (1971) the cells are arranged in three layers in an ovate structure. In *S. ovalis* Sheffy and Dilcher (1971) the cell are arranged in to two rows. *S. allomorphus* Sheffy and Dilcher (1971) is oblong in shape. The present species is distinct by its subcircular to oval shape and irregularly arranged cells.

Occurrence : Core no. 2.

Staphlosporonites sp.

Pl. II, fig. 19

Description : Quadrangular fungal spores; size range 18-21 μm; tetracellate, individual cells ± triangular in shape, all cells almost equal in size and not arranged in a single row or along one axis; inaperturate, tetraseptate, septa slightly thicker than spore wall; spore wall 3 μm thick; psilate, pigment dark to medium.

Comparison : The present specimen differs from *S. conoideus, S. tristratosus, S. ovalis* and *S. allomorphus*, all described by Sheffy and Dilcher (1971) and from *S. subcircularis* sp. nov. by being tetracellate.

Occurrence : Core no. 2

Genus — *Polycellaesporonites* **gen. nov.**

Type species : Polycellaesporonites bellus gen. et sp. nov.

Generic diognosis : Capsular fungal spores, one end of the spore is rounded while other one gives rise to a tube-like projection, multicellate, inaperturate, cells arranged in clusters and not in a row or along a single axis, spore wall laevigate.

Comparison : Polycellaesporonites is closely comparable to *Multicellaesporites* Elsik (1968) emend. Sheffy and Dilcher (1971) in being multicellate and inaperturate but can be differentiated from the latter by its cells arranged in more than one row *Staphlosporonites* Sheffy and Dilcher (1971) resembles the present genus in being multicellate, inaperturate and the arrangement of the cells in more than one row but lacks a tube like projection emerging form one end of the spore. *Pluricellaesporites* van der Hammen (1954) emend. Sheffy and Dilcher (1971) is also multicellate but is provided with an apical aperture. *Diporicellaesporites* Elsik (1968) differs by having apertures on both the apices.

Polycellaesporonites bellus sp. nov.

Pl. II, figs. 20, 21, Text-fig, 2

Holotype : Pl. II, fig. 20, size 45 × 15 μm; Slide no. BSIP 6302/2.

Type Locality : Arabian Sea, 17°.7.9' : 70°46·0, core no. 1

Diagnosis : Fungal spore with a capsular body and a tube-shaped unicellular appendage emerging from one end; size range 45-68 × 13-15 μm: main body of spore 33-48 × 13-15 μm; tube-like pojection hyaline, 12-20 μm long, multicellate individual cell rectangular, not arranged along one axis; inaperturate; spore wall 1-1·5 μm thick, posilate.

Fig. 2 *Polycellaesporonites bellus*, gen. et sp. nov. × 1500.

Occurence : Core no. 1

Possible affinity : Alternaria sp.

Genus—*Monoporisporites* van der Hammen, 1954 emend. Sheffy and Dilcher 1971.

***Monoporisporites singularis* Sheffy and Dilcner, 1971**

Occurrence : Core no. 4

Monoporisporites psilatus sp. nov.

Pl. II, fig. 22

Holotype : Pl. II, fig. 22 size 62 × 55 μm; Slide no. BSIP 6303/9

Type Locality : Arabian Sea, 17°57·9 : 70° 46·0', Core no. 1

Diagnosis : Spherical fungal spore, size 62 × 55 μm; unicellate, nonseptate, monoporate, pore circular, 4·5 μm in diameter, by a surrounded prominent thickening, darker than the rest of the body; spore wall 2 μm thick psilate.

Comparison : The present species can be distinguished from *M. burgli* van der Hammen (1954) and *M. glubosus* Clarke (1965) as both the species are punctuate. *M. annulatus* van der Hammen (1954). *M. stoverii* Elsik (1968), *M. koenigii* Elsik (1968) and *M. singularis* Sheffy and Dilcher (1971) differ in being much smaller in size.

Occurrence : Core no. 1

Monoporisporites novus sp. nov.

Pl. II, figs. 23, 24

Holotype : Pl. II, fig. 23, size 17 μm; Slide no. BSIP 6337°/6

Type Locality : Arabian Sea, 20°10·0' : 70°26·9', Core no. 4.

Diagnosis : Spherical to oval fungal spores; size range 10-19 μm, unicellate, nonseptate; monoporate, pore small, ca. 0·5 – 1·5 μm in diameter, circular, without any distinct annulus; spore wall upto 1·0 μm thick, psilate, single layered, pigment medium to dark, area around the pore darker than rest of the spore.

Comparison : The present species differs from *M. annulatus* van der Hammen (1954) and *M. singularis* Sheffy and Dilcher (1971) by not possessing an annulus. *M. psilatus* sp. nov. differs in being larger in size.

M. stoverii Elsik (1968) differs by having bulged pore. *M. koenigii* and *M. smithii* both described by Elsik (1968) are larger in size. Other species of this genus differ either in shape or in size.

Occurrence : Cores no. 2, 3, 4 and 5.

Monoporisporites sheffvi sp. nov.

Pl. II, fig. 25

Holotype : Pl. II, fig. 25, size 15 μm; Slide no. BSIP 6342/1.

Type Locality : Arabian Sea, 20°04·5'; 69°26·0', core no. 5.

Diagnosis : Spherical-subspherical fungal spores; unicellate, monoporate, size range 15-17 × 13-15 μm, pore *ca.* 3 μm, wide; spore wall 2-layered, 1·5 μm thick, psilate.

Comparison : The present species is comparable with *M. novus* sp. nov. in shape and size but can be differentiated by its 2-layered spore wall. *M. stoverii* Elsik (1968) differs by having single-layered spore wall. *M. smithii* Elsik (1968) in much larger in size while *M. koenigii* Elsik (1968) has 3-layered spore wall.

Occurrence : Core no. 5.

Derivation of name : The present species has been named in honour of Dr. M. V. Sheffy of the Department of Botany, Indiana University, Bloomington, Indiana.

Monoporisporites sp.

Pl. II, fig. 26

Description : Spherical fungal spore, size 17 μm; unicellate nonseptate; monoporate, pora *ca.* 1·0 μm in diameter. rimmed by distinct thickening; spore wall 3·0 μm thick, psilate.

Comparison : The specimen resembles *M. psilatus* sp. nov. in shape and size but can be distinguished by its thicker spore wall and smaller size.

Occurrence : Core no. 2.

Genus—*Lacrimasporonties* Clarke 1965, emend. Elsik, 1968

Lacrimasporonites levis **Clarke, 1965**

Pl. 1, fig., 27

Occurrence : Cores no. 1 and 5.

Lacrimasporonites bellus sp. nov.

Pl. II, fig. 28

Holotype : Pl. II, fig. 28, size 70 × 42 μm; Slide no. BSIP 6300/5.

Type Locality : Arabian Sea, 17°57·0' : 70°46·0' Core no. 1.

Diagnosis : Oval fungal spore, size 70 × 42 μm; unicellate, nonseptate, monoporate, pore apical; spore wall upto 1 μm thick, psilate, irregularly folded.

Comparison : The present species can be distinguished from the other species of *Lacrimasporonites* by its larger size and folded spore wall.

Occurrence : Core no. 1.

Lacrimasporonites ovaliformis sp. nov.

Pl. II, fig. 29

Holotype : Pl. II, fig. 29, size 55×41 μm Slide no. BSIP 6306/2.

Type Locality : Arabian Sea, 17°57·9' : 70°46·0', Core no. 1.

Diagnosis : Subspherical to oval fungal spores; size range 42-55×32-41 μm; unicellate, nonseptate; monoporate, pore apical, 6-13 μm in diameter, pore margin faintly thickened; spore wall 0·5 μm thick, psilate to±intrapuntate.

Comparison : *L. basidii* Elsik (1968) resembles the present species in shape and general organisation but differs in being smaller in size and having very minute

pore. *L. levis* Clarke (1965), *L. westii* Elsik (1968), *L. stoughii* Elsik (1968) and *L. singularis* Sheffy and Dilcher (1971) differ from the present species by their smaller size range and smaller pore.

Occurrence : Cores no. 1 and 5.

Genus—*Basidiosporites* **Elsik 1968**

Basidiosporites sadasivanii sp. nov.

Pl. II. fig. 30.

Holotype : Pl. II, fig. 30, size 43 × 21 μm Slide no. BSIP 6302/6.

Type Locality : Arabian Sea, 17°57·9′ : 70°46·0′, Core no. 1.

Diagnosis : Biconvex, lanceolate or oval-elliptical fungal spores, size range 33—43 × 20—21 μm; unicellate, nonseptate: monoporate, pore offset from apex being situated in the centre of the longer axis, circular, 1—3 μm in diameter, pore margin slightly thickened, spore wall 0·5 μm thick, psilate.

Comparison : The present species can be differentiated from *R. fournierii* Elsik 1968 by its larger size, placement of pore in the middle of the longer axis and thickened pore margin.

Occurrence : Cores no. 1 and 5.

Derivation of name : The specific name is in honour of Prof. T. S. Sadasivan,, formerly Head of the Botany Department, Madras University, Madras.

Genus—*Didymoporisporonites* **Sheffy and Dilcher, 1971.**

Pluricellaesporites annulatus sp. nov.

Pl. II, fig. 33

Holotype : Pl. II, fig. 31, size 35 × 15 μm Slide no. BSIP 6297/9.

Type Locality : Arabian Sea, 17°57·9′ : 70°46.0′. Core no. 1.

Diagnosis : Spindle-shaped fungal spore, size 35×15 μm; dicellate, both cells almost equal in size, uniseptate; monoporate, pore on the apex of one cell, pore margin not thickened wall, 0·5μm thick, punctate.

Comparison : D. normalis Sheffy and Dilcher (1971) resembles the present species in shape but can be differentiated by its smaller size and psilate spore wall. *D. obtectus* Sheffy and Dilcher (1971) is heavily punctate and smaller in size. *D. psilatus* and *D. inaequalis* both proposed by Sheffy and Dilcher (1971) differ from the present species in having unequal cells, psilate spore wall and smaller size.

Occurrence : Core no. 1.

Didymoporisporonites siddiquiei sp. nov.

Pl. II, fig. 32

Holotype : Pl. II. fig. 32, size 38 × 26 μm: Slide no. BSIP 6312/9.

Type locality : Arabian Sea , 18°35.2′–69° 17.2′, Core no. 2.

Diagnosis : Oval fungal spores, size 38 × 21 μm, dicellate, closed apex of the spore rounded while the other one conical; uniseptate, septa faint but complete, about 1 μm thick, monoporate, pore margin not thickened, spore wall very thin, hyaline, psilate, finely folded.

Comparison : The present species can be differentiated from *D. inaequalis* and *D. psilatus* both proposed by Sheffy and Dilcher (971) in having two cells almost similar in size while in latter species the cells are unequal. *D. indicus* sp. nov. differs by its punctate spore wall. *D. normalis* and *D. obtectus* both described by Sheffy and Dilcher (1971) have a thick prominent septum in comparison to the faint and thin septum of the present species.

Occurrence : Core no. 2.

Derivation of name : The present species has been named in honour of Mr. H. N. Siddiquie of the National Institute of Oceanography, Panji, Goa.

Genus—*Pluricellaesporites* van der Hammen, 1954 emend. Sheffy and Dilcher, 1971

Pluricellaesporites annulatus sp. nov.

Pl. II, fig. 33

Holotype : Pl. II, fig. 33, size 49×20 μm; Slide no. BSIP 6314/18.

Type Locality : Arabian Sea, 17°5/·9′ : 70°46·0′ , Core no. 1.

Diagnosis : Elongated fungal spores; size 49×20μm hexacellate, cells elongated rectangular, 5 septa, monoporate, pore surrounded by thick annulus, spore wall less than 0·5 μm thick, psilate.

Comparison : The present species can be differentiated from *P. typicus, P. minutigranulatus, P. filiformis, P. krauseli* and *P. erdtmani* all pro posed by van der Hammen (1954) by having 6 cells and thick annulus. *P. melanii* Elsik (1968) differs by having bladder like basal cell. *P. simplicissimus, P. subcapsularis, P. longicollus* and *P. minusculus* all described by Sheffy and Dilcher (1971) are tricellate. *P. suboblongatus* Sheffy and Dilcher (1971) is tetracellate while *P. ovatus* and *P. serratus* both proposed by Sheffy and Dilcher (1971) are pentacellate. *P. tenuis* Sheffy and Dilcher (1971) resembles the present species in being hexacellate but latter is conspicuous by it thick annulus and wider cells.

Occurrence : Core no 1, 2 and 5.

Possible Affinity : Curvularia sp.

Pluricellaesporites misrae sp. nov.

Pl. II, figs. 34, 35

Holotype : Pl. II, fig. 34, size 23×13 μm; Slide no. BSIP 6336/7.

Type Locality : Arabian Sea, 20°10.0′ : 70°26·9' Core no. 4.

Diagnosis : Oval fungal spores, si ze range 15—23×10—13μm; tetracellate, terminal cells smaller than those in centre; triseptate, septa 1·5—2·5 μm thick, thicker in centre; monoaperturate, pore apical 3—5 μm in diameter; spore wall 0·5 μm thick, psilate.

Comparison : *P. melanii* Elsik (1968) differs from the present species by having large (30μm) basal chamber. *P. simplicissimus, P. subcapsularis, P. longicollus, P. minusculus,* all described by Sheffy and Dilcher (1971) can be distinguished from the present species by being tricellate. *P. ovatus* and *P. serratus* both described by Sheffy and Dilcher (1971) are separable by being pentacellate, *P. tenuis* Sheffy and Dilcher (1971) is hexacellate; while *P. suboblongatus* sheffy and Dilcher (1971) has a basal attachment.

Occurrence : Core no. 4.

Possible affinity : Curvularia sp.

Derivation of name : We feel pleasure in naming the present species in honour of Prof. R. C. Misra, F. N. A. formerly Head of the Geology Department, Lucknow University, Lucknow.

Genus — *Diporisporites* van der Hammen, 1954 emend Elsik, 1968

Diporisporites major sp. nov.

Pl. II, fig. 36

Holotype : Pl. II, fig. 36. size 62×25 μm; Slide no. BSIP 6298/2.

Type Locality : Arbian Sea 17°57·9' : 70°46·0' Core no. 1.

Diagnosis : Tube–shaped fungal spore; size 62×25 μm; unicellate, nonseptate; diporate, pores on both ends, circular, 7 μm in diameter, pore margin not thickened; spore wall about 1 μm thick leavigate.

Comparison : *D. major* sp. nov. can be differentiated from all the known species of


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PLATE—II

1. *Inapertisporites ellipticus* sp. nov., slide no.—6298/5 (Holotype) × 500.
2. *Inapertisporites cephalus* sp. nov., slide no. —6296/4 ((Holotype).
3. *Inapertisporites punctatus* sp. nov., slide no.—6297/3 (Holotype).
4. *Inapertisporites dilcheri* sp. nov., slide no.—6303/7 (Holotype).
5. *Inapertisporites quadraugularis* sp. nov., slide no.—6336/11 (Holotype).

6,7. *Inapertisporites hammenii* sp. nov., slides no.—6337/11 (Holotype). 6337/15.

8. *Inapertisporites granulosus* sp. nov., slide no.—6338/3 (Holotype) × 500.
9. *Inapertisporites* sp. cf. *I. nodulus* Sheffy and Dilcher, 1971 slide no.—6337/1.
10. *Inapertisporites* sp., slide no.—6304/11.
11. *Dicellaesporites* sp. 1. slide no.—6306/6 × 500.
12. *Dicellaesporites* sp. 2. slide no.—6343/2.
13. *Multicellaesporites karii* sp. nov. slide no.—6316/9 (Holotype).
14. *Multicellaesporites confusus* sp. nov., slide no.—6332/5 (Holotype) × 500.
15. *Multicellaesporites tricellatus* sp. nov., slide no.—6347/1. (Holotype).
16. *Multicellaesporites* sp., slide no.—6299/1.

17, 18. *Staphlosporonites subcircularis* sp. nov., slides no—6314/2 (Holotype), 6314/1.

19. *Staphlosporonites* sp. slide no.—6316/13.

20, 21. *Polycellaesporonites bellus* gen. et sp. nov., slides no.—6302/2 (Holotype) × 500. 6307/5 × 500.

22. *Monoporisporites psilatus* sp. nov., slide no.—6309/9 (Holotype) × 500.

23,24. *Monoporisporites novus* sp. nov., slides no.—6337/6 (Holotype), 6315/7.

25. *Monoporisporites sheffy* sp. nov., slide no.—6342/1 (Holotype).
26. *Monoporisporites* sp., slide no. 6317/4.
27. *Lacrimasporonites levis* Clarke, 1965, slide no.—6345/7.
28. *Lacrimasporonites bellus* sp. nov., slide no.—6300/5 (Holotype). × 500.
29. *Lacrimasporonites ovaliformis* sp. nov., slide no.—6306/2 (Holotype) × 4500.
30. *Basidiosporites sadasivanii* sp. nov., slide no.—6302/6 (Holotype) × 500.
31. *Didymoporisporonites indicus* sp nov., slide no.—6297/9 (Holotype).
32. *Didymoporisporonites siddiquiei* sp. nov., slide no.—6312/9 (Holotype).
33. *Pluricellaesporites annulatus* sp. nov., slide no.—6314/18. (Holotype). × 500.

34, 35. *Pluricellaesporites misrae* sp. nov., slides no.—6336/7 (Holotype), 6331/1.

36. *Diporisporites major* sp. nov., slide no.—6298/2 (Holotype)l × 500.

37, 38 . *Diporisporites fusiformis* sp. nov., slides no.—6296/2, 6307/2 (Holotype).

39. *Diporicellaesporites prakashii* sp. nov., slide n.o—6296/11 (Holotype).

Diporisporites by its tube–shaped structure and a wide aperture.

Occurrence : Core no. 1.

Diporisporites fusiformis sp. nov.

Pl. II, figs 37, 38

Holotype : Pl. II fig. 38. size 35 × 18 μm; Slide no. BSIP 6307/2.

Type locality : Arabian Sea, 17°57·9' : 70° 46·0', Core no. 1.

Diagnosis : Fusiform – elliptical fungal spores, size range 35-70 × 16-18 μm; unicellate; non-septate; diporate, pores on both apices of spore, 4-6 μm in diameter, pore margin not thickened; spore wall 0·5-1·0 μm thick, psilate, sometimes dark – pigmented, occasionally slightly folded.

Comparison : The present species resembles *D. elongatus*, *D. minutiporatus* and *D. minutus* proposed by van der Hammen (1954) and *D. hammenii* Elsik (1968) in shape and psilate spore wall but can be differentiated by its much larger size. *D. ankleshwarensis* (Varma and Rawat, 1963) Elsik (1968) has foveolate spore wall.

Occurrence : Core no. 1.

Possible affinity : Mitteriella sp.

Genus—*Diporicellaesporites* Elsik, 1968

Diporicellaesporites prakashii **sp. nov.**
Pl. II, fig. 39

Holotype : Pl. II, fig. 39, size 62 × 10 μm; side no. BSIP 6296/11.

Type locality : Arabian Sea, 17°57·9' : 70°46·0', Core no. 1.

Diagnosis : Elongated fungal spore; size 62 × 10 μm; septacellate, middle cells larger than the terminal ones; 6-septate; diporate, one pore at each apex of the spore; spore wall 1 μm thick, psilate, pigment medium to dark.

Comparison : This species differs from *D. stacyi* Elsik (1968) and *D. puryearensis* and *D. tetralocularis* proposed by Sheffy and Dilcher (1971), as all these species are smaller in size and tetracellate. *D. acuminatus* Sheffy and Dilcher (1971) is tricellate. *D. pluricellus* Kar and Saxena (1976) is comparable with the present species in shape and number of cells but can be distinguished by larger size range (67-94 × 19-38 μm).

Occurrence : Cores no. 1 and 4.

Derivation of name : The present species has been named in honour of Dr. Uttam Prakash, of the Birbal Sahni Institute of Palaeobotany, Lucknow.

DISCUSSION

An analysis of the fungal spore assemblages recovered from Cores 1 to 5 reveals that they consist of 12 genera and 42 species. The new genus is *Polycellaesporonites*. It has been observed that the occurrence of various fungal spore species is not consistent in all the cores. Assemblage from Core no. 1 (slope) which is 1·75 m thick and at a water depth of 649 m. consists of 11 genera and 22 species. Core no. 2 (basin) 1·90 m thick and at a water depth of 2960 m., includes 6 genera and 17 species. Core no. 3 (shelf) is poor in fungal spores containing only 2 genera and 8 species. This core is 1·15 m thick at a water depth of 64 m. Assemblage from Core no. 4 (shelf), which is only 0·50 m thick and at a water depth of 73 m, consists of 5 genera and 15 species. From Core no. 5 (shelf), which is 2·35 m thick and at a water depth of 63 m, 7 genera and 18 species have been recovered. The core-wise distribution of the various species is given in Table-II and generic occurrence in each sample is given in Table-III.

The genus *Inapertisporites* is the dominant element of the assemblage, both in number and variety. This genus is represented by 16 species and has been recovered from all 45 samples studied (Table-III). Next to this come *Multicellaesporites* (5 spp.) and *Monoporisporites* (5 spp.). The former is represented in Cores no. 1, 2, 4 and 5 while the latter occurs in all the sediment cores Other fungal spore genera, which are common but present only in a few samples are (in order of their relative abundance): *Pluricellaesporites* (2 spp.), *Lacrimasporonites* (3 spp.), *Dicellaesporites* (2 spp) and *Staphlosoronites* (2 spp.), whereas *Polycellaesporonites* (1 sp.), *Basidiosporites* (1 sp.), *Didymoporisporonites* (2 spp.), *Diporisporites* (2 spp.) and *Diporicellaesporites* (1 sp.) are sporadically present.

Limited efforts have so for been made to study fungal spores from the Indian Quaternary sediments (Rao and Menon, 1970, Gupta, 1970, Sharma, 1976, Prasad and Ramesh, 1983). Rao and Menon (1970) described many fungal spore types from the Quaternary bed of Pykara, Ootacamund, South India. Of these, the following types appear to be comparable with some of the present taxa; Types 2 and 3, cf. *Helminthosporium* (± = *Multicellasporites*), Type 4, of. *Curvularia* (± = *Multicellaesporites*), Type 5, cf. *Alternaria* (± = *Polycellaesporonites*, Type 11 (± = *Multicellaesporites*), Types 12, 13 and 14 (± = *Dicellaesporites*), Type 15 and 16 (± = *Inapertisporites*) and Type 17 (± = *Staphlosporonites*). However, many taxa of the present assemblage are unrepresented in the Pykara assemblage while reverse is the case with microthyriaceous thyriothecia, *Sclerospora Tetraploa*, *Aspergillus* etc.

Gupta (1970) published a short note on fungal remains from Pleistocene Bengal Peat exposed at Sankrail, Rajganj, Howrah. All the three genera reported by him viz. *Tetraploa*, *Anellophora* and *Entoplyctis* are absent from the present assemblage.

Sharma (1976) described six fungal spore taxa from Quaternary deposits of Malvan, District Surat, Gujarat. Of these, *Alternaria* (± = *Polycellaesporonites*), *Helminthosporium* and *Curvularia* (± = *Muticellaesporites*) appear to be represented in the present assemblage too. However a close comparison between the two is not possible as Malvan assemblages is much less diversified than the present one.

The present assemblage compares closely with the one reported recently by Prasad and Ramesh (1983) from the Holocene sequence of Khowai and Sonai Valleys in West Tripura district. This assemblage consists of 14 genera, of which 7 genera viz. *Inapertisporites*, *Dicellaesporites*, *Multicellaesporites*, *Monoporisporites*, *Pluricellaesporites*, *Diporisporites* and *Diporicellaesporites* also occur in the present assemblage. However, it would be too premature to draw any conclusion on such a broad comparison.

Setty (1972a, p 118) notices some similarities between Core no. 3 and part (0-65 cm) of Core no. 5 in their lithology and organic matter content. Similarly, part (174-235 cm) of Core no. 5 and entire Core no. 4 are similar in lithology and in number and variety of foraminifera and other kind of fossils. However, no such similarity could be observed as far as fungal spore assemblages are concerned. It is hoped that further study on microplankton and spore-pollen assemblages from these cores may provide some clue to the identical features of the different cores and may enable us to establish mutual relationship of these cores on palynological grounds.

REFERENCES

Clarke, R. T. 1965. Fungal spores from Vermejo Formation coal beds (Upper Cretaceous) of Central Colorado. *Mountain Geologist*, **2** : 85-93.

Elsik, W. C. 1968. Palynology of a Paleocene Rockdale lignite, Milam County, Texas. 1. Morphology and taxonomy. *Pollen Spores*, **10** (2) : 263-413.

Gupta, H. P. 1970. Fungal remains from Bengal Peat. *Curr. Sci.*, **39** (10) : 236-237.

Kar, R. K. & R. K. Saxena. 1976. Algal and fungal microfossils from Matanomadh Formation (Palaeocene), Kutch, India. *Palaeobotanist*, **23** (1) : 1-15.

Prasad. M. N. V. & N. R. Ramesh 1983. Fungal spores from the Holocene sediments of Tripura *Curr. Sci.*, **52** (6) : 254-256.

Rajagopalan, G., Vishnu-Mittre & B. Sekar. 1978. Birbal Sahni Institute radiocarbon measurements 1. *Radiocarbon*, **20** (3) : 398-404.

Rao, A. R. & V. K. Menon. 1970. Fungal remains and associated leaf cuticles from the Quaternary bed of Pykara, Ootacamund, South India. *J. Palynol.*, **5** (2) 9 74-84.

Rouse, G. E. 1959. Upper Jurassic plant microfossils. *Micropaleontology*, **5** (3) : 303-324.

Setty, M. G. A. P. 1972a. A description of sediment cores from the Arabian Sea. *24th Int. Geol. Congr.*, **8** : 109-119.

Setty, M. G. A. P. 1972b. Phosphate, carbonate and organic matter distribution in sediment cores of Bombay-Saurashtra Coast, India. *24th Int. Geol Congr.*, **8** : 182-191.

Sharma, C. 1976. Some fungal spores from Quaternary deposits of Malvan, Gujarat. *Palaeobotanist*, **23** (2) : 79-81.

Sheffy, M. V. & D. L. Dilcher. 1971. Morphology and taxonomy of fungal spores. *Palaeontographica*, **133** B (1–3) : 34-51.

Singh, H. P. & R. K. Saxena. 1981. Palynology of the Upper Siwalik sediments in Una district, Himachal Pradesh. *Geophytology*, **11** (2) : 173-181.

Van der Hammen, T. 1954. El dessarollo de la flora Colombiana en los periodos Geologicos 1. Maestrichtiano hastsa Terciario mass Inferior. *Boln. Geol. Bogota*, **2** (1) : 49-106.

Varma, C. P. & M. S. Rawat. 1963. A note on some diporate grains recovered from Tertiary horizons of India and their potential marker value. *Grana palynol.*, **4** (1) : 130-139.

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TABLE I

Table—1 Station location and other core data of the scientific Cruise of USC & GSS OCEANOGRAPHER Bombay—Bombay Leg. (Setty 1972a).

Core No.	Station Location — Serial No. as per Oceanographer	Latitude North	Longitude East	Depth (meters)	Core Length (centimeters)
1	29	17°57.9′	70°46.0	649	175
2	43	18°35.2′	69°17.2	2650	190
3	66	19°32.8′	71°21.5′	64	115
4	73	20°10.0′	70°26.9′	73	50
5	146	20°04.5′	69°26.0′	63	235

TABLE II

Distribution of the fungal spore species in each core.

Species	Cores				
	1	2	3	4	5
Inapertisporites minutus					
I. kedvesii					
I. vulgaris					
I. ovalis					
I. subcapsularis					
I. subovoideus					
I. scabridus					
I. ellipticus					
I. cephalus					
I. cephalus					
I. punctatus					
I. dilcheri					
I. quadrangularis					
Inapertisporites sp. cf. *I. nodulus*					
I. hammenii					
I. granulous					
Inapertisporites sp.					
Dicellaesporites sp. 1					
Dicellaesporites sp. 2					
Multicellaesporites didymus					
M. karii					
M. confusus					
M. tricellatus					
Multicellaesporites sp.					
Staphlosporonites subcircularis					
Staphlosporonites sp.					
Polycellaesporonites bellus					
Monoporisporites singularis					
M. psilatus					
M. novus					
M. sheffyi					
Monoporisporites sp.					
Lacrimasporites levis					
L. bellus					
L. ovaliformis					
Basidiosporites sadasivanii					
Didymoporisporonites indicus					
D. siddiquici					
Pluricellaesporite annulatus					
P. misrae					
Diporisporites major					
D. fusiformis					
Diporicellaesporites prakashii					

TABLE III

Distribution of fungal spore genera in each sample of the cores.

CORE	CORE NO. 1	CORE NO. 2	CORE NO. 3	CORE NO. 4	CORE NO. 5
Genera Samp.	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9 10 11 12	1 2 3 4 5 6 7 8 9	1 2 3	1 2 3 4 5 6 7 8 9 10 11 12
Inapertisporites	+ + + + + + + + +	+ + + + + + + + + + + +	+ + + + + + + + +	+ + +	+ + + + + + + + + + + +
Dicellaesporites	– – – – + – –	– – – – – – – – – – – –	– – – – – – – – –	– – –	– – – – – + – – – – –
Multicellaesporites	– + – – – – – –	– – + – – – – – – – – –	– – – – – – – – –	+ – –	– – – – – – – – – + – +
Staphlosporonites	– – – – – – – –	– + + – – – – – – – – –	– – – – – – – – –	– – –	– – – – – – – – – – –
Polycellaesporonites	– – + – – – + –	– – – – – – – – – – – –	– – – – – – – – –	– – –	– – – – – – – – – – –
Monoporisporities	– – – – – – – – +	– – + + – – – – + – –	– – – – – + – – +	+ + +	– – – + – – – – + – +
Lacrimasporonites	+ – + – – – + – –	– – – – – – – – – – – –	– – – – – – – – –	– – –	+ – – – – – – – – + – –
Basidiosporites	– – + – – – – – –	– – – – – – – – – – – –	– – – – – – – – –	– – –	– – – – – – – – – + – –
Didymoporisporonites	+ – – – – – – – –	– + – – – – – – – – – –	– – – – – – – – –	– – –	– – – – – – – – – – –
Pluricellaesporites	+ – – – – – – – –	– + – – – – – – – – – –	– – – – – – – – –	+ – +	– – – – – – – – – + – –
Diporisporites	+ + – – – – – + – –	– – – – – – – – – – – –	– – – – – – – – –	– – –	– – – – – – – – – – –
Diporicellaesporites	+ – – – – – – + –	– – – – – – – – – – – –	– – – – – – – – –	+ – –	– – – – – – – – – – –