

PALYNOLOGICAL INVESTIGATION OF THE ARABIAN SEA SEDIMENTS: FUNGAL SPORES

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ABSTRACT

Fungal spores recovered from the grab samples collected along the Western Coast of India, off Bombay and from the Gulf of Kachchh, show higher frequency along the coast than away from it in the sea, and poorer spore frequency in the Gulf of Kachchh. It has been observed that the diversity of the fungal spores decreases with the increase of distance from the coast (off-shore).

INTRODUCTION

The knowledge of various factors involved in the origin, distribution and preservation of pollen spores in the modern sediments and their comparison with the plant communities surrounding them is of fundamental importance in the application of palynology to the problems of sedimentation, stratigraphy, palaeoecology and other aspects of oceanography. According to ERDTMAN (1943) and DYAKOWSKA (1948), at least 90 per cent of pollen in the atmosphere are deposited in the ocean within 100 km from the coast. FEDEROVA (1952), INAGRAM *et al.* (1959), MULLER (1959), CROSS AND SHAEFER (1965), ROSSIGNOL (1961) and STANLEY (1965) have shown the importance of stream transportation in microfossil distribution. Most of the pollen found 100 km or more off-shore are water transported (GROOT & GROOT, 1966). FAEGRI AND IVERSEN (1964) noted 50-100 km off-shore as the natural limit of pollen dispersal.

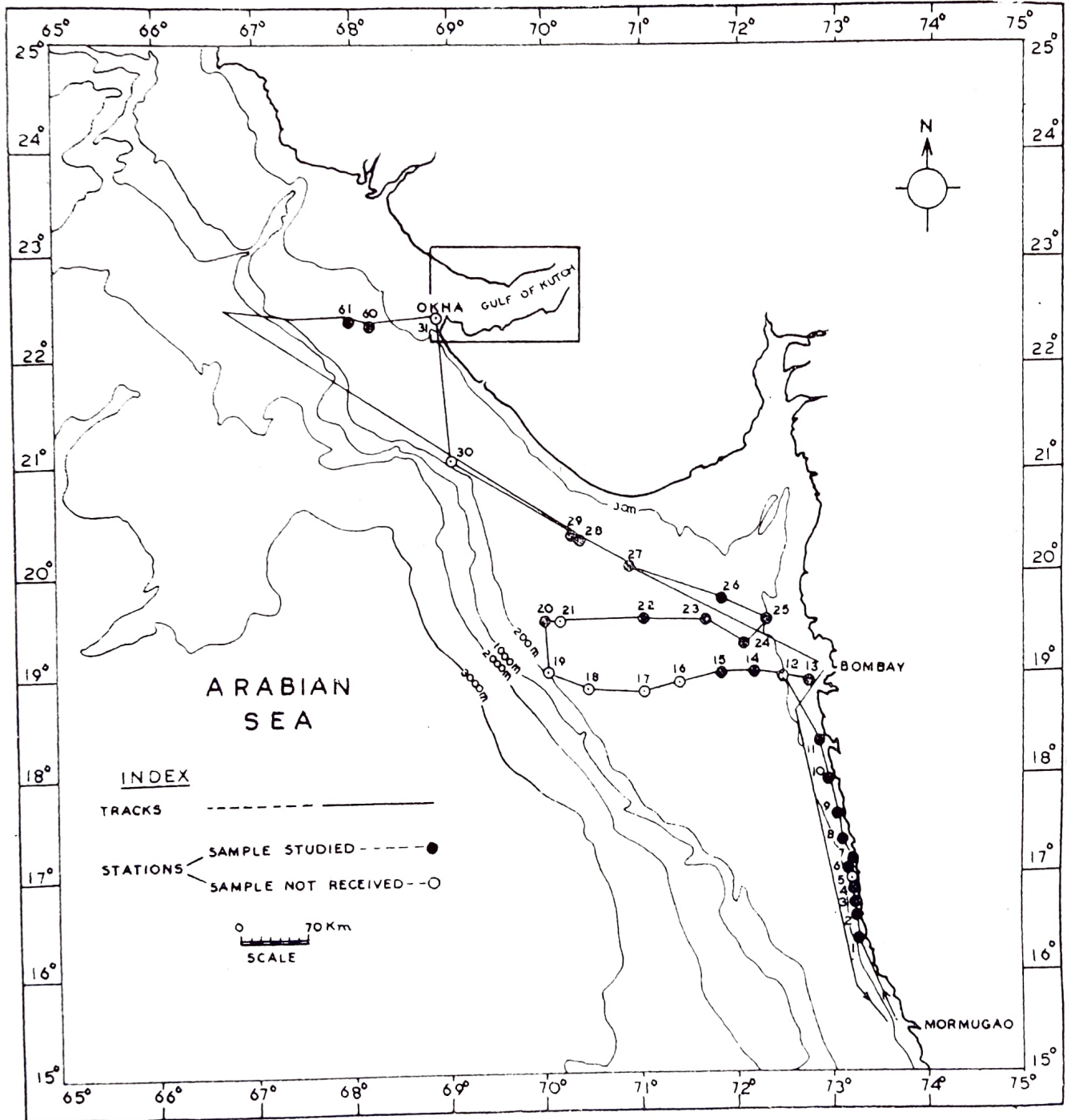
The fungal spores are less subjected to the initial wind transport as these are generally produced in the thick mats of the decaying plant material. Once free, they are transported to far distances mainly because of their smaller size. MULLER (1959) and CROSS *et al.* (1966) pointed out that the weak wind transport results in the lower distribution of the fungal spores than that of the pollen. Most of the marine fungi are known from the intertidal and eulittoral zones and also from the neritic regions (JOHNSON & SPARROW, 1961). SPARROW (1937) and HOHNK (1956, 1959) reported the presence of fungi from more than 200 m, 1150 m and 4610 m depths, respectively. JONES (1962) studied the lignicolous Pyrenomycetes from the sea.

The present paper gives an account of the fungal spore composition of the surface sediments from the Gulf of Kachchh and the continental shelf off Bombay. A rich assemblage of pollen and spores has already been recovered from these samples (RATAN & CHANDRA, *Pers. ob.*).

MATERIAL AND METHODS

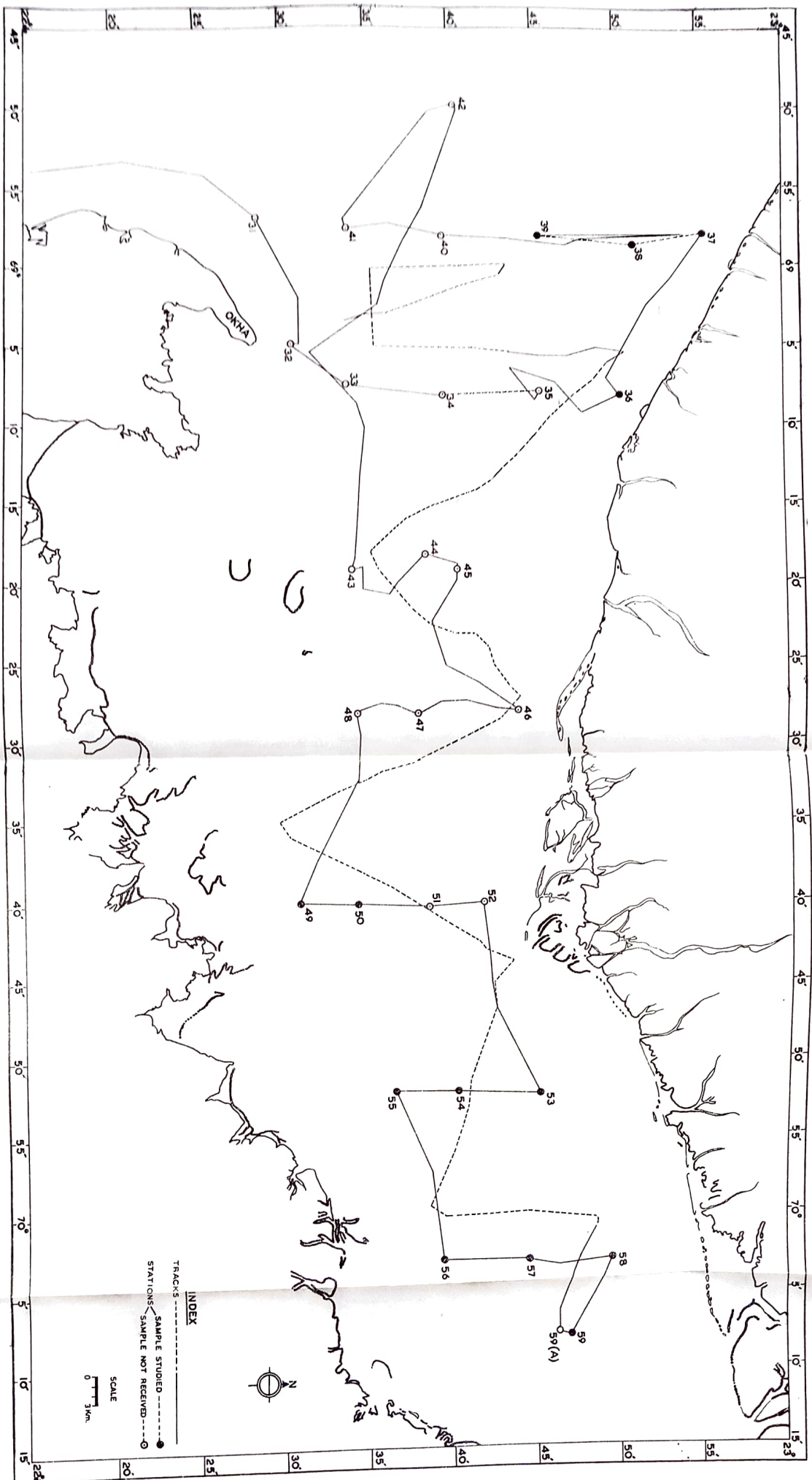
Thirty-five grab samples (Cruise II, *R. V. Gveshani*, Maps 1, 2; Table 1) were collected along the selected tracks from the continental shelf off-Bombay and from the Gulf of Kachchh. The samples were macerated by the standard procedure of ERDTMAN (1943). The multicelled rounded fungal spores up to 50 μm have also been counted.

According to the *Report on Second Oceanographic Cruise of R. V. Gaveshani* (1976, unpublished) the topography is smooth, off and northwest of Bombay from 40-60 m and varies from uneven to rugged on the outer-shelf to the shelf-break. The inner-shelf off-Kathiawar is also smooth but the topography is very rugged. The Gulf of Kachchh is very rugged with sharp ridges and undulations. The topography between 60-80 m west-ward of Okha is uneven to rugged.



Map 1 & 2—Showing the location of the samples (Report, *R. V. Gaveshani*)

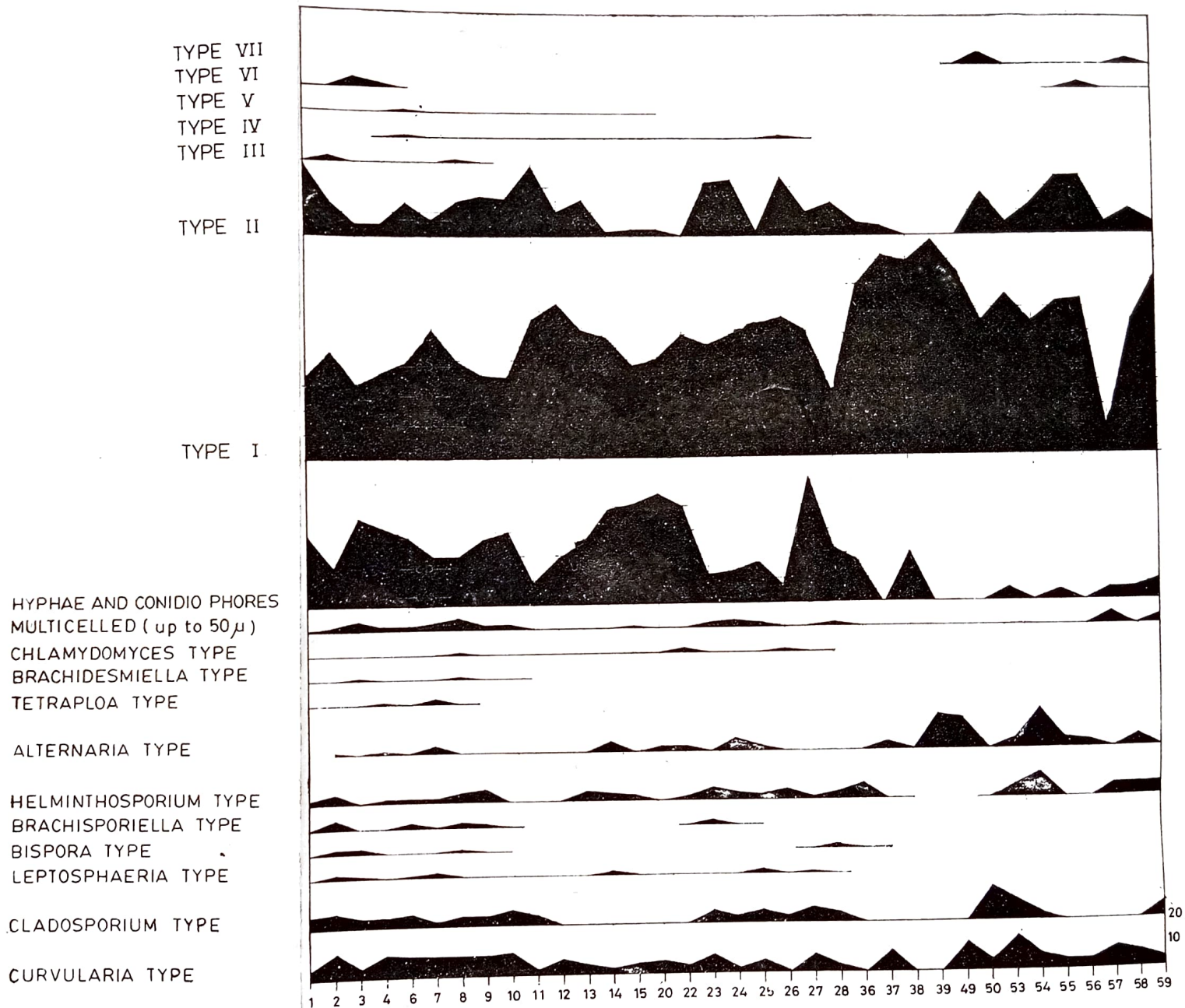
In the eastern part of the Gulf, sediments have rocks with a thickness of about 20 m while the north-eastern margin is underlain by horizontal or sub-horizontal rocks. Coralline algae and non-carbonate sands are found near the mouth of the Gulf with



MAP 2

Table 1—Showing the station location and other data of *the Cruise II, R. V. Gaveshani*

Serial No.	Station No. (Sample No.)	Position		Depth in meters	Collected from
		Latitude	Longitude		
1.	1	16°17.8' N	73°19.3' E	26.5	Outer Shelf
2.	2	16°33.4' N	73°17.0' N	18.5	—do—
3.	3	16°41.1' N	73°15.3' E	20.5	—do—
4.	4	16°51.9' N	73°14.4' E	20.5	—do—
5.	6	17°03.0' N	73°13.5' E	18.5	—do—
6.	7	17°06.0' N	73°14.5' E	16.5	—do—
7.	8	17°18.0' N	73°08.1' E	22.5	—do—
8.	9	17°34.1' N	73°06.1' E	12.0	—do—
9.	10	17°57.6' N	72°59.2' E	10.5	—do—
10.	11	18°18.5' N	72°53.8' E	10.5	—do—
11.	12	18°58.1' N	72°30.0' E	33.5	—do—
12.	13	18°53.1' N	72°42.3' E	15.0	—do—
13.	14	19°00.0' N	72°11.0' E	62.5	Inner shelf
14.	15	18°58.0' N	71°50.0' E	70.0	—do—
15.	20	19°30.0' N	70°00.0' E	88.5	—do—
16.	22	19°31.5' N	71°01.5' E	48.0	Outer shelf
17.	23	19°30.5' N	71°44.8' E	47.0	—do—
18.	24	19°16.0' N	72°03.0' E	48.0	—do—
19.	25	19°30.5' N	72°20.5' E	24.0	—do—
20.	26	19°43.5' N	71°51.0' E	31.0	—do—
21.	27	20°03.0' N	71°00.0' E	68.0	Inner shelf
22.	28	20°19.5' N	70°20.5' E	78.0	—do—
23.	36	22°50.2' N	69°08.2' E	17.0	Gulf of Kachchh
24.	37	22°55.4' N	68°57.9' E	16.0	—do—
25.	38	22°51.0' N	68°58.6' E	15.0	—do—
26.	39	22°45.3' N	68°58.3' E	26.0	—do—
27.	49	22°31.1' N	69°40.2' E	38.0	—do—
28.	50	22°34.4' N	69°39.9' E	38.0	—do—
29.	53	22°45.2' N	69°52.2' E	30.0	—do—
30.	54	22°41.7' N	69°52.2' E	39.0	—do—
31.	55	22°36.7' N	69°52.1' E	32.0	—do—
32.	56	22°39.4' N	70°03.1' E	22.0	—do—
33.	57	22°44.4' N	70°03.1' E	21.0	—do—
34.	58	22°49.5' N	70°03.0' E	21.0	—do—
35.	59	22°47.0' N	70°08.2' E	15.0	—do—



Histogram 1—Showing the percentage frequency of fungal spores in various samples

extensive development of reef corals in the centre followed by the shelly limestone and sandstones towards the head. The bottom of the head is composed of fine clays. The near-shore waters contain high suspended matter as compared to the outer-shelf waters. Higher values of suspended matter are encountered at the mouth than at the head of the Gulf of Kachchh.

RESULTS

Fungal spores, found in all the 35 grab samples (Pl. 1, Histogram I), have been identified with the help of guide books on fungal taxonomy (SUBRAMANYAN, 1971; AINSWORTH *et al.*, 1973). The unassignable forms have been referred to as only 'Types'. *Cladosporium* and *Helminthosporium*-type consist of two-celled and more than three-celled spores, respectively. *Leptosphaeria*-type of spore is distinguished from the *Cladosporium*-type by the presence of ringed septation and rounded ends. The Spore Type IV resembles to that of *Leptosphaeria discors*. Various spores, along with their distribution, are described below.

Inner Shelf—The locations of the samples (nos. 1 to 4, 6 to 13 and 22 to 26) collected along Mormugaon to Bombay and Okha from the inner continental shelf, are 7 to 175 km off the coast and show remarkable decrease of fungal spore diversity with the increase of distance from the coast. *Alternaria-Curvularia* and *Cladosporium*-type of spores are present almost in all the samples which should have been transported by water and air from the continental edge. *Tetraploa*-type of spores have been found up to 7 km off the coast. It is a litter fungus and produces low number of spores and, therefore, their water transportation to far distances is low. The *Chlamydomyces*-type of spores have been found in Sample no. 8 and 2 (8 km and 175 km off the coast respectively). The multi-celled rounded spores (up to 50 μ m in size) produced possibly by *Stemphylium*, have been found in significant number up to 91 km off the coast. One specimen of *Botryodiplodia*-type (Pl. 1, Fig. 20) has been found in Sample no. 2. The hyphae and conidiophores are found in all the samples but their frequency decreases with the increase in distance off the coast. In general, the diversity of the fungal spores decreases with the increase in distance from the coast except the spore Type I and II.

Outer Shelf—The samples up to 280 km off-Bombay and Okha (outer-shelf) have lesser number of fungal spores in comparison to the inner-shelf sediments. The *Curvularia*-type of spores are present in the samples up to 119 km off the coast. The abundance of hyphae and conidiophores in relation to the spores in the outer-shelf may be the indication of marine origin of the parental fungi.

Gulf of Kachchh—There is low diversity of fungal spores in the samples from the Gulf. The spores of *Curvularia-Alternaria*- and *Helminthosporium*-types are present in all samples (nos. 36 to 39, 49, 50 and 53 to 59). Multi-celled fungal spores are present in two samples. The frequency of the hyphae and conidiophores is low in comparison to the spore Type I and II. There is thus low diversity of the fungal spores with the dominance of a few types in the Gulf. Furthermore, these are more diverse in the mouth than in the head of the Gulf of Kachchh.

It is concluded from this study that the fungal spore diversity is higher near the coast and it decreases with the increase of distance off the coast. The spore Type I and II are present in all samples. The high values of the suspended matter at the mouth and the low values at the head of the Gulf (Cruise Report, R. V. *Gaveshani*, 1976) are supported by our findings of high diversity of the spores at the mouth and their less diversity at the head of the Gulf of Kachchh.

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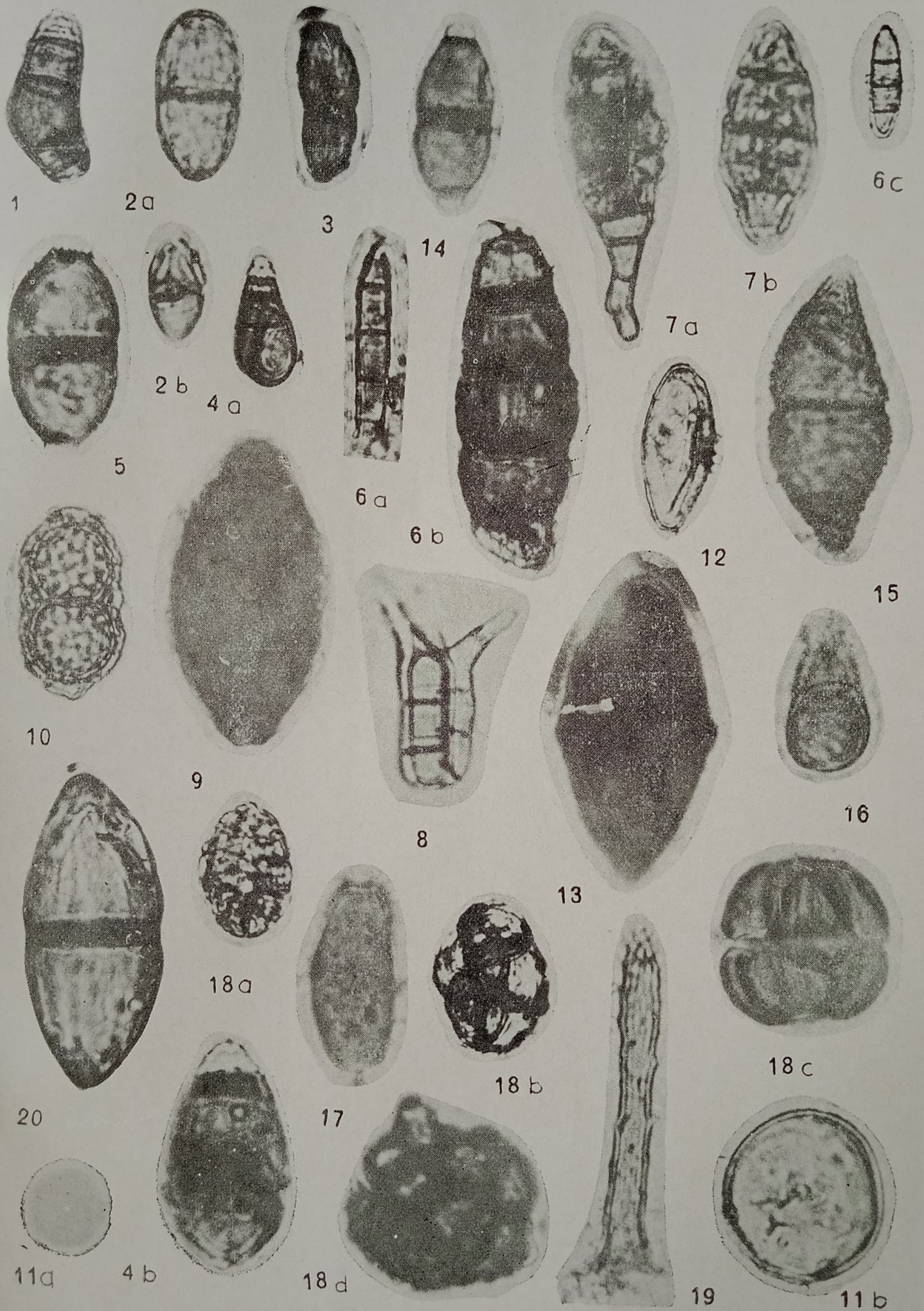
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EXPLANATION OF PLATE 1

(All photomicrographs $\times 1000$. Negatives preserved in the Museum, B.S.I.P., Lucknow).

1. *Curvularia* type spore, Sample No. 2.
- 2a, 2b. *Cladosporium* type spore, Sample No. 1.
3. *Leptosphaeria* type spore, Sample No. 2
- 4a, 4b. *Brachisporiella* type spore, Sample No. 1.
5. *Bispora* type spore, Sample No. 2.
- 6a, 6b, 6c. *Helminthosporium* type spores, Sample No. 2.
- 7a, 7b. *Alternaria*-type spore, Sample Nos. 6, 56.
8. *Tetraploa* type spore, Sample No. 4.
9. *Brachidesmiella*-type spore, Sample No. 8.



10. *Chlamydomyces*-type Spore, Sample No. 22.
- 11a, 11b. Fungal Spore Type I, Sample Nos. 1, 2.
12. Fungal Spore Type II, Sample No. 2.
13. Fungal Spore Type III, Sample No. 2.
14. Fungal Spore Type IV, Sample No. 26.
15. Fungal Spore Type V, Sample No. 6.
16. Fungal Spore Type VI, Sample No. 56.
17. Fungal Spore Type VII, Sample No. 50.
- 18a, 18b, 18c, 18d. Multicelled Fungal Spores up to 50 μ m in size, Samples Nos. 1, 2,
19. Conidiospores and Hyphae, Sample No. 24.
20. *Botrydiolophidia*-type, Sample No. 2.