

POLLEN MORPHOLOGY OF SOME IMPORTANT PLANTS OF TROPICAL DECIDUOUS SAL FOREST, DISTRICT SIDHI, MADHYA PRADESH

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Abstract

Pollen morphology of 45 species belonging to 31 families from the tropical deciduous Sal (*Shorea robusta*) forests distributed in District Sidhi, Madhya Pradesh has been dealt with. The pollen show a wide range of variations in respect of number, nature of apertures and sexine pattern. Besides, a concise account of the mode of pollination, habit and habitat of the species has also been incorporated. This study can greatly help in precise identification of sub-fossil pollen and their interpretation in unfolding palaeo-floristics of tropical regions in Madhya Pradesh

Introduction

The paper deals with pollen morphology of 45 species belonging to equal number of genera under 31 families. The taxa dealt with in the text are the major constituents of tropical deciduous Sal forest distributed in District Sidhi, Madhya Pradesh. Besides pollen morphology, brief account of pollination mechanism, habit and habitat of the taxa have also been provided, wherever available. This study was conducted during the course of pollen analytical investigation of lake and swamp sediments from three sites, viz., Amgaon, Bastua and Chhui stream. The modern palynomorphs of the region have been frequently recovered in the profile sediments.

The main objective of study is to obtain pollen morphological data for precise identification of sub-fossil pollen deposited in the lakes and swamp so as to enable correct interpretation of pollen spectra.

Vegetation

District Sidhi lies in the north-eastern part of Madhya Pradesh between 81°51'E and 24°43'N. The present study is centred in Bastua and Pondi forest ranges where the vegetation is dominated by tropical deciduous Sal (*Shorea robusta*) forests. The important associates of Sal are: *Boswellia*

serrata, *Adina cordifolia*, *Anogeissus latifolia*, *Terminalia tomentosa*, *Buchanania lanzan*, *Lannea coromandelica*, *Mitragyna parvifolia*, *Lagerstroemia parviflora*, *Butea monosperma*, *Sterculia urens*, *Flacourtia indica*, *Elaeodendron glaucum*, *Semecarpus anacardium*, *Aegle marmelos*, *Helicteres isora*, *Ehretia laevis*, *Embllica officinalis*, *Bombax malabaricum*, *Bauhinia variegata*, etc. The shrubby vegetation is mainly represented by *Ziziphus nummularia*, *Strobilanthes angustifrons*, *Adhatoda vasica*, *Woodfordia fruticosa*, *Melastoma malabaricum*, etc.

The ground vegetation of the forest is poor and comprises mainly *Justicia simplex*, *Mazus japonicus*, *Ajuga bracteosa*, *Lindernia diffusa*, *Ageratum conyzoides*, *Gnephallium* sp., *Tribulus alatus*, *Colebrookia oppositifolia*, *Argemone mexicana*, etc.

Material and method

Collection of plants for polliniferous material was made from several localities in Bastua and Pondi Forest ranges and identification of specimens was done in consultation with the herbarium of National Botanical Research Institute, Lucknow. Pollen slides were prepared by acetolysis method (Erdtman, 1952) and have been deposited to the sporothek of B. S. I. P., Lucknow. The terminology used for pollen description is mainly after Erdtman (1952) and partly after Faegri and Iversen (1964).

The families in the text are arranged according to Bentham and Hooker's (1862-1883) system of classification. However, in some cases Hutchinson's (1959) classification has also been followed for further splitting of the families.

Description

Flacourtia indica (Burm. F.) Merr. (Flacourtiaceae)
Pl. 4, figs. 11, 12

Pollen 3-colporate, subprolate, $16.3 \times 12 \mu\text{m}$. Colpi long, crassimarginate. Os slightly lalongate. Exine $1 \mu\text{m}$ thick. Sexine slightly thicker than nexine, finely reticulate; tegillate.

M—melittogamy; H—tree; Hab—dry forest.

Polygala glomerata Lour. (Polygalaceae)
Pl. 3, figs. 11, 12

Pollen large, stephanocolporate, subprolate ($66.5 \times 52.4 \mu\text{m}$). Colpi $33 \mu\text{m}$ long, broad, apices blunt. Os synorate, large. Exine $2.5 \mu\text{m}$ thick. Sexine thicker than nexine, \pm obscure.

M—entomogamy; H—Herb; Hab—marshy places.

Dillenia indica Linn. (Dilleniaceae)
Pl. 2, figs. 10, 11

Pollen 3-colporate, brevicolpate, subspheroidal ($28.5 \times 29.5 \mu\text{m}$). Colpi broad. Os lalongate. Exine $3 \mu\text{m}$ thick. Sexine slightly thicker than nexine, retipilate; integillate.

M—entomogamy; H—tree; Hab—moist evergreen forest.

Shorea robusta Gaertn. (Dipterocarpaceae)
Pl. 4, figs. 13-15

Pollen 3-colpate, oblate ($15.6 \times 17.4 \mu\text{m}$). Golpi $12.6 \mu\text{m}$ long, much broader at the middle, apices blunt. Exine $2 \mu\text{m}$ thick. Sexine slightly thicker than nexine, cannalicate; tegillate.

M—entomogamy; H—tree; Hab—

dry and moist forests.

Sida grewoides Guill. (Malvaceae)
Pl. 6, fig. 4

Pollen large, polyporate, spheroidal ($97.6 \mu\text{m}$). Pore diam. $3.8 \mu\text{m}$. Exine $3.6 \mu\text{m}$, crassisexinous, spine $7.2 \mu\text{m}$ long with bulbous base and acute apex, reticulate; tegillate.

M—melittogamy; H—shrub; Hab—common in cultivated fields.

Bombax malabaricum DC. (Bombacaceae)
Pl. 3, figs. 9, 10

Pollen 3-colporate, planaperturate. Amb triangular ($65 \times 25 \mu\text{m}$). Exine $3.6 \mu\text{m}$ thick. Sexine thicker than nexine, reticulate, distinctly heterobrochate, brochi very fine particularly at the angles; tegillate.

M—ornithogamy; H—tree; Hab—river bank and scattered mixed forest.

Helicteres isora Linn. (Sterculiaceae)
Pl. 1, figs. 5, 6

Pollen 3-porate, oblate ($21 \times 32 \mu\text{m}$). Amb subtriangular. Pore sub-circular (diam. $2.5 \mu\text{m}$), annulate with beset margin. Exine $1.5 \mu\text{m}$ thick. Sexine thicker than nexine, finely granulate.

M—melittogamy; H—shrub; Hab—dry forest.

Sterculia urens Roxb. (Sterculiaceae)
Pl. 4, figs. 8-10

Pollen 3-colporate, prolate spheroidal ($28.2 \times 25.2 \mu\text{m}$). Colpi $22.3 \mu\text{m}$ long. Os lalongate ($2.7 \times 1.3 \mu\text{m}$). Exine $2.5 \mu\text{m}$ thick. Sexine thicker than nexine, supra-reticulate; tegillate.

M—entomogamy with a possible tendency to melittogamy; H—tree; Hab—dry rocky hills.

Tribulus alatus Linn. (Zygophyllaceae)
Pl. 2, figs. 4, 5

Pollen polyporate, spheroidal (diam. $57 \mu\text{m}$). Pore \pm circular or oval and enclosed inside hexagonal or pentagonal lumina. Exine $6.5 \mu\text{m}$ thick. Sexine thicker than nexine, retipilate (retibaculate); integillate.

M—entomogamy; H—herb; Hab—

Abbreviations:

M—Mode of pollination

H—Habit

Hab—Habitat

sandy and rocky places.

Aegle marmelos correa. (Rutaceae)

Pl. 5, figs. 8, 9

Pollen 3-4 colporate, prolate spheroidal ($36 \times 34 \mu\text{m}$). Colpi $28.6 \mu\text{m}$ long. Os lalongate ($3.6 \times 1.8 \mu\text{m}$). Exine $3.6 \mu\text{m}$ thick. Sexine thicker than nexine, retipilate; integillate.

M—entomogamy; H—tree; Hab—dry deciduous forest.

Murraya paniculata Spr. (Rutaceae)

Pl. 5, figs. 1-3

Pollen 3-colporate, prolate ($50 \times 40 \mu\text{m}$). Colpi $40 \mu\text{m}$ long, crassimarginate. Os lalongate ($8.5 \times 3.8 \mu\text{m}$). Exine $3.1 \mu\text{m}$ thick. Sexine thicker than nexine, distinctly reticulate; tegillate.

M—entomogamy; H—tree; Hab—dry deciduous forest.

Boswellia serrata Roxb. (Burseraceae)

Pl. 3, figs. 1, 2

Pollen 3-colporate, subprolate ($57.6 \times 49.6 \mu\text{m}$). Colpi long, tenuimarginate. Os lalongate. Exine $2 \mu\text{m}$ thick. Sexine thicker than nexine, finely reticulate; tegillate.

M—entomogamy; H—tree; Hab—dry forest.

Elaeodendron glaucum (Rottb.) Pers. (Celastraceae)

Pl. 2, figs. 6, 7

Pollen large, 3-colporate, prolate spheroidal ($52 \times 46 \mu\text{m}$). Colpi $42 \mu\text{m}$ long, crassimarginate. Os large, lalongate ($7 \times 5 \mu\text{m}$). Exine $7 \mu\text{m}$ thick, crassisexinuous, retipilate; integillate.

M—entomogamy; H—tree; Hab—dry mixed forest.

Buchanania lanzan spr. (Anacardiaceae)

Pl. 3, fig. 15

Pollen large, 3-colporate, prolate ($59 \times 40 \mu\text{m}$). Colpi $42 \mu\text{m}$ long, crassimarginate. Os lalongate large. Exine $3 \mu\text{m}$ thick, crassisexinuous, striato-reticulate; tegillate.

M—entomogamy; H—tree; Hab—dry sal forest.

Lannea coromandelica (Houtl.) Merr. (Ana-

cardiaceae)

Pl. 3, figs. 7, 8

Pollen 3-colporoidate, subprolate ($37.4 \times 26.8 \mu\text{m}$). Colpi $32.5 \mu\text{m}$ long, crassimarginate, constricted at the middle. Exine $3 \mu\text{m}$ thick. Sexine thicker than nexine, striate; tegillate.

M—non-specialised entomogamy; H—tree; Hab—dry mixed forests.

Semecarpus anacardium Linn. (Anacardiaceae)

Pl. 2, figs. 1-3

Pollen large, 3-colporate, subprolate ($54.4 \times 42.5 \mu\text{m}$). Colpi $50 \mu\text{m}$ long, crassimarginate. Os large, lalongate ($6.9 \times 4.9 \mu\text{m}$). Exine $4.4 \mu\text{m}$ thick, crassisexinuous, striato-reticulate, brochi large; tegillate.

M—entomogamy; H—tree; Hab—dry forest.

Butea monosperma (Lamk.) Taub. (Fabaceae)

Pl. 1, figs. 1-4

Pollen 3-colporate, prolate spheroidal ($37.6 \times 34.8 \mu\text{m}$). Colpi long, broad, tenuimarginate. Os large, circular (diam. $8 \mu\text{m}$), sometimes lalongate. Grain protruded at the equator. Exine $1.5 \mu\text{m}$ thick. Sexine slightly thicker than nexine, granulate.

M—entomogamy; H—tree; Hab—open grassland.

Crotalaria juncea Linn. (Fabaceae)

Pl. 6, figs. 10, 11

Pollen 3-colporate, prolate ($38.4 \times 20.2 \mu\text{m}$), rectangular. Colpi $35.1 \mu\text{m}$ long. Os lalongate. Exine $1.6 \mu\text{m}$ thick. Sexine slightly thicker than nexine, finely reticulate; tegillate.

M—entomogamy; H—shrub; Hab—cultivated area.

Millettia thyrsofolia Benth. (Fabaceae)

Pl. 1, figs. 11-13

Pollen 3-colporate, subprolate ($27 \times 24 \mu\text{m}$). Colpi $24 \mu\text{m}$ long. Os lalongate and extended on either sides. Exine $2 \mu\text{m}$ thick. Sexine thicker than nexine, finely reticulate; tegillate.

M—melittogamy; H—climber; Hab—dry miscellaneous forest.

Bauhinia variegata Linn. (Caesalpinaceae)
Pl. 1, figs. 9, 10

Pollen large, 3-colporoidate, subprolate (79.2 — 51.2 μm). Colpi 60 μm long, broad, crassimarginate. Exine 3-4 μm thick. Sexine thicker than nexine, striato-reticulate; tegillate.

M—entomogamy; H—tree; Hab—mixed forests of hilly grounds.

Acacia catechu Willd. (Mimosaceae)
Pl. 4, fig. 7

Polyad 16-celled, size 45 \times 43 μm . Exine 2 μm thick. Sexine thicker than nexine, granulate.

M—differentiated melittogamy or psychogamy; H—tree; Hab—dry alluvial places.

Terminalia tomentosa W. & A. Prodr (Com-
bretaceae)
Pl. 3, figs. 5, 6

Pollen 3-colporate, heterocolpate, prolate (19.7 \times 14.6 μm). Colpi 13.9 μm long. Os lalongate (2.5 \times 1.8 μm), margin indistinct. Exine 1.5 μm thick. Sexine thinner than nexine, obscure.

M—entomogamy; H—tree; Hab—dry forest.

Syzygium cuminii (Linn.) Skeels. (Myrtaceae)
Pl. 5, fig. 13

Pollen 3-colporate, parasyncolpate. Amb triangular, oblate (11 \times 17 μm). Colpi long, broad. Os lalongate (1.6 \times 1.9 μm). Exine 2.6 μm thick. Sexine thinner than nexine, obscure.

M—chiropterogamy; H—tree; Hab—stream bank, damp and marshy places.

Melastoma malabathricum Linn. (Melasto-
maceae)
Pl 4, figs. 18, 19

Pollen 3-colporate, heterocolpate, oblate spheroidal (20 \times 22.5 μm). Os large, lalongate. Exine 1.5 μm thick. Sexine slightly thicker than nexine, \pm obscure.

M—entomogamy with the possible tendency of myogamy; H—shrub; Hab—stream bank.

Ammania baccifera Linn. (Lythraceae)
Pl. 1, figs. 14, 15

Pollen 3-colporate, heterocolpate, subprolate (16 \times 12.5 μm). Colpi long, narrow. Os circular, annulus distinct. Exine 1.2 μm thick. Sexine as thick as nexine, finely granulate.

M—myogamy; H—herb; Hab—moist and marshy places.

Lagerstroemia parviflora Roxb. (Lythraceae)
Pl. 5, figs. 6, 7

Pollen 3-colporate, prolate spheroidal (45.6 \times 40.8 μm). Colpi long, margin thick and rough. Os lalongate. Exine 4 μm thick. Sexine thicker than nexine but much thicker at the poles, finely reticulate; tegillate.

M—myogamy or melittogamy; H—tree; Hab—dry forest.

Hydrocotyl sibthorpioides Lam. (Apiaceae)
Pl. 4, figs. 16, 17

Pollen 3-colporate, prolate (ellipsoidal) (21.6 \times 17.3 μm). Colpi 18 μm long. Os widely ellipsoidal (2 \times 1.5 μm). Exine 2 μm thick. Sexine thicker than nexine but slightly thickened at the poles, finely reticulate; tegillate.

M—entomogamy; H—herb; Hab—marshy and shady places.

Adina cordifolia Hook. (Rubiaceae)
Pl. 3, figs. 3, 4

Pollen 3-colporate, suboblate (16.2 \times 12.5 μm). Colpi long, tenuimarginate. Os \pm circular, margin distinct. Exine 1.8 μm thick. Sexine thicker than nexine, finely reticulate; tegillate.

M—entomogamy; H—tree; Hab—moist forest.

Mitragyna parvifolia Roxb. (Rubiaceae)
Pl. 5, figs. 10-12

Pollen 3-colporate, proplate spheroidal (20 \times 20 μm). Colpi long. Os \pm circular. Exine 2 μm thick. Sexine thicker than nexine, reticulate, brochi small; tegillate.

M—non-specialised entomogamy to psychogamy; H—tree; Hab—moist forest.

Rubia cordifolia Linn. (Rubiaceae)
Pl. 6, figs. 12, 14

Pollen 5 or 6 colpate, prolate spheroidal ($24 \times 18 \mu\text{m}$). Colpi long, acute. Exine $2 \mu\text{m}$ thick. Sexine as thick as nexine, \pm obscure.

M—non-specialised entomogamy; H—climbing herb; Hab—open shady places.

Xanthium strumarium Linn. (Asteraceae)
Pl. 2, figs. 12, 13

Pollen 3-colporate, oblate spheroidal ($22 \times 24 \mu\text{m}$). Colpi faint, short ($8 \times 1 \mu\text{m}$), narrow with tapering apices. Os lalongate ($3 \times 1 \mu\text{m}$). Exine $4 \mu\text{m}$ thick, crassisexinous, provided with small spinules. Sexine pattern granulate; tegillate.

M—entomogamy; H—herb; Hab—wasteland.

Blumea obliqua Linn. (Asteraceae)
Pl. 6, figs. 6, 7

Pollen 3-colporate ($28 \mu\text{m}$). Amb subtriangular $30 \mu\text{m}$. Exine 3-layered. Sexine thicker than nexine, reticulate.

M—entomogamy; H—herb; Hab—moist shady places.

Vernonia cinerea (Linn.) Less. (Asteraceae)
Pl. 6, fig. 5

Pollen 4-porate, echinolophate, spheroidal ($52 \mu\text{m}$). Exine $4.5 \mu\text{m}$ thick, crassisexinous, spines $3 \mu\text{m}$ long, polar thickening six angular.

M—entomogamy; H—herb; Hab—open waste lands and shaded localities.

Madhuca indica J. E. Gmel. (Sapotaceae)
Pl. 3, figs. 13, 14

Pollen large, 4-colporate, prolate spheroidal ($54 \times 48 \mu\text{m}$). Colpi medium-sized ($40 \mu\text{m}$), narrow. Os large, lalongate ($5.5 \times 4 \mu\text{m}$), margin distinct. Exine $2 \mu\text{m}$ thick. Sexine thicker than nexine, \pm obscure.

M—chiropterogamy; H—tree; Hab—dry mixed forest of rocky and sandy soil.

Diospyros melanoxylon Roxb. (Ebenaceae)
Pl. 4, figs. 1-3

Pollen large, 3-colporate, prolate ($43.7 \times 27.5 \mu\text{m}$). Colpi long, margin indistinct. Os large, lalongate. Exine 1.8

μm thick. Sexine thicker than nexine, \pm obscure.

M—entomogamy; H—tree; Hab—dry mixed forest.

Canscora diffusa Br. (Gentianaceae)
Pl. 2, figs. 8, 9

Pollen 3-colporate, subprolate ($35 \times 30 \mu\text{m}$). Colpi $30 \mu\text{m}$ long, broad, crassimarginate. Os \pm circular (diam. $2 \mu\text{m}$). Exine $2 \mu\text{m}$ thick. Sexine thicker than nexine, distinctly striato-reticulate; tegillate.

M—entomogamy; H—herb; Hab—wet places.

Nymphoides indica Linn. (Gentianaceae)
Pl. 6, fig. 13

Pollen 3-colpate, parasyncolpate, oblate ($18.8 \times 34 \mu\text{m}$). Amb triangular. Exine $2.5 \mu\text{m}$ thick. Sexine thicker than nexine and provided with small excrescences. Sexine pattern finely reticulate; tegillate.

M—entomogamy; H—herb; Hab—aquatic.

Ehretia laevis Roxb. (Ehretiaceae)
Pl. 1, figs. 7, 8

Pollen 3-colporate; heterocolpate, subprolate ($34 \times 27 \mu\text{m}$). Amb hexagonal. Colpi $28 \mu\text{m}$ long. Os lalongate and constricted at the middle. Exine $2 \mu\text{m}$ thick. Sexine thicker than nexine, finely reticulate; tegillate.

M—anemogamy; H—tree; Hab—dry deciduous forest.

Evolvulus alsinoides Linn. (Convolvulaceae)
Pl. 5, figs. 4, 5

Pollen large, stephanocolpate (6-colpate), brevicolpate, spheroidal (diam $33 \mu\text{m}$). Exine $2 \mu\text{m}$ thick, crassisexinous, reticulate; tegillate.

M—entomogamy; H—herb; Hab—open sandy ground.

Justicia simplex Don (Acanthaceae)
Pl. 6, fig. 16

Pollen 2-porate with 3-pseudocolpi, subprolate ($30 \times 19 \mu\text{m}$). Sexine thicker than nexine, much thicker at meridional region, reticulate, brochi larger on the lateral sides; tegillate.

M—entomogamy; H—herb; Hab—open ground.

Strobilanthes angustifrons Cl. (Acanthaceae)
Pl. 6, figs. 1, 2

Pollen large, 3-colporate, heterocolpate, prolate ($53.2 \times 35.4 \mu\text{m}$). Colpi $40.7 \mu\text{m}$ long, narrow. Os large, lalongate (rectangular), ($5.3 \times 3.5 \mu\text{m}$). Exine $3.3 \mu\text{m}$ thick. Sexine much thicker than nexine and provided with bands of reticulation; tegillate.

M—entomogamy; H—shrub; Hab—moist places.

Polygonum plebeium R. Br. (Polygonaceae)
Pl. 6, fig. 15

Pollen small, 3-colporate, subprolate ($15.5 \times 14.5 \mu\text{m}$). Colpi long, tenuimarginate. Os lalongate, synorate. Exine $1.5 \mu\text{m}$ thick. Sexine slightly thicker than nexine, granulate.

M—entomogamy; H—herb; Hab—marshy places.

Chrozophora prostrata Dalz (Euphorbiaceae)
Pl. 6, fig. 3)

Pollen large, stephanocolpate (7-9 colpate), spheroidal (diam. $67.5 \mu\text{m}$). Brevicolpate. Exine $3 \mu\text{m}$ thick. Sexine thicker than nexine, reticulate; tegillate.

M—entomogamy; H—herb; Hab—open ground.

Emblica officinalis Gaertn. (Euphorbiaceae)
Pl. 4, figs. 4-6

Pollen 4-colporate, oblate spheroidal ($20 \times 20 \mu\text{m}$). Colpi tenuimarginate. Os \pm circular. Exine $2 \mu\text{m}$ thick. Sexine thicker than nexine, distinctly reticulate; tegillate.

M—entomogamy; H—tree; Hab—dry deciduous forest.

Cyperus rotundus Linn. (Cyperaceae)
(Pl. 6, figs. 8, 9)

Pollen pear-shaped ($45 \times 35 \mu\text{m}$), 1-ulceroidate and with three longitudinal colpoid streaks on the lateral side. Exine $1.5 \mu\text{m}$ thick. Sexine slightly thicker than nexine, granulate.

M—anemogamy; H—herb; Hab—marshy places.

The pollen morphological study from

tropical deciduous Sal forest described in the text is very significant for the identification of pollen grains recovered from Quaternary sediments. The information on pollination mechanism coupled with ecological distribution of the plant species provides data base for decoding the precise interpretation of the pollen diagram enabling the reconstruction of palaeovegetation and palaeoenvironment. This would also facilitate the generic/specific identification of tropical taxa, which otherwise owing to stenopalyny are difficult to differentiate from each other.

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Explanation of Plates

Plate 1

(All figures $\times 1000$ otherwise stated)

- 1-4. *Butea monosperma*
- 5,6. *Helicteres isora*
- 7,8. *Ehretia laevis*
- 9,10. *Bauhinia variegata*
- 11-13. *Millettia thyrsofolia*
- 14,15. *Ammania baccifera*

Plate 2

- 1-3. *Semecarpus anacardium*
- 4,5. *Tribulus alatus*
- 6,7. *Elaeodendron glaucum*
- 8,9. *Canscora diffusa*
- 10,11. *Dillenia indica*
- 12,13. *Xanthium strumarium*

Plate 3

- 1,2. *Boswellia serrata*
- 3,4. *Adina cordifolia* × 1500.
- 5,6. *Terminalia tomentosa* × 1500.
- 7,8. *Lannea coromandelica*
- 9,10. *Bombax malabaricum*
- 11,12. *Polygala glomerata*
- 13,14. *Madhuca indica*
- 15. *Buchanania lanzan*

Plate 4

- 1-3. *Diospyros melanoxylon*
- 4-6. *Embllica officinalis*
- 7. *Acacia catechu*
- 8-10. *Sterculia urens*
- 11,12. *Flacourtia indica* × 1500
- 13-15. *Storea robusta*
- 16,17. *Hydrocotyl sibthorpioides*
- 18,19. *Melastoma malabathricum*

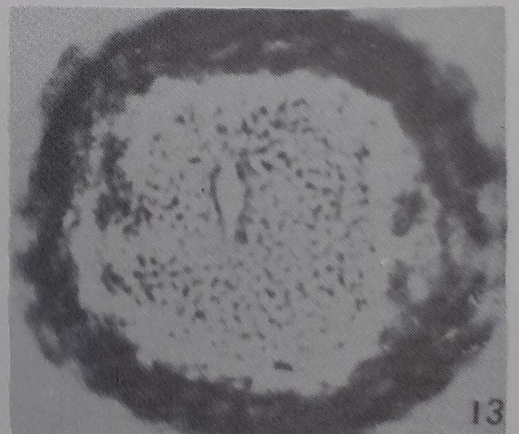
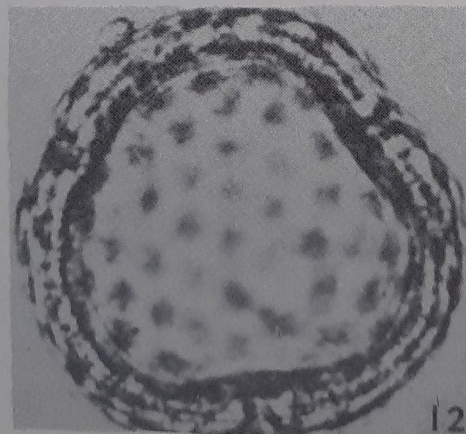
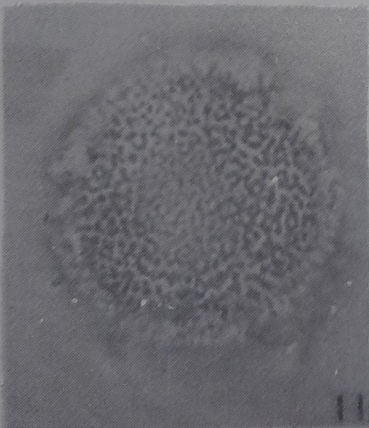
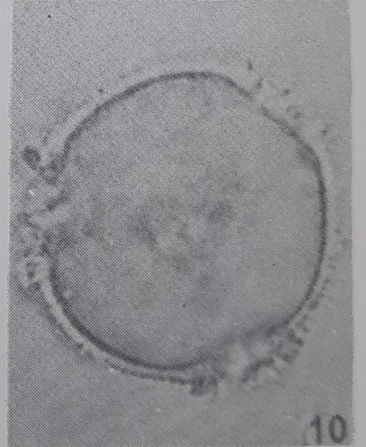
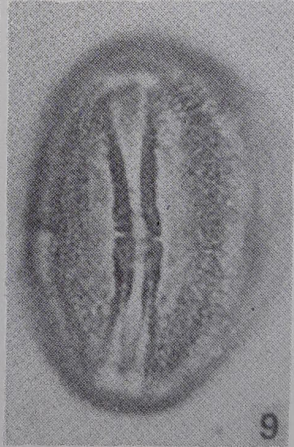
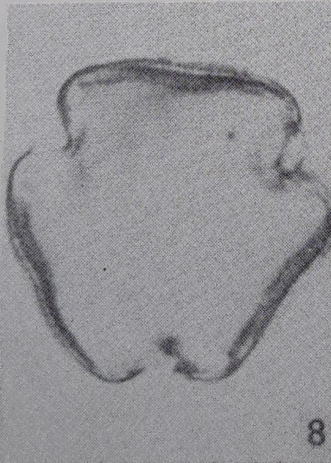
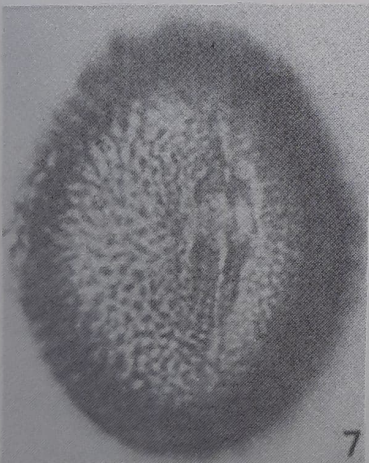
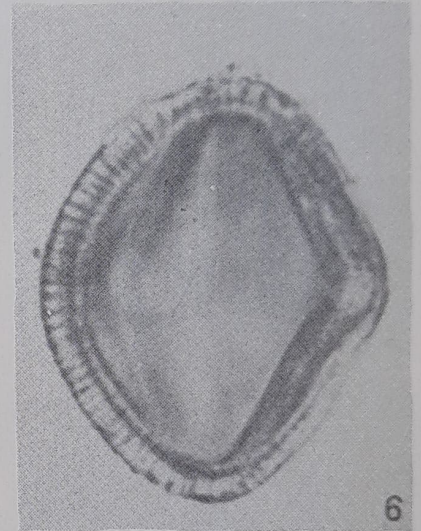
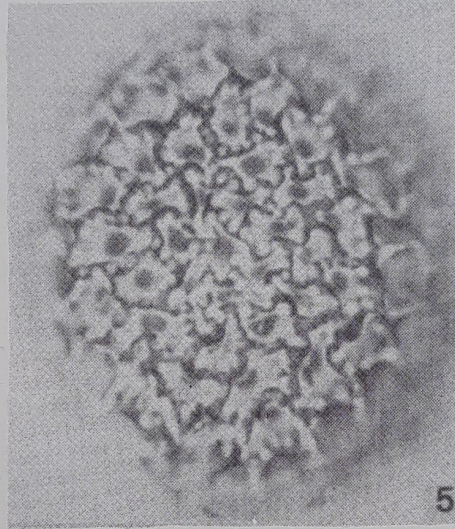
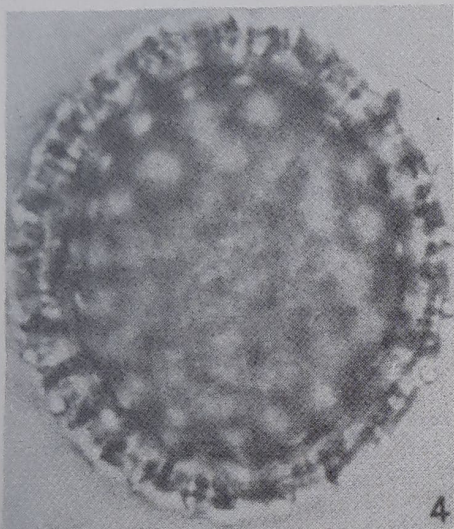
Plate 5

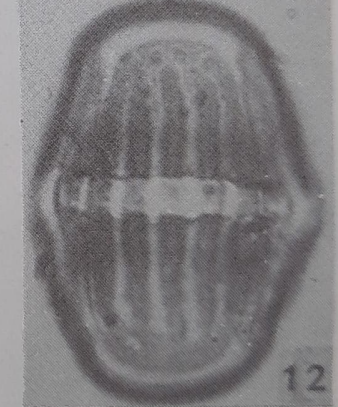
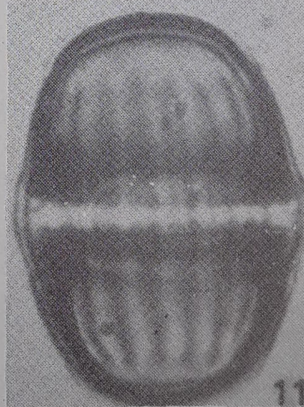
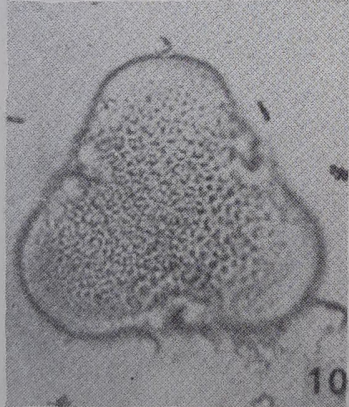
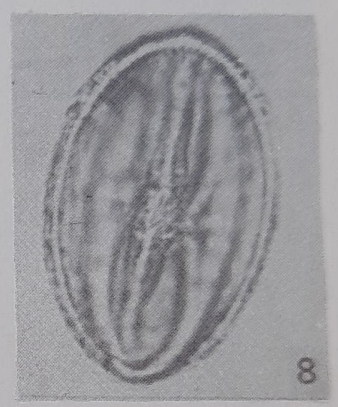
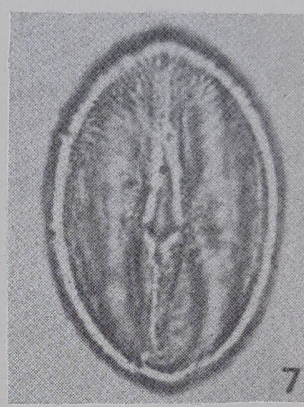
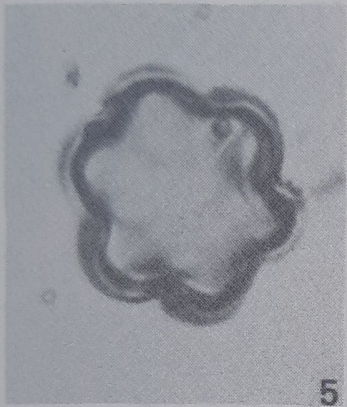
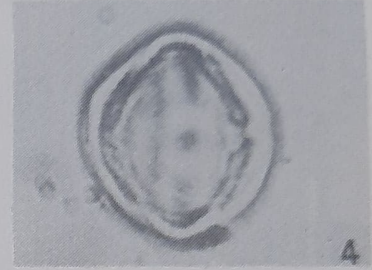
- 1-3. *Murraya paniculata*
- 4,5. *Evolvuls alsinoides*
- 6,7. *Lagerstroemia parviflora*
- 8,9. *Aegle marmelos* × 1500
- 10-12. *Mitragyna parvifolia*
- 13. *Syzygium cumini*

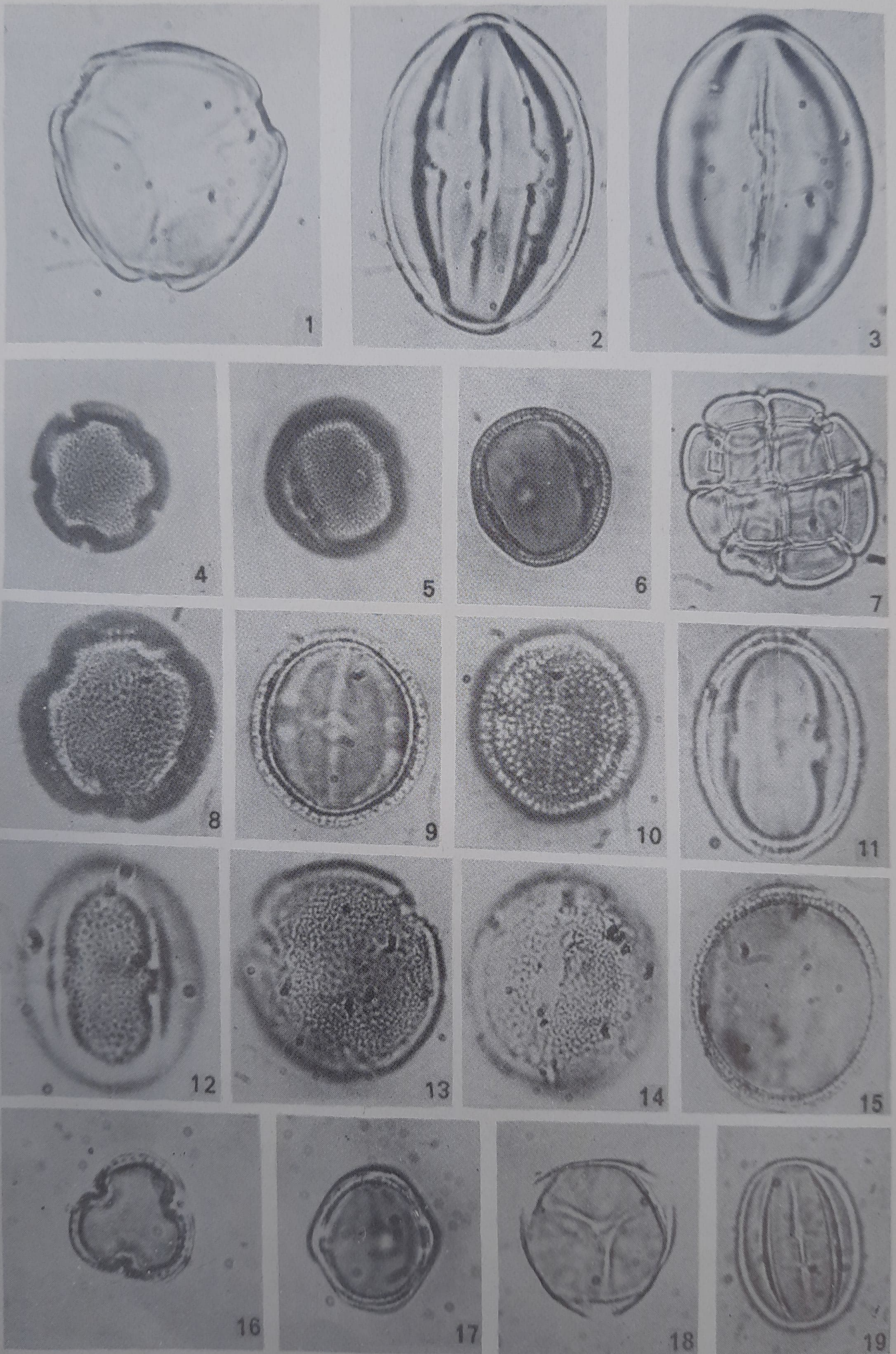
Plate 6

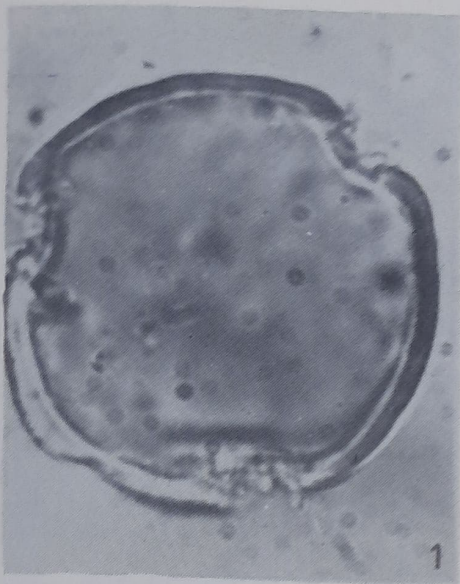
- 1,2. *Strobilanthes angustifrons*
- 3. *Chrozophora prostrata*
- 4. *Sida grewioides*
- 5. *Vernonia cinerea*
- 6,7. *Blumea obliqua*
- 8,9. *Cyperus rotundus*
- 10,11. *Crotalaria juncea*
- 12&14. *Rubia cordifolia*
- 13. *Nymphoides indica*
- 15. *Polygonum plebeium*
- 16. *Justicia simplex*



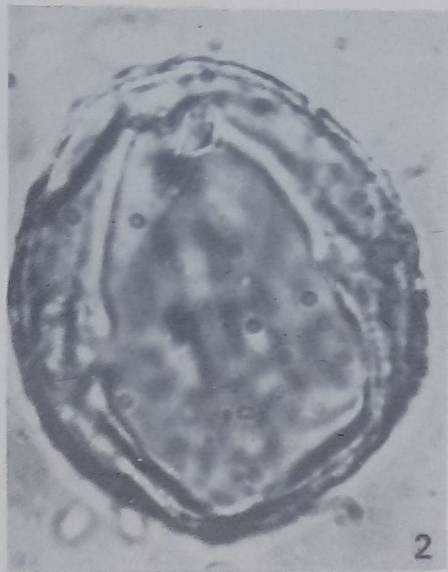




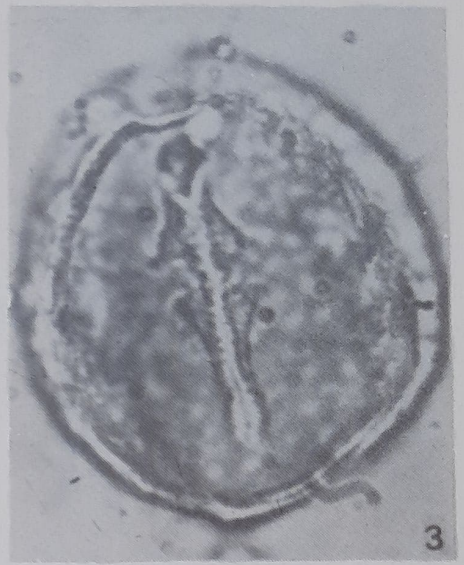




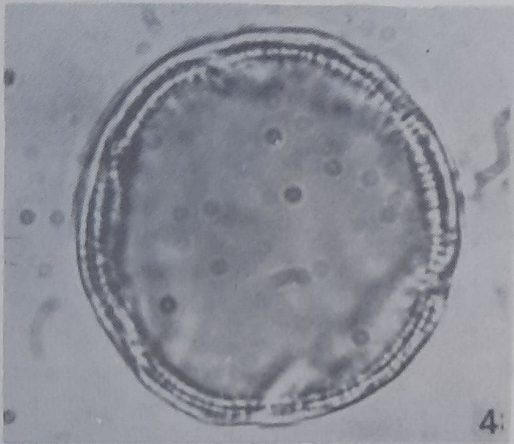
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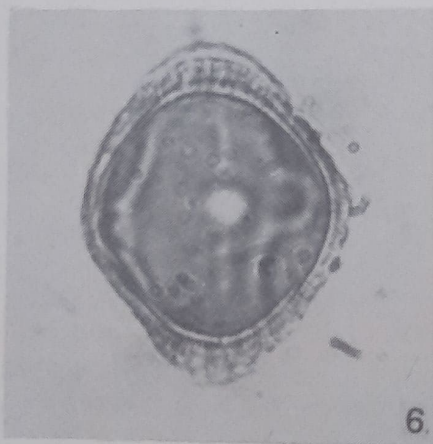
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3



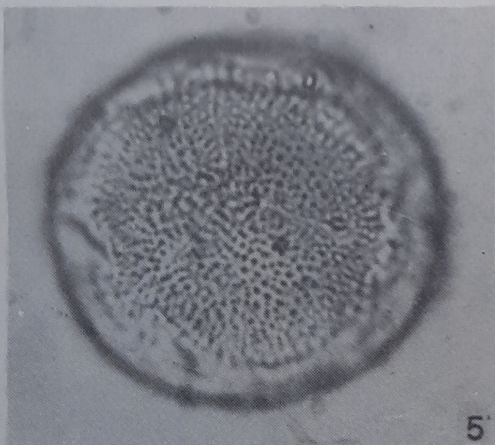
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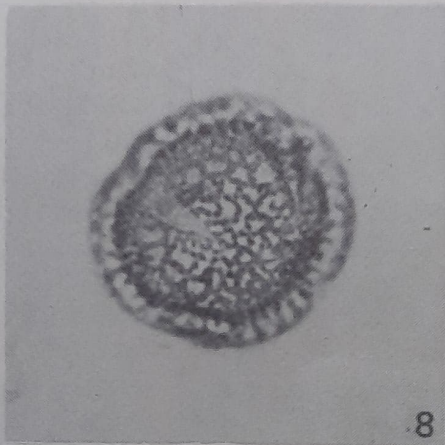
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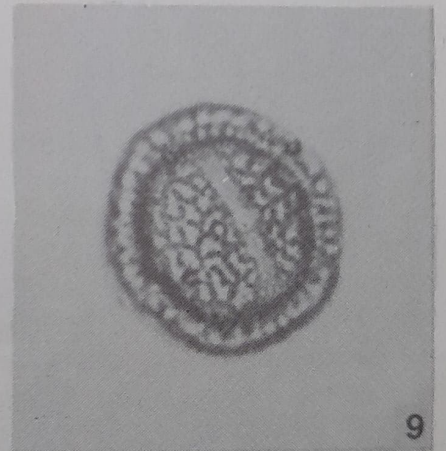
7



5



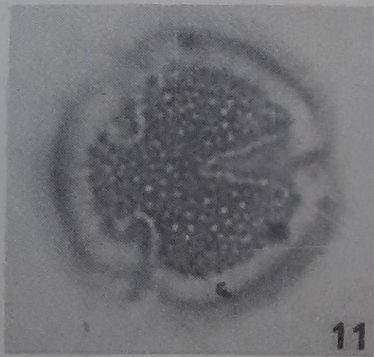
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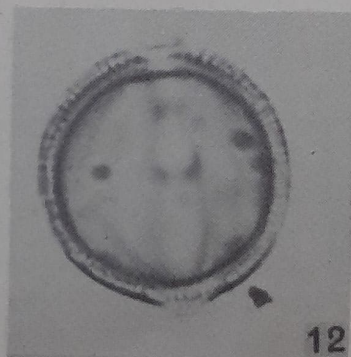
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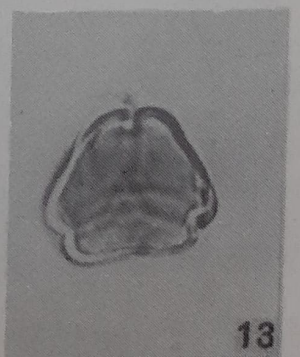
10



11



12



13

