ON THE POLLEN MORPHOLOGY OF COMMON GROUND VEGETATION OF LAVA, RECHI LA AND LULAGAOUN, DARJEELING DISTRICT

APARNA PAL, N. PARIA* AND SUNIRMAL CHANDA

Division of Palynology and Environmental Biology, Bose Institute, Calcutta 700 009, India

Abstract

Pollen grains of 25 taxe from the part of a disappearing ground vegetation of Lava, Rechi La and Lulagaoun have been investigated covering the entire range of morphological parameters. The implication of the result of this investigation has been discussed with a reference to the endangered plant community of these places.

Introduction

Pollen grains and spores are extremely resistant to decay and get permanently preserved in various types of sedimentary deposits. They provide necessary clues to the past vegetational history and palaeoecology. Fossil pollen data, therefore, are increasingly used to trace the history of the individual species population (Davis, 1976; Watts, 1973). The use of such historical records, in combination with contemporary research on species ecology and demography, offers one of the more promising means of approaching the elusive problem of the existence of a species in the past. With the essence of such an understanding, the pollen morphology of some endangered plants commonly growing at Lava, Rechi La and Lulagaoun, which are reported to be disappearing gradually due to biotic and other factors, has been studied.

The forests of Lava, Rechi La and Lulagaoun at altitudes of 1,895 m, 2, 440 m and 1,685 m respectively under Kalimpong Subdivision of Darjeeling District of West Bengal are a luxuriant blend of subtropical and temperate plant populations with a rich ground flora like Darjeeling (Paria & Pal, 1983). These natural forests are gradually being depleted by various destructive biotic influences including clearance of the forests by indulging in slash-and-burn techniques at the steeper slopes for cultivation which probably will amount to destruction of the characteristic vegetation of these places. During a recent botanical survey it was found out that the plant cover, particularly the ground vegetation in certain places of Lava, Rechi La and Lulagaoun is badly threatened and is in a state of decline (Paria & Pal, 1983). An attempt, therefore, has been made to put a part of such declining ground vegetation in respect of pollen morphology to record for future reference.

Materials and methods

Fresh pollen materials were collected from the ground vegetation of Lava, Rechi La and Lulagaoun. These materials were acetolysed and a part chlorinated after acetolysis following the methods as suggested by Erdtman (1952, 1969).

*Department of Botany, University of Calcutta, 35 Ballygunge Circular Road, Calcutta 700 019.

The light microscopical work was done with a binocular Leitz Wetzlar Microscope (Oit-immersion objective 100X, eye piece 8X). The factor for measurements in all cases was 0.7 μm for one ocular micrometer division (using the oil-immersion objective). For photomicrographs, Zeiss binocular research microscope with an Olympus camera attachment was used. In all cases, measurements and other observations are based on acetolysed grains. The measurements, quoted in the pollen descriptions, are generally based on an average of 10 readings randomly chosen.

The pollen morphology of the relevant taxa is investigated and described. Pollen descriptions are provided (arranged alphabetically) alongwith suitable illustrations wherever possible.

Pollen description

ASTERACEAE

Anaphalis cinnamomea C. B. Clarke

Tricolporate, isopolar, radially symmetrical, amb circular, peritreme, spheroidal, diameter of grain 17.5 μm; apocolpium 10.5 μm, mesocolpium 6.0 μm, L/B of colpi 14/2.0 μm, ora circular, diameter of os 2.0 μm. Thickness of exine (with spine) 6.0 μm, echinate, thickness of sexine 1.0 μm, tectate, L/B of the spine 4.0/2.0 μm, thickness of nexine 1.0 μm. NPC 345.

A. contorta Hook. f.

Tricolporate, isopolar, radially symmetrical, amb circular, peritreme, prolate, PA/ED 24.5/21 μm, apocolpium 10.5 μm, mesocolpium 6.0 μm, L/B of colpi 17.5/2.0 μm, ora circular, diameter of os 1.0 μm. Thickness of exine (with spine) 6.0 μm, echinate, thickness of sexine 1.5 μm, L/B of spine 3.5/1.4 μm, thickness of nexine 1.0 μm. NPC 345.

BORAGINACEAE

Cynoglossum furcatum Wall.

Tricolpate, isopolar, radially symmetrical, amb circular, peritreme, prolate-spheroidal, PA/ED 35/33 μm, apocolpium 10.5 μm, mesocolpium 8.0 μm, L/B of colpi 24.5 μm/21 μm. Thickness of exine 3.0 μm, baculate, thickness of sexine 2.0 μm, tectate, bacula present in optical section, length of bacula 0.7 μm, thickness of nexine 1.0 μm. NPC 343.

CAMPANULACEAE

Campanumoea inflata C. B. Clarke
Pl. 1 , Fig. 1

7-colpate, isopolar, radially symmetrical, amb circular, peritreme, prolate, PA/ED 49/45.5 μm, apocolpium 9.0 μm, mesocolpium 14 μm, L/B of colpi 28/2.0 μm. Thickness of exine 2.0 μm, spinulose, thickness of sexine 1.0 μm, tectate, spinules present in optical section, length of spinules 0.3 μm, thickness of nexine 1.0 μm. NPC 743.

Pratia begonifolia Lindl.
Pl. 1, Fig. 8

Tricolporate, isopolar, radially symmetrical, amb circular, peritreme, prolate, PA/ED 22.5/17.5 μm, apocolpium 3.5 μm, mesocolpium 7.0 μm, L/B of colpi 17.5/2.0 μm, ora circular, diameter of os 1.5 μm. Thickness of exine 3.0 μm, baculate, thickness of sexine 1.5 μm, tectate, bacula present in optical section, thickness of nexine 1.5 μm. NPC 345.

CARYOPHYLLACEAE

Drymaria cordata Willd. ex Edgeworth

Pantocolpate with 12 colpi (dodecacolpate), arranged in a definite geometric pattern, spheroidal, diameter of the grain 26.5 μm, intercolpal distance 13.5 μm, L/B of colpi 4.5/2.0 μm, colpi provided with granulate membrane. Thickness of exine 2.0 μm, thickness of sexine 1.0 μm, tectate, punctitegillate, provided with fine supratectal processes, crassisexinous, thickness of nexine 1.0 μm. NPC 763.

COMMELINACEAE

Streptolirion volubile Edgew.
Pl. 1, Fig. 2

Monosulcate, heteropolar, oblate, PA/ED 21/35 μm, L/B of sulcus 31.5 μm/1.5 μm. Thickness of exine 2.0 μm, psilate, thickness of sexine 1.0 μm, tectate, thickness of nexine 1.0 μm. NPC 133.

ERICACEAE

Gaultheria nummularioides D. Don
Pl. 1, Fig. 7

Tricolporate with permanent tetrahedral tetrads, diameter of the tetrads 35 μm, diameter of the individual pollen grains 21 μm, isopolar, radially symmetrical, amb circular, peritreme, apocolpium 10.5 μm, L/B of colpi 11.0/2.0 μm, ora circular, diameter of the os 2.0 μm. Thickness of exine 2.0 μm, scabrate, thickness of sexine 1.0 μm, tectate, thickness of nexine 1.0 μm. NPC 345.

FABACEAE

Parochitus communis Buch.-Ham.
Pl. 1, Fig. 11

Tricolporate, isopolar, radially symmetrical, amb circular, peritreme, prolate, PA/ED 21/14 μm, apocolpium 3.0 μm, mesocolpium 3.5 μm, L/B of colpi 17.5/1.5 μm, ora circular, diameter of the os 1.5 μm. Thickness of exine 2.0 μm, thickness of sexine 1.0 μm, tectate, finely reticulate, thickness of nexine 1.0 μm. NPC 345.

GENTIANACEAE

Swertia chirata Buch.-Ham.
Pl. 1, Fig. 10

Tricolporate, isopolar, radially symmetrical, amb circular, peritreme, spheroidal, diameter of the grain 35 μm, apocolpium 3.5 μm, mesocolpium 21 μm, L/B of colpi 21/2.0 μm, ora circular, diameter of the os 2.0 μm. Thickness of exine 3.5 μm, baculate, thickness of sexine 2.0 μm, tectate, thickness of nexine 1.5 μm. NPC 345.

HYPERICACEAE

Hypericum patulum Thunb.
Pl. 1, Fig. 13

Tricolporate, isopolar, radially symmetrical, amb circular-lobate, peritreme, prolate, PA/ED 17.5/14 μm, apocolpium 8.5 μm, mescolpium 10.5 μm, L/B of colpi 21/2.0 μm, ora lalongate, L/B of os 1.0/2.0 μm. Thickness of exine 2.0 μm, thickness of sexine 1.0 μm, intectate, reticulate, thickness of nexine 1.0 μm. NPC 345.

LAMIACEAE

Calamintha umbrosa Benth.
Pl. 1, Figs. 14, 15

Hexacolpate, isopolar, radially symmetrical, amb circular, peritreme, prolate, PA/ED 28/24.5 μm, apocolpium 4.0 μm, mesocolpium 7 μm, L/B of colpi 17.5/2.0 μm. Thickness of exine 3.0 μm, thickness of sexine 1.5 μm, intectate, reticulate, thickness of nexine 1.5 μm. NPC 643.

MELASTOMACEAE

Osbeckia crinita Benth.
Pl. 1, Fig. 5

Tricolpoidate with alternate tripseudocolpi, isopolar, amb circular, peritreme, prolate, PA/ED 27.0 /21 μm, apocolpium 3.5 μm, mesocolpium 5.0 μm, L/B of colpi 10.5/2.0 μm. Thickness of exine 3.0 μm, scabrate, thickness of sexine 1.5 μm, tectate, thickness of nexine 1.5 μm. NPC 343.

ONAGRACEAE

Epilobium roseum Schreb.
Pl. 1, Fig. 16

Tripororate, isopolar, radially symmetrical, amb semi-angular, goniotreme, oblate, PA/ED 56/70 μm, diameter of pore 7 μm, thickness of ora 3.5 μm, aspidote. Thickness of the exine 2.0 μm, scabrate, thickness of sexine 1.0 μm, tectate, thickness of nexine 1.0 μm. NPC 346.

PAPAVERACEAE

Dicentra thalictrifolia Hook. f. & Thoms.

Tricolpate, isopolar, radially symmetrical, amb circular, peritreme, prolate, PA/ED 24.5/17.5 μm, apocolpium 7 μm, mesocolpium 8.0 μm, L/B of colpi 17.5/2.0 μm. Thickness of exine 2.0 μm, thickness of sexine 1.0 μm, intectate, reticulate thickness of nexine 1.0 μm. NPC 343.

PLANTAGINACEAE

Plantago major Linn.
Pl. 1, Fig. 9

Haxaporate, amb circular, spheroidal, diameter of the grain 24.5 μm, diameter of the pore 2.0 μm, pores operculate and distributed all over the surface. Thickness of exine 2.0 μm, outer margin wavy, thickness of sexine 1.0 μm, tectate, thickness of nexine 1.0 μm. NPC 664.

POLYGONACEAE

Polygonum capitatum Buch.-Ham.

Tricolpate, isopolar, radially symmetrical, amb circular, peritreme, spheroidal, diameter of grain 35 μm, apocolpium 10.5 μm, mesocolpium 21 μm, L/B of colpi 21/2.0 μm. Thickness of exine 5.0 μm, thickness of sexine 3.5 μm, intectate, reticulate, muri provided with two types of bacula, thickness of nexine 1.5 μm. NPC 343.

P. chinense Linn.
Pl. 1, Fig. 3

Tricolpate, isopolar, radially symmetrical, amb semi-angular, goniotreme, spheroidal, diameter of the grain 49 μm, L/B of colpi 13.0/3.5 μm, partly beset with bacula. Thickness of exine 6.0 μm, baculate, thickness of sexine 4.5 μm, tectate, bacula present in optical section, multiduplibaculate, irregularly arranged, L/B of bacula 4.0/1.5 μm, diameter of lumina 5.5 μm, L/B of microbacula 3.0/1.5 μm, irregularly distributed, thickness of nexine 1.5 μm. NPC 343.

P. molle D. Don.

Tricolpate, isopolar, radially symmetrical, amb circular, peritreme, prolate, PA/ED 21/17.5 μm, apocolpium 8.5 μm, mesocolpium 14 μm, L/B of colpi 17.5/2.0 μm. Thickness of exine 3.5 μm, baculate, thickness of sexine 2.0 μm, tectate, bacula present in optical section, thickness of nexine 1.5 μm. NPC 343.

P. runcinatum Buch.-Ham. ex D. Don

Polyrugate, spheroidal, diameter of grain 36.5 μm, diameter of rugae 2.0 μm. Thickness of exine 3.5 μm, thickness of sexine 2.0 μm, intectate, duplibaculate, reticulate, lumina provided with granules, thickness of nexine 1.5 μm. NPC 764.

ROSACEAE

Potentilla fulgens Wall. ex Hook.
Pl. 1, Fig. 18

Tricolporoidate, isopolar, bilaterally symmetrical, amb circular, peritreme, spheroidal, diameter of grain 21 μm, apocolpium 6 μm, mescolpium 10.5 μm, L/B of colpi 14/2.0 μm, ora circular, diameter of the os 2.0 μm. Thickness of exine 2.0 μm, thickness of sexine 1.0 μm, subtectate, finely reticulate, thickness of nexine 1.0 μm. NPC 345.

RUTACEAE

Boenninghausenia albiflora Reichenb.
Pl. 1, Fig. 17

Tricolporate, isopolar, radially symmetrical, amb semi-angular, goniotreme, prolate, PA/ED 31.5/24.5 μm, apocolpium 8.0 μm, mesocolpium 14 μm, L/B of colpi 14/2 μm, ora circular, diameter of os 1.0 μm. Thickness of exine 2.0 μm, thickness of sexine 1.0 μm, tectate, finely reticulate, thickness of nexine 1.0 μm. NPC 345.

SCROPHULARIACEAE

Torenia peduncularis Benth.
Pl. 1, Fig. 6

Tricolpate, isopolar, radially symmetrical, amb circular, peritreme, prolate, PA/ED 21/17.5 μm, apocolpium 5 μm, mesocolpium 16 μm, L/B of colpi 23/2 μm. Thickness of exine 3 μm, thickness of sexine 1.5 μm, intectate, reticulate, thickness of nexine 1.5 μm. NPC 343.

URTICACEAE

Elatostema hookerianum Wedd.
Pl. 1, Fig. 12

Biporate, heteropolar, spheroidal, diameter of grain 7 μm, diameter of pore 3.5 μm. Thickness of exine 2.0 μm, psilate, thickness of sexine 1.0 μm, tectate, thickness of nexine 1.0 μm. NPC 234.

VALERIANACEAE

Valeriana hardwickii Wall.
Pl. 1, Fig. 4

Tricolporoidate, isopolar, radially symmetrical, amb triangular, goniotreme, prolate, PA/ED 35/21 μm, apocolpium 7 μm, mesocolpium 10.5 μm, L/B of colpi 21/1.0 μm, ora indistinct. Thickness of exine 3.5 μm (with spine), echinate, thickness of sexine 2.0 μm, L/B of spine 1.5/1.0 μm, thickness of nexine 1.5 μm. NPC 345.

Table 1—List of plants treated in the investigation with pollen morphological characters

Name of the plant	Family	Pollen characters at a glance		
		Shape	Aperture	Surface ornamentation
Anaphalis cinnamomea C. B. Clarke	Asteraceae	Spheroidal	Tricolporate	Tectate, echinate
A. contorta Hook. f.	Asteraceae	Prolate	Tricolporate	Tectzte, echinate
Boenninghausenia albiflora Reichenb.	Rutaceae	Prolate	Tricolporate	Subtectate, finely reticulate
Calamintha umbrosa Benth.	Lamiaceae	Prolate	Hexacolpate	Intectate, reticulate
Campanumoea inflata C. B. Clarke	Campanulaceae	Prolate	7-colpate	Tectate, echinate
Cynoglossum furcatum Wall.	Boraginaceae	Prolate-spheroidal	Tricolpate	Tectate, baculate
Dicentra thalictrifolia Hook. f. & Thoms.	Papaveraceae	Prolate	Tricolpate	Reticulate
Drymaria cordata Willd. ex Edgeworth	Caryophyllaceae	Spheroidal	Dodecacolpate	Punctitegillate
Elatostema hookerianum Wedd.	Urticaceae	Spheroidal	Biporate	Psilate
Epilobium roseum Schreb.	Onagraceae	Oblate	Tripororate	Tectate, scabrate
Gaultheria nummularioides D. Don	Ericaceae	Spheroidal	Tricolporate	Tectate, scabrate
Hypericum patulum Thunb.	Hypericaceae	Prolate	Tricolporate	Intectate, reticulate
Osbeckia crinita Benth.	Melastomaceae	Prolate	Tricolpoidate + Tripseudocolpate	Tectate, Scabrate
Parochetus communis Buch.-Ham.	Fabaceae	Prolate	Tricolporate	Reticulate
Plantago major Linn.	Plantaginaceae	Spheroidal	Hexaporate	Tectate
Polygonum capitatum Buch.-Ham.	Polygonaceae	Spheroidal	Tricolpate	Intectate, reticulate
P. chinense Linn.	Polygonaceae	Spheroidal	Tricolpate	Tectate, duplibaculate
P. molle D. Don	Polygonaceae	Prolate	Tricolpate	Tectate, baculate
P. runcinatum Buch.-Ham. ex D. Don	Polygonaceae	Spheroidal	Polyrugate	Intectate, duplibaculate, reticulate
Potentilla fulgens Wall. ex Hook.	Rosaceae	Spheroidal	Tricolporoidate	Finely striato-reticulate
Pratia begonifolia Lindl.	Campanulaceae	Prolate	Tricolporate	Tectate, baculate
Streptolirion volubile Edgew.	Commelinaceae	Oblate	Monosulcate	Psilate
Swertia chirata Buch-. Ham.	Gentianaceae	Spheroidal	Tricolporate	Tectate, baculate
Torenia peduncularis Benth.	Scrophulariaceae	Prolate	Tricolpate	Reticulate
Valeriana hardwickii Wall.	Valerianaceae	Prolate	Tricolporoidate	Echinate

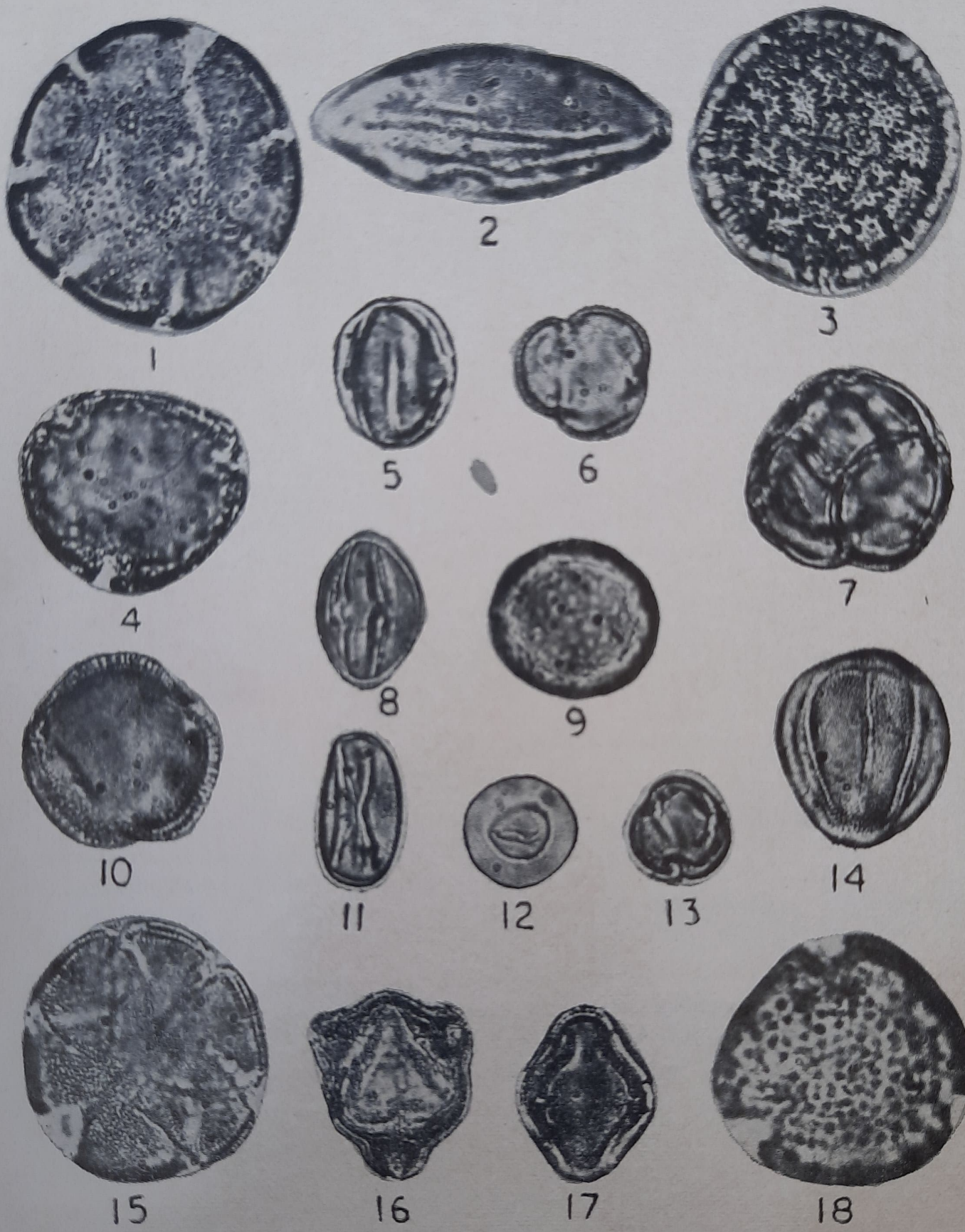
Discussion

A general survey of the pollen morphology of investigated species of the ground vegetation of Lava, Rechi La and Lulagaoun reveals a heterogeneous assemblage of pollen types. The apertural types vary from colpate to porate, colporate, pororate, colpoidate, pseudocolpate, pantoporate, colporoidate, polyrugate and sulcate types. The other morphological characters like shape, size, surface ornamentations, exine stratifications, etc. have also been taken into consideration.

The biporate, spheroidal (7 μm) and psilate grains are found in *Elatostema hookeriana*, an urticaceous plant with minute, green, unisexual flowers, which are wind pollinated. The monosulcate, oblate and psilate grains of *Streptolirion volubile*, a member of Commelinaceae, originate from white flowers. The character of the grain is primitive, the plant is a rare climber in the family. Tricolpate grains are found in *Cynoglossum furcatum*, *Dicentra thalictrifolia*, *Polygonum capitatum*, *P. chinense*, *P. molle* and *Torenia peduncularis*. Tricolporate grains are found in *Anaphalis cinnamomea*, *A. contorta*, *Boenninghausenia albiflora*, *Gaultheria mummularioides*, *Hypericum patulum*, *Osbeckia crinita*, *Parochetus communis*, *Pratia begonifolia* and *Swertia chirata;* triporate in *Epilobium roseum* and tricolporoidate in *Potentilla fulgens* and *Valeriana hardwickii*. The hexa-aperturate condition with colpate or porate condition is found in *Calamintha umbrosa* and *Plantago major* respectively. The poly-aperturate condition with more than six apertures (colpi) is found in *Campanumoea inflata* and *Drymaria cordata* and polyrugate in *Polygonum runcinatum*.

The shape of the grains also vary, e.g. *Campanumoea inflata* have prolate grain (PA/ED : 49/45.5 μm) with tectate exine stratification and echinate surface ornamentation. This plant is a climber with large white flowers. Thus both pollen and flower characters of the plant denote entomophilous pollination. The other prolate grains are mostly tectate (intectate in *Calamintha umbrosa* & *Hypericum patulum*) and either echinate or baculate (scabrate in *Osbeckia crinita*). The spheroidal grains are mostly tectate (intectate in *Polygonum capitatum*, *P. runcinatum*) and either echinate or provided with some other processes (psilate in *Elatostema hookeriana*). The oblate grains are found in *Epilobium roseum* (PA/ED : 56/70 μm) with tripororate, tectate and scabrate nature.

The variation and heterogeneity in pollen characters refers to the statement of West (1964) who pointed out that the pollen assemblage does not normally represent an even mixture of pollen types derived from a homogeneous vegetation, rather does it comprise a collection of pollen from a complex mosaic of plant communities. The different species of such communities have a distinctive pollen morphology which allows a specific determination of the vegetation. The value of such studies could be augmented appreciably where it is possible to supplement the data with pollen records for the more distant past and experimental treatment of postulated vegetational processes (Harris, 1965; Sauer, 1967). However, the present investigation is expected to invoke an integrated view on the plant community of the ground vegetation of relevant places from the fossil recovery of pollen grains, when the existing vegetation may get exterminated by biotic and other factors in course of time. This is probably quite natural because there is hardly any doubt from the previous and present vegetational records that qualitatively and quantitatively the plant community is being depleted. As a matter of fact, the heterogeneous pollen assemblage, as we usually find in fossil record, will reflect the nature of plant population composing the ground vegetation, which in turn will signify the past climatic condition along with a glimpse of the nature of topography of those places.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Explanation of Plate

1. *Campanumoea inflata* (×1000); Polar view showing apertures and surface ornamentation.
2. *Streptolirion volubile* (×1000); Polar view showing aperture.
3. *Polygonum chinense* (×1000); A grain in optical section showing surface ornamentation and baculа (in part).
4. *Valeriana hardwickii* (×1000); Polar view (slightly inclined) showing apertures.
5. *Osbeckia crinita* (×1000); Equatorial view in optical section showing apertures.
6. *Torenia peduncularis* (×1000); Polar view in optical section showing apertures.
7. *Gaultheria nummularioides* (×1000); Whole view of tetrad showing pattern of arrangement of individual cells and apertures (indiscernible).
8. *Pratia begonifolia* (×1000); Equatorial view in optical section showing apertures.
9. *Plantago major* (×1000); A grain showing apertures.
10. *Swertia chirata* (×1000); Inclined polar view in optical section showing apertures and bacula.
11. *Parochetus communis* (×1000); Equatorial view (slightly inclined) showing apertures.
12. *Elatostema hookerianum* (×1000); Polar view showing aperture.
13. *Hypericum patulum* (×1000); Polar view showing aperture .
14. *Calamintha umbrosa* (×1000); Equatorial view showing apertures and surface ornamentation.
15. *Calamintha umbrosa* (×1000); Polar view in optical section showing apertures and surface ornamentation.
16. *Epilobium roseum* (×1000); Polar view showing apertures.
17. *Boenninghausenia albiflora* (×1000); Equatorial view showing apertures.
18. *Potentilla fulgens* (×1000); Polar view showing apertures and surface ornamentation.