

APPENDIX I

IDENTIFICATION AND DESCRIPTION OF POLLEN AND SPORE TAXA
RECORDED FROM MARKHAM VALLEY CORES AND SURFACE SAMPLES

Morphological descriptions and photographs of all identified pollen and spore types and the more common or distinctive unknown types are contained in this appendix. All were recorded on Kodak Panatomic-X film using a Carl Zeiss automatic photomicroscope equipped with X 40 and X 100 planapochromatic oil-immersion objectives.

The identification of unknown types was achieved by comparison with the Dept of Biogeography and Geomorphology's collection of nearly 15 000 reference slides of pollen and spores. The matching of unknown grains with the reference material was aided by the use of photographs and punched-card descriptions of sections of the collection, and also by the computer assisted retrieval system for morphological details of nearly 3 000 of the slides, described by Walker *et al.* (1968) and Guppy *et al.* (1973).

Despite its large size, the reference collection tends predominantly to represent material from the New Guinea highlands and temperate Australia. Although this bias was to a small extent rectified during the course of the project, there still remained a lack of adequate representation from the area under study in particular, and from tropical lowlands in general. For this reason many of the identifications set out below remain tentative only, a few relying solely on published accounts, whilst the general level of identification is certainly not as critical as perhaps could otherwise have been achieved.

The degree of certainty of an identification is indicated by the following conventions:

The suffix 'T.' ('type') indicates that the fossil taxon is identical with the named taxonomic unit although not always uniquely so, other taxa also producing grains or spores that are morphologically indistinguishable from the named type.

The prefix 'cf.' signifies that the type is closely similar, but not identical in every respect with the named taxon or taxa.

The prefix '?' indicates a very tentative identification. The unknown type possibly lies within the group or groups of taxa mentioned, but the allocation is by no means certain.

MORPHOLOGICAL DESCRIPTIONS

The pollen types are grouped into the morphological classes of Faegri and Iversen (1964), except that the sections Polyplicate, Trichotomocolpate, Dicolporate, Fenestrate, Dyad, and Polyad have been omitted as no grains of these categories were found during the course of the investigation. For convenience, all Cyperaceae grains have been included as a subsection of the Monoporate category, although many possess more than one pore. In addition to the pollen morphological groups, two classes (Monolete and Trilete) are used to encompass pteridophyte and allied spores. The complete groups and their representation are shown in Table I.1

The terms used in the morphological description of pollen grains are, except where stated, those defined by Faegri and Iversen (1964), whilst terms relating to pteridophyte spore morphology adhere to the usage of Harris (1955). The term 'exine' is used *sensu* Erdtman (1952) to describe the entire outer sporoderm of both pollen and pteridophyte spores. The

perisporium, or perine, is defined as the outermost layer of some spores, whether or not it is supposed part of the exine, or extraexinous. The descriptions employ the minimum number of terms required to describe a taxon uniquely. Except where statistical parameters are given, size measurements are 'typical' rather than results based on a number of systematic measurements.

TABLE I.1. *Pollen- and spore-morphological groups recognised and their representation*

Number	Morphological category	Number of types recognised	
		Identified	Unidentified
1.	Vesiculate	3	-
2.	Inaperturate	4	1
3.	Monocolpate	4	1
4.	Monoporate & Cyperaceae	15	1
5.	Dicolpate	2	-
6.	Tricolpate	7	3
7.	Stephanocolpate	2	-
8.	Tricolporate	53	17
9.	Stephanocolporate	5	2
10.	Pericolpate/colporate	2	-
11.	Diporate	7	2
12.	Triporate	13	2
13.	Stephanoporate	1	1
14.	Periporate	2	1
15.	Syncolpate/colporate	5	-
16.	Heterocolporate	2	-
17.	Tetrad	4	-
18.	Monolete	15	2
19.	Trilete	9	4

1. VESICULATE

Phyllocladus (Podocarpaceae) (Plate I.1, 1)
128 PHYLO

Bisaccate grain, oval to rectangular in shape in polar view with narrow, flat, bladders. Size variable, max. dimension 30-40 μm .

Podocarpus (Podocarpaceae) (Plate I.1, 2,3)
127 PODOC

Bisaccate grain with large reticulate bladders. Size variable, max. dimension usually between 40-80 μm .

Dacrycarpus T. (Podocarpaceae) (Plate I.1, 4)
129 DACRY

Trisaccate \pm spherical grain. Diameter *c.* 60 μm . This type also includes some *Podocarpus* spp., notably *P. imbricatus*, *P. compactus*, *P. papuanus*, and *P. cinctus*.

2. INAPERTURATE

cf. *Cananga odorata* (Annonaceae) (Plate I.1, 5)
41 CANAN

Grain flattened, \pm oval in ?polar view. Exine thin, sculpturing \pm psilate, but variable. Size very variable, typically 50-90 μm max. dimension.

cf. *Gnetum* (Gnetaceae) (Plate I.1, 6)
130 GNETU

Grain spheroidal, diameter *c.* 15 μm . Exine covered with regularly distributed micro-echinae less than 1 μm in length. Pattern appears almost foveolate at low focus.

Pandanus radula T. (Pandanaeae) (Plate I.1, 7)
2 PANDA

Grain a flattened sphere, maximum dimension *c.* 17 μm . Sculpturing consists of irregularly distributed micro-echinae less than 1 μm in length. A faint porus may be visible. Similar types probably occur in many other *Pandanus* spp.

cf. *Colocasia* (Araceae) (Plate I.1, 8)
20 COLOC

Grain + spherical with regularly distributed, broad-based echinae, at least 2 μm in length.

Unknown 274 (Plate I.1, 9)
135 UK274

Grain with thick, heavily sculptured gemmate exine. Gemmae c. 3 μm in length.

3. MONOCOLPATE

?*Normanbya* T. (Palmae) (Plate I.1, 10)
18 NORMA

A plano-convex grain in equatorial view, with a long colpus. Exine psilate or faintly scabrate. Slightly similar to several Palmae including *Normanbya* and *Archontophoenix*.

cf. Liliaceae (Plate I.1, 11)
22 LILIA

Grain typically 26 x 22 μm . Exine reticulate, with two distinct layers. Generic affinity unknown. Some Palmae, such as *Caryota* have slightly similar pollen.

?Palmae (Plate I.2, 12)
15 PALMA

Grain c. 18 x 12 μm , faintly reticulate. Exine not visibly more than single layered.

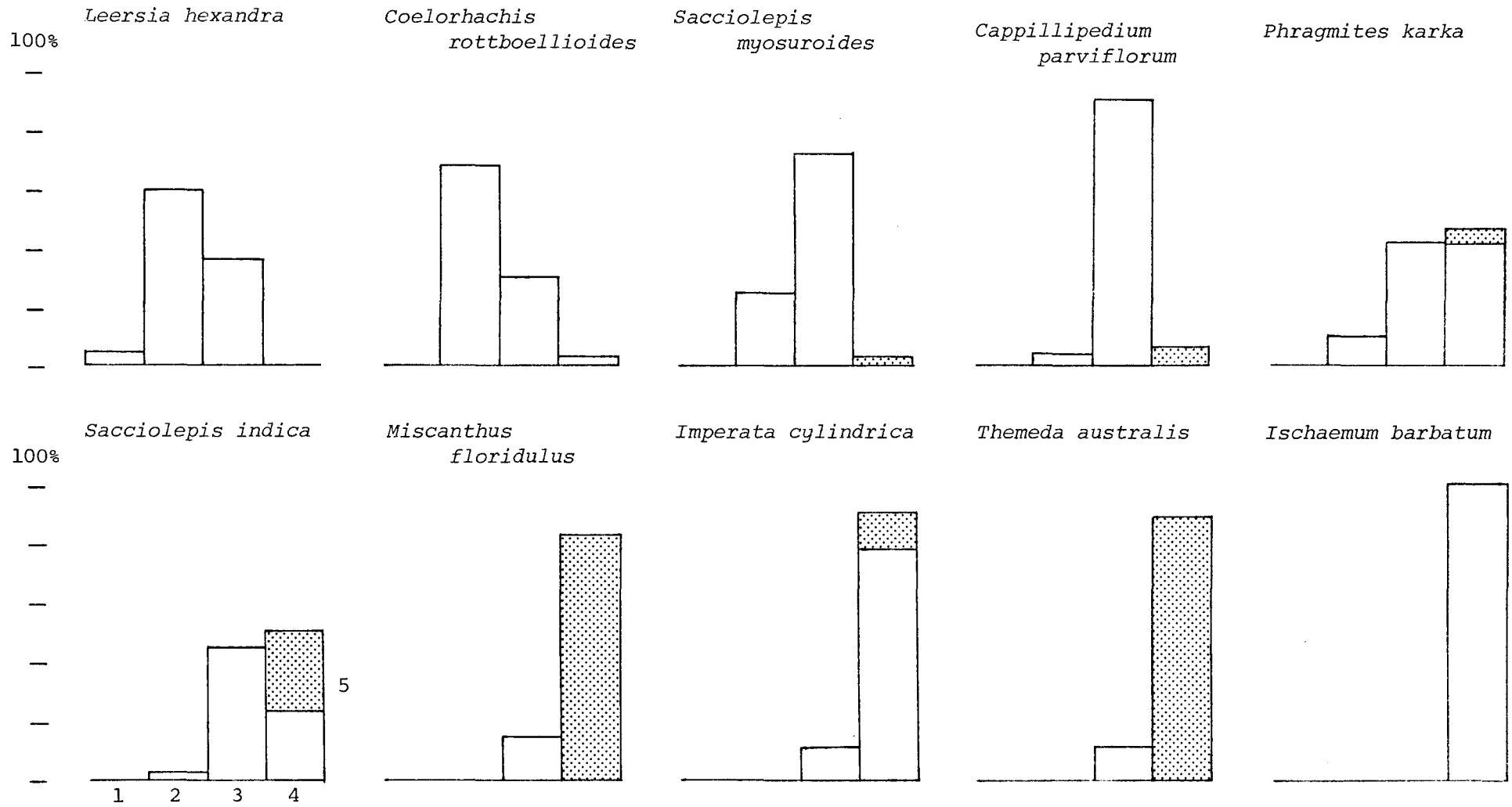
cf. *Arenga* (Palmae) (Plate I.2, 13)
19 ARENG

Grain circular in polar view, oval in equatorial view. Exine echinate, colpus indistinct.

Unknown 156 (Plate I.2, 14)
136 UK156

Plano-convex grain in equatorial view, with thick exine. Sparsely covered with small verrucae.

FIGURE I.1. Size-class distribution of pollen grains from some common grass species



4. MONOPORATE AND CYPERACEAE

4A. Monoporate

Gramineae 1

4 GRAM1

Max. dimension less than 20 μm .

Gramineae 2

5 GRAM2

Max. dimension 20-25 μm .

Gramineae 3

6 GRAM3

(Plate I.2, 15)

Max. dimension 25-30 μm .

Gramineae 4

7 GRAM4

Max. dimension larger than 30 μm .

Gramineae 5

8 GRAM5

(Plate 1.2, 16)

Grain with distinct areolate or coarse scabrate pattern, max. dimension greater than 30 μm . The distribution of the morphological types amongst the more common Markham Valley grasses is shown in Fig. I.1.

Flagellaria (Flagellariaceae)

(Plate I.2, 17)

21 FLAGE

Grain + spherical, c. 16 μm in diameter. Exine reticulate in high focus, becoming almost foveolate in low focus. Porus circular, with annulus, slightly protruding.

Sparganium antipodum T. (Sparganiaceae)

(Plate I.2, 18)

3 SPARG

Grain + spherical. Exine finely reticulate. Porus circular, unpatterned, without annulus.

Typha (Typhaceae)

(Plate I.2, 19)

1 TYPHA

Grain oval to rectangular in either polar or equatorial aspect. Exine thick with reticulate sculpturing. Porus uneven in shape, sometimes indistinct. Grains frequently found clumped, or in tetrads.

Unknown 292

(Plate I.2, 20)

137 UK292

Grain + spherical, exine scabrate. Porus diffuse with ragged edges, no annulus. *Cyrtospermum* (Araceae) is slightly similar, but larger.

Monoporate (undifferentiated)

138 MONPU

4B Cyperaceae

Hypolytrum nemorum T. (Cyperaceae)

(Plate I.2, 21)

14 HYPOL

Grain + spherical, diameter 16 μm . Exine scabrate. Porus unevenly circular or rectangular with distinct, but ragged edge; no annulus. *H. compactum* is similar to *H. nemorum*. Other *Hypolytrum* spp. differ in their pollen morphology.

Cyperaceae A1

(Plate I.2, 22)

9 CYPAL

Heteropolar 'pear-shaped' grains less than 30 μm maximum diameter. This type includes c. 8% of two common *Cyperus* spp., *C. platystylis* and *C. polystachos*.

Cyperaceae A2

10 CYPA2

Heteropolar 'pear-shaped' grain, max. dimension larger than 30 μm . Includes minor proportions of the grains from *Eleocharis dulcis*, *Scirpus grossus*, *Fuirena ciliaris*, and c. 20% of *Carex sarawaketensis* grains.

Cyperaceae B1

11 CYPB1

Grains rectangular to oval from either aspect, max. dimension less than 30 μm . Includes over 90% of *Cyperus polystachos*, *C. platystylis*, *Fimbristylis tenuinervia* and some *Fuirena ciliaris* grains.

Cyperaceae B2

12 CYPB2

(Plate I.2, 23)

Grains rectangular to oval in either aspect, max. dimension larger than 30 μm . Includes a large majority of *Eleocharis dulcis*, *Fuirena ciliaris*, *Fimbristylis dichotoma* and *Carex sarawaketensis* grains.

Cyperaceae C

13 CYP CI

Spherical cyperaceous grains (excluding *Hypolytrum nemorum* T.). About 15% of *Fimbristylis dichotoma* grains belong to this group.

5. DICOLPATE

Calamus (Palmae)

17 CALAM

(Plate I.2, 24)

Grain oval in polar view. Scabrate-reticulate, or verrucate sculpturing. Colpus margin ragged.

? *Metroxylon sagu* (Palmae)

16 METRO

(Plate I.2, 25)

Tentative identification based on description and illustration in Thanikaimoni (1970). Psilate grain with uneven colpus margins. Size *c.* 32 x 23 μm .

6. TRICOLPATE

Anisoptera T. (Dipterocarpaceae) (Plate I.3, 26,27)
93 ANISO

Grain + spherical, diameter c. 17 μm , or oblate (split colpi).
Exine regularly scabrate or per-reticulate. In polar optical
section colpus edges appear rounded; only one layer distinguish-
able in exine. This type also includes *Vatica*. Most *Hopea* grains
are 4- or 6-colpate.

Dysophylla T. (Labiatae) (Plate I.3, 28,29)
119 DYSOP

Grain + spherical, diameter c. 18 μm , or oblate (split colpi).
Exine reticulate with two distinct layers. In polar optical
section, colpus edges appear pointed. Similar pollen grains also
occur in other families including Hammamelidaceae and Verbenaceae.
Many other Labiatae genera produce pollen that is stephanocolpate
or tricolpate and psilate.

cf. Verbenaceae/Bignoniaceae (Plate I.3, 30)
117 VERBI

Grains spherical, or oblate (split colpi). Size c. 35 x 25 μm .
Exine thick, reticulate. Two distinct layers sometimes visible in
exine. This type is found in *Gmelina* and *Callicarpa* (Verbenaceae)
and *Haussemanianthes* (Bignoniaceae).

Timonius T. (Rubiaceae) (Plate I.3, 31)
121 TIMON

Grain + spherical, sometimes appearing inaperturate. Thick exine,
with visible columellae. Sculpturing consists of a large-scale
reticulum, diameter of lumina c. 3 μm . Muri become 'bead-like' in
low focus. *Antirhea* produces similar pollen grains.

Nelumbo nucifera (Nymphaeaceae) (Plate I.3, 32)
37 NELUM

Grain + spherical, although usually found oblate with split colpi.
Diameter variable, typically c. 60 μm . Exine c. 4 μm in thickness,
semitectate, dense columellae becoming + fused in surface focus,
discrete in low focus.

Ilex (Aquifoliaceae)

(Plate I.4, 33,34)

76 ILEXA

Grain prolate to oblate, size variable, diameter typically 18 μm . Exine clavate, clavae becoming smaller towards the psilate colpus. A small circular porus is sometimes visible within the colpus.

Endospermum (Euphorbiaceae)

(Plate I.4, 35)

72 ENDOS

Grain oblate, size variable. Exine thick, sculpturing consists of verrucae or gemmae that appear angular in optical section. Maximum diameter of elements is 2 μm , becoming smaller towards the colpi.

Unknown 235

(Plate I.4, 36)

139 UK235

Grain prolate, lobate in polar view, size c. 43 x 24 μm . Sculpturing reticulate, columellae clearly visible in exine optical section.

Unknown 293

(Plate I.4, 37)

140 UK293

Grain \pm circular in equatorial view, inter-hexagonal in polar view. Diameter c. 31 μm . Sculpturing reticulate, scale becoming smaller towards poles. Maximum exine thickness c. 4 μm .

Tricolporate (undifferentiated)

141 TRICU

7. STEPHANOCOLPATE

cf. *Myrsine* T. (Myrsinaceae)

(Plate I.4, 38,39)

107 MYRSI

Grain prolate to slightly oblate. Three to five colpi, often not parallel to polar axis. Colpus \pm straight, with ragged margin. Exine scabrate or faintly microreticulate. Diameter c. 20 μm . Pollen grains of this type from various species of *Myrsine* have been described by Morley (1976) and Selling (1974). Some *Rapanea* spp. appear to produce similar grains (van der Hammen *et al.* 1973).

Nothofagus (Fagaceae)
25 NOTHO

(Plate I.4, 40)

Grain \pm hexagonal, depressed oval shape in equatorial view. Colpus short; sculpturing composed of regularly arranged minute baculae. All grains encountered fall within the '*brassii*' pollen subtype.

8. TRICOLPORATE

8A. Tricolporate - max. diameter smaller than 15 μm

Elaeocarpus T. (Elaeocarpaceae)
85 ELAEO

(Plate I.4, 41)

Grain oblate to prolate, usually inter-sub-angular. Max. dimension 7 - 10 μm . Exine psilate. Meridional colpus interrupted at equator, although no distinct transverse aperture usually distinguishable.

Octomeles sumatrana (Datiscaceae)
96 OCTOM

(Plate I.4, 42)

Grain oblate, \pm sub-angular, typically 9.5 x 11 μm . Sculpturing faintly scabrate. Exine Max. thickness greater than 1 μm , becoming thinner towards the colpi. Polar area small, colpus long, unpatterned, although often indistinct. Porus small, \pm circular, indistinct especially in surface focus.

Macaranga ovatifolia T. (Euphorbiaceae)
67 MACOV

(Plate I.4, 43)

Grain \pm spherical, diameter less than 10 μm . Faintly but distinctly scabrate. Transverse colpus almost slit-like, patterned in surface focus. Apart from the shape and patterning of the transverse colpus, this pollen type is almost identical to that produced by some *Aceratium* spp. (Elaeocarpaceae). A proportion of grains from other *Macaranga* spp., in particular *M. fimbriata*, may be included in this category.

Macaranga (Euphorbiaceae)
66 MACAR

(Plate I.4, 44,45)

Grains prolate or oblate, semi-angular, or inter-sub-angular, maximum diameter usually less than c. 13 μm . Exine scabrate to microreticulate, appearing thickened around the colpi in polar view. Transverse colpus rectangular or slit-like, patterned in surface focus only.

Macaranga/Mallotus (Euphorbiaceae)

61 MACMA

Pollen grains of *Macaranga* or *Mallotus* configuration that cannot be assigned with certainty to either genus. Size range c. 13 to 18 μm max. dimension.

Rhamnaceae

(Plate I.4, 46,47)

84 RHAMN

Grains usually oblate to circular in equatorial view, \pm angular in polar view. Size variable, max. diameter usually less than 15 μm . Sculpturing psilate to faintly scabrate. Colpus long, transverse porus \pm circular, with partial annulus. This type probably includes many rhamnaceous genera with predominantly small pollen grains, such as *Ventilago* and *Gouania*, and a minor proportion of the pollen of others, such as *Zizyphus*, and *Alphitonia*.

Spiraeopsis T. (Cunoniaceae)

(Plate I.5, 48)

47 SPIRA

Grains \pm spherical, very small, diameter c. 8 μm . Sculpturing faintly reticulate, columellae visible in exine optical section. Transverse porus \pm circular, although small and indistinct especially in surface focus. This type also includes a large proportion of grains from the genera *Pullea*, *Aistopetalum*, *Opocunonia*, *Spiraeanthemum* and *Ackama*.

Weinmannia T. (Cunoniaceae)

(Plate I.5, 49)

46 WEINM

Grain oblate, semi-angular or sub-angular, c. 10 x 11 μm . Sculpturing faintly reticulate, columellae visible in exine section. Transverse colpus \pm rectangular, slightly constricted by the meridional colpus. This type may include a small proportion of grains from other tricolporate genera of Cunoniaceae.

Hypserpa (Menispermaceae)

(Plate I.5, 50)

39 HYPSE

Grain oblate to prolate, polar axis c. 12 to 15 μm . Exine distinctly two-layered, sculpturing reticulate or microreticulate. Transverse porus \pm circular, patterned in surface focus, sometimes indistinct.

Uncaria T. (Rubiaceae)
125 UNCAR

(Plate I.5, 51,52)

Grain oblate to prolate, maximum diameter usually less than 11 μ m. Morphologically similar to *Neonauclea*, although sculpturing less distinct, usually microreticulate or faintly scabrate, and porus smaller. A small proportion of *Neonauclea* grains may be included in this type.

Nauclea T. (Rubiaceae)
124 NAUCL

(Plate I.5, 53)

Grains usually oblate, equatorial diameter 11 - 15 μ m. Exine up to 1.5 μ m in thickness, columellae visible in optical section. Sculpturing finely reticulate. Meridional colpus distinct with thickened margo. Porus circular with thickened annulus. The type is also found in *Neonauclea*, *Sarcocephalus* and *Anthocephalus*. Pollen of these genera tends to be smaller with less pronounced sculpturing than that of *Nauclea*, although ranges overlap. This is perhaps to be expected given the complex generic synonymy of the *Naucleae* (Ridsdale, 1970). A small proportion of *Uncaria* grains may also be represented in this category.

Tetracera T. (Dilleniaceae)
92 TETRA

(Plate I.5, 54)

Grain oblate to prolate. Exine visibly two-layered, sculpturing clearly reticulate. Size and shape very variable. Colpus usually splits, enclosing a large \pm oval porus, unpatterned, with ragged edges. This pollen type also occurs in some species of *Hibbertia*.

Olea (Oleaceae)
112 OLEAS

(Plate I.5, 55)

Grain oblate, or \pm spherical, diameter c. 14 μ m. Exine thick, distinctly two layered, columellae visible. Sculpturing reticulate in surface focus, discrete columellae visible at low focus. Porus indistinct.

Rapanea cf. *achradaefolia* T. (Myrsinaceae)
106 RAPAN

(Plate I.5, 56)

Grain prolate, circular to inter-semi-angular in polar view. Sculpturing regularly scabrate, polar area small. Colpus unpatterned with slightly thickened margo, constricted at equator although no clear transverse aperture visible.

Unknown 194
142 UK194

(Plate I.5, 57)

Grain prolate, \pm sub-angular, size variable, typically 12 x 10 μm . Exine relatively thick *c.* 1 μm , sculpturing psilate to faintly scabrate. Meridional colpus interrupted at equator, although transverse aperture not clearly visible.

Unknown 109
143 UK109

(Plate I.5, 58)

Grain \pm spherical, diameter *c.* 12 μm . Exine distinctly two layered; sculpturing scabrate. Meridional colpus narrow; transverse colpus large, rectangular to oval, unpatterned. This type bears a slight similarity to some grains from the genus *Ternstroemia* (Theaceae).

Unknown 104
144 UK104

(Plate I.5, 59)

Grain oblate, almost apiculate in equatorial view, angular in polar view. Diameter *c.* 12 μm . Max. exine thickness *c.* 1.5 μm . Sculpturing psilate, or faintly scabrate. Transverse colpus protruding, constricted by meridional colpus, unpatterned.

Unknown 60
145 UK060

(Plate I.5, 60)

Grain \pm spherical, diameter *c.* 14 μm . Sculpturing consists of a fine reticulum of isodiametric elements. Columellae clearly visible in exine optical section. Meridional colpus narrow, unpatterned; transverse colpus rectangular, patterned in surface focus. This type bears a superficial resemblance to the pollen produced by some genera of Sterculiaceae, Euphorbiaceae and Flacourtiaceae.)

Tricolporate, Section A, (undifferentiated)
146 3CPAU

8B. Tricolporate, max. diameter larger than 15 μm sculpturing scabrate or psilate, grain prolate

Castanopsis T. (Fagaceae) (Plate I.5, 61,62)
26 CASTA

Grains prolate, polar axis usually 14 - 20 μm , although may be larger. Inter-semi-angular or inter-semi-lobate in polar view. Sculpturing usually psilate or faintly scabrate, a few species coarsely scabrate. Transverse colpus rectangular or slit-like.

Lithocarpus spp. are generally more prolate, and larger than those of *Castanopsis*, however ranges of size and morphology overlap considerably.

Rhizophora apiculata T. (Rhizophoraceae) (Plate I.5, 63)
99 RHIZO

Grain prolate, size variable, polar axis usually 17 - 25 μm . Exine thick, evenly scabrate. Columellae sometimes visible. Distinct equatorial colpus is faintly patterned in surface focus.

cf. *Crotalaria* T. (Leguminosae) (Plate I.5, 64)
53 CROTA

A very variable type, both in size and morphology. Usually prolate, inter-semi-lobate c. 20 x 13 μm . Sculpturing evenly scabrate, or faintly microreticulate. Meridional colpus long, with slightly thickened margo, usually asymmetrically constricted at equator. Transverse colpus oval, patterned in surface focus. This pollen type is produced by some genera of Papilionatae, including *Crotalaria*, and by several species of *Cassia* (Caesalpinioideae).

?Leguminosae (Papilionatae) B (Plate I.5, 65)
50 LEGPB

Grains prolate, inter-sub-angular, or inter-semi-lobate. Sculpturing psilate or faintly scabrate. Colpus long, interrupted at equator by large indistinct, sometimes oval, transverse aperture.

cf. *Bischofia* (Euphorbiaceae) (Plate I.5, 66,67)
71 BISCH

Grain circular or prolate in equatorial view, \pm circular in polar view. Size variable, polar axis c. 14 - 18 μm . Sculpturing microreticulate or regularly scabrate. Distinct columellae visible in exine section. Transverse colpus rectangular, patterned in surface focus, often slit-like. Meridional colpus narrow, unpatterned at any level.

Antidesma (Euphorbiaceae) (Plate I.6, 68,69)
68 ANTID

Grain prolate, often lobate. Size variable, typically 18 x 12 μm . Transverse colpus rectangular, bordered by distinct, parallel costae.

Euphorbia hirta T. (Euphorbiaceae) (Plate I.6, 70)
59 EUPHI

Grain prolate, inter-semi-lobate, c.24 x 16 μm . Exine thick, up to 3 μm , with distinct columellae; sculpturing coarsely scabrate, or almost microreticulate. Exine becomes thinner around the psilate colpus area. Transverse colpus \pm oval or rectangular. This type is also found in other *Euphorbia* spp. including *E. velutina*.

cf. *Euphorbia* (Euphorbiaceae) (Plate I.6, 71)
58 EUPHA

Grains prolate c. 25 x 20 μm , with small polar area. Sculpturing coarsely scabrate to unevenly reticulate. Exine thick, two layers visible. Type found in some *Euphorbia* spp. and may also include representatives from other genera of the family, such as *Sapium*.

Rhus T. (Anacardiaceae) (Plate I.6, 72)
75 RHUST

Grain prolate, sub-angular, or semi-angular. Sculpturing scabrate to microreticulate. Transverse colpus rectangular, very equatorially elongated, edges ragged. This type closely resembles *Rhus taitensis* and similar forms occur in other genera of Anacardiaceae.

Diospyros cf. *ferrea* (Ebenaceae) (Plate I.6, 73)
110 DIOSP

Grain prolate, inter-hexagonal to semi-lobate. Exine faintly scabrate to psilate. Meridional colpus faint in surface focus, transverse colpus \pm circular, with indistinct edges.

Planchonella T. (Sapotaceae) (Plate I.6, 74,75)
108 PLANC

Grain prolate, size variable but polar axis usually larger than 30 μm . Colpus long and narrow. Porus well defined, circular or oval, unpatterned, without thickened annulus; often protruding. This type also includes *Chrysophyllum* and *Pouteria*. Most other genera of Sapotaceae produce 4-colporate pollen predominantly.

cf. *Palaquium* (Sapotaceae) (Plate I.6, 76)
109 PALAQ

Grain prolate, sub-angular, c. 31 x 26 μm . Sculpturing evenly scabrate or faintly microreticulate. Faint columellae visible in exine optical section. Transverse colpus oval, equatorially elongated. This type resembles a proportion of grains from the genus *Palaquium* but differs from *Planchonella* T. only in the sculpturing pattern and transverse colpus morphology.

Unknown 79 (Plate I.6, 77,78)
147 UK079

Grain prolate, inter-semi-angular size c. 18 x 12 μm . Sculpturing psilate or faintly scabrate. Colpus long and narrow, polar area small. Transverse aperture small, shape indistinct. Thickened costae visible around aperture especially in optical section.

Unknown 119 (Plate I.6, 79)
148 UK119

Grain prolate, inter-sub-angular, size c. 18 x 11 μm . Sculpturing scabrate. Exine max. thickness c. 2.5 μm . Meridional colpus long, polar area small. Transverse colpus wide, slit-like, patterned, with distinct thickened costae.

Unknown 174 (Plate I.6, 80)
149 UK174

Grain prolate, apiculate in equatorial view, sub-angular in polar view. Sculpturing coarsely scabrate to microreticulate. Polar area small. Transverse aperture indistinct.

Tricolporate, Section B, (undifferentiated)
150 3CPBU

8C. Tricolporate, larger than 15 μm , sculpturing scabrate or psilate, grain spherical to oblate

cf. Euphorbiaceae (Plate I.6, 81)
56 EUPHT

Grain oblate c. 14 x 15.5 μm . Sculpturing scabrate, meridional colpus narrow, polar area small. Transverse colpus patterned in surface focus; faint costae present.

Mallotus T. (Euphorbiaceae) (Plate I.6, 82)
60 MALLO

Grain spherical to oblate, max. diameter larger than 17 μm . Two broad types may be distinguished:

M. philippinensis T. with very short colpi, \pm circular in polar view.

M. paniculata T. with longer colpi, semi-angular or almost inter-hexagonal in polar view. (Includes *M. ricinoides*).

Cleidion T. (Euphorbiaceae) (Plate I.6, 83)
73 CLEID

Grain inter-semi-lobate, \pm circular in equatorial view. Max. diameter c. 17 - 20 μm . Transverse colpus wide, patterned in surface focus.

cf. *Muehlenbeckia* (Polygonaceae) (Plate I.6, 84)
36 MUEHL

Grain spherical to prolate, diameter c. 18 μm . Exine coarsely scabrate. Polar area small. Transverse colpus rectangular to oval, equatorially elongated.

cf. *Rumex brownii* (Polygonaceae) (Plate I.7, 85)
35 RUMEX

Grain inter-sub-angular, oblate, c. 20 x 22 μm . Sculpturing scabrate to unevenly reticulate. Porus \pm circular, with slightly thickened annulus. Heteropolar, with arci linking colpi at one pole.

Dodonaea (Sapindaceae) (Plate I.7, 86)
81 DODON

Grain \pm spherical, size variable. Colpus narrow and long, polar area small. Porus circular to slightly oval, equatorially elongated, and protruding. This type is characteristic of some New Guinea and North Queensland *Dodonaea* spp.

Acaena (Rosaceae) (Plate I.8, 87)
48 ACAEN

Grain spherical, or oblate, max. diameter c. 27 μm . Sculpturing coarsely scabrate. Meridional colpus short, often indistinct. Transverse colpus \pm oval, equatorially elongated, with thin protruding operculum.

?*Parinari* (Rosaceae)

(Plate I.7, 88)

49 PARIN

Grain oblate to prolate, semi-angular. Size variable. Sculpturing coarsely scabrate. Polar area small. Meridional colpus with slightly thickened margo. Transverse colpus indistinct. This type slightly resembles pollen from some species of *Thea* and *Gordonia* (Theaceae), *Indigofera* (Leguminosae).

Unknown 123

(Plate I.7, 89)

151 UK123

Grain oblate to prolate, inter-semi-angular. Max. diameter c. 16 μm . Sculpturing microreticulate, elements less than 1 μm in diameter. Columellae clearly visible in exine section. Meridional colpus constricted at equator although clear transverse aperture not visible in surface focus.

Unknown 221

(Plate I.7, 90)

152 UK221

Grain oblate, \pm sub-angular, c. 15 x 17 μm . Sculpturing coarsely scabrate, colpus area psilate. Polar area small. Porus \pm oval, equatorially elongated, extending to the margin of the meridional colpus.

Unknown 218

(Plate I.7, 91)

153 UK218

Grain oblate, c. 18 x 14 μm . Exine scabrate. Meridional colpus wide, unpatterned. In polar view exine becomes thinner towards colpus. Meridional colpus constricted at equator. Transverse colpus patterned in surface focus.

Tricolporate, Section C (undifferentiated)

154 3CPCU

8D. Tricolporate, larger than 15 μm , sculpturing reticulate

Vandasia T. (Leguminosae) (Plate I.7, 92)
52 VANDA

Grain \pm circular in equatorial view, semi-angular in polar view. Max. diameter *c.* 16 μm . Sculpturing a small scale reticulum, with a psilate margo around the meridional colpus. Transverse colpus rectangular to oval, unpatterned. Morphologically similar grains occur in other genera of the Papilionatae, including *Pterocarpus*, *Pueraria*, and *Tephrosia*, and in some species of *Ternstroemia* (Theaceae).

cf. *Sterculia edelfeltii* (Sterculiaceae) (Plate I.7, 93,94)
91 STERE

Grain \pm spherical, diameter *c.* 18 μm . Reticulate sculpturing consisting of elongated elements of variable size. Transverse colpus \pm rectangular, patterned in surface focus.

Platea excelsa (Icacinaceae) (Plate I.7, 95)
80 PLATE

Grain \pm spherical. Exine *c.* 2.5 μm thick, two layered, with clearly visible columellae. Reticulum breaks up into separate columellae in low focus. Transverse colpus \pm rectangular, indistinct in surface focus.

Melanolepis T. (Euphorbiaceae) (Plate I.7, 96,97,98)
70 MELAN

Grain spherical to oblate, diameter *c.* 25 μm . Exine thick, sculpturing reticulate. Transverse colpus \pm rectangular, patterned in surface focus only. This type is found also in *Bridelia* and *Cleistanthus*, although the grains are usually slightly smaller. In some *Bridelia* spp., the muri are aligned to form 'pseudo-striations' *sensu* Punt (1962), whereas in *Cleistanthus*, the reticulum is less distinct.

Boerlagiodendron (Araliaceae) (Plate I.7, 99,100)
104 BOERL

Grain angular to sub-angular, oblate. Sculpturing dimorphic: microreticulate around colpi and porae, and disjunctly reticulate between the colpi.

Morinda (Rubiaceae)
123 MORIN

(Plate I.7, 101)

Oblate to spherical grain, size variable. Sculpturing reticulate, colpus area psilate. Porus large, \pm circular with heavily thickened annulus.

Echium cf. *plantagineum* (Boraginaceae)
116 ECHIP

(Plate I.8, 102)

Grain heteropolar, 'pear-shaped' c. 22 x 15 μm . Exine microreticulate. Porus oval, with slightly thickened annulus.

Evodia T. (Rutaceae)
55 EVODI

(Plate I.8, 103,104)

Grain prolate c. 18 x 13 μm . Exine two-layered, evenly reticulate. Transverse colpus rectangular, unpatterned. This type includes *E. xanthoxyloides* and other *Evodia* spp., and some species of *Melicope*.

Aporosa (Euphorbiaceae)
69 APORO

(Plate I.8, 105,106)

Grain inter-sub-angular, prolate to circular in equatorial view, size c. 18 x 14 μm . Exine finely reticulate. Transverse colpus narrow, slit-like, c. 6 μm in length.

?Leguminosae (Papilionatae) D
51 LEGPD

(Plate I.8, 107,108)

Grains prolate, inter-sub-angular or inter-semi-lobate. Max. diameter 18-25 μm . Sculpturing distinctly microreticulate. Meridional colpus, long, constricted or distorted at equator by the transverse aperture. This type is found in genera of the Papilionatae such as *Pueraria*, and *Gompholobium* and in several species of *Hypericum* (Guttiferae).

Brachychiton T. (Sterculiaceae)
88 BRACH

(Plate I.8, 109)

Grain prolate, size variable. Exine two layered; sculpturing reticulate; max. diameter of luminae c. 2 μm , smaller towards colpi. Meridional colpus unpatterned, sharply defined. Transverse aperture oval or rectangular. Grains of this type occur in some *Brachychiton*, *Argyrodendron*, *Pterocymbium*, and *Sterculia* species.

Microcos T. (Tiliaceae) (Plate I.8, 110)
86 MICRO

Grain prolate to spherical, typically 21 x 14 μm . Reticulum similar to *Trichospermum*, but smaller scale, and more uniform in size. Transverse colpus wide but indistinct. Similar grains are produced by *Columbia*, and *Grewia paniculata*.

Trichospermum (Tiliaceae) (Plate I.8, 111)
87 TRICO

Grain prolate c. 30 x 18 μm . Exine reticulate, largest diameter of lumenae c. 2.5 μm , decreasing in size towards the colpi.

Rutaceae/Araliaceae T. (Plate I.8, 112,113)
54 RUTAR

Grains prolate, usually 20 - 30 μm polar axis. Exine + reticulate, often distinctly two layered. Meridional colpus clearly interrupted by transverse aperture, usually rectangular, which may be patterned in surface focus. A diverse type found in many genera including *Evodiella*, *Acronychia* and *Flindersia* (Rutaceae), and *Schefflera* and *Harmsioplanax* (Araliaceae).

Unknown 309 (Plate I.8, 114)
155 UK309

Grain slightly oblate, semi-angular, size c. 20 x 22 μm . Sculpturing finely reticulate, colpus area psilate. Porus oval, meridionally elongated, unpatterned.

Unknown 310 (Plate I.8, 115)
156 UK310

Grain + spherical, diameter c. 40 μm . Max. exine thickness c. 2.5 μm . Sculpturing a reticulum consisting of + circular elements. Colpus area psilate. Porus unpatterned, + circular, without annulus, fully enclosed by colpus. Polar area small.

Tricolporate, Section D, (undifferentiated)
157 3CPDU

8E. Tricolporate, larger than 15 μm . Other sculpturing configurations.

Anacardiaceae (Plate I.8, 116,117)
74 ANACA

Grains \pm spherical with long meridional colpus and distinct \pm rectangular transverse colpus. Sculpturing faintly striate. Pollen similar to this type is produced by several genera of Anacardiaceae, including *Euroschinus* and *Semecarpus*.

cf. *Vitex acuminata* (Verbenaceae) (Plate I.9, 118)
118 VITEX

Grain prolate, inter-sub-angular, size c. 18 x 12 μm . Exine thick with strongly striate sculpturing. Transverse colpus \pm oval to rectangular. This type is very similar to *V. acuminata*, although is generally slightly smaller, and has more pronounced sculpturing. Slightly similar striate grains are found in several genera of the Anacardiaceae.

Ganophyllum falcatum (Sapindaceae) (Plate I.9, 119,120)
82 GANOP

Grain \pm spherical to prolate. Size variable, polar axis c. 12 - 16 μm . Exine sparsely covered with minute verrucate or baculate elements less than 1 μm in height. Porus \pm circular, patterned in surface focus.

Trichadenia philippinensis (Flacourtiaceae) (Plate I.9, 121)
95 TRICA

Grain spherical to prolate, c. 23 x 20 μm , size variable. Sculpturing dimorphic; \pm regularly arranged gemmae, c. 2 - 3 μm in width interspersed with smaller (less than 1 μm) gemmate elements.

Compositae (Tubuliflorae) (Plate I.9, 122)
126 COMPT

Grains usually oblate to spherical, size variable. Exine thick, with echinate sculpturing of variable size and density. An unpatterned, usually circular, porus may be visible. This type includes the majority of genera in the Tubuliflorae sub-family.

Tricolporate, Section E, (undifferentiated)
158 3CPEU

9. STEPHANOCOLPORATE

Acalypha (Euphorbiaceae) (Plate I.9, 123)
64 ACALY

Grain circular to oblate, 3- or 4-colporate. Colpus very short, often indistinct. Exine scabrate. Porus \pm circular, with irregular annulus, slightly protruding in polar view.

Quintinia (Saxifragaceae) (Plate I.9, 124,125)
44 QUINT

Grain prolate, 5-colporate, *c.* 15 x 13 μ m. Exine thick, psilate to slightly scabrate. Colpus interrupted at equator, although clear porus not always visible in surface focus.

Claoxylon (Euphorbiaceae) (Plate I.9, 126)
62 CLAOX

Grain prolate, 4- or 3-colporate. Exine faintly reticulate, transverse colpus indistinct.

Phyllanthus cf. urinaria (Euphorbiaceae) (Plate I.9, 127,128)
63 PHYLA

Grain prolate, 21 x 14 μ m, 5-colporate, or 3-colporate. Exine thick, *c.* 2.5 μ m, columellae visible in optical section, strongly reticulate. Colpus straight, porus small, circular, patterned in top focus only. This type closely resembles *Phyllanthus urinaria* although the slide in the ANU collection has predominantly 4-colporate grains. Punt and Rentrop (1973) describe a similar 5-colporate morphology for *P. caroliniensis*.

Glochidion T. (Euphorbiaceae) (Plate I.9, 129)
65 GLOCH

Grain 4-colporate or 4-colpate, usually prolate, circular in polar view. Exine *c.* 3 μ m thick, with reticulate sculpturing; diameter of luminae up to 2 μ m. Colpus straight, very distinct, small circular porus sometimes visible. Closely similar types are found in some *Phyllanthus* spp.

Unknown 106
159 UK106

(Plate I.9, 130)

Grain + circular, angular in polar view, diameter *c.* 18 - 24 μm , 4-colporate. Sculpturing coarsely scabrate. Colpus narrow and short, length not more than twice the diameter of the transverse porus. Exine thickened around the protruding porus. Two or more of the porae may be connected by an equatorial arcus. This type superficially resembles some *Dysoxylum* spp. (Meliaceae) although the latter are psilate, and larger than 30 μm .

Stephanocolporate (undifferentiated)
160 STCPU

10. PERICOLPATE/COLPORATE

?*Evolvulus* (Convolvulaceae)
115 EVOLV

(Plate I.9, 131)

Grain + spherical, diameter *c.* 21 μm , with six short colpi. Exine minutely baculate in surface focus, becoming scabrate to reticulate in low focus. Colpus patterned in surface focus. This type slightly resembles *Evolvulus*, and some *Merremia* spp. (Convolvulaceae), although these are generally larger than 30 μm in diameter, and have a less complex exine pattern.

?Euphorbiaceae
57 EUPHO

(Plate I.9, 132)

Grain 5- or 6-colporate, reticulate. Transverse colpus and sculpturing similar to some euphorbiaceous taxa such as *Claoxylon*.

11. DIPORATE

Urticaceae/Moraceae (diporate)
30 URMO2

(Plate I.9, 133)

Grain + circular in polar view, oval in equatorial view. Psilate or scabrate. Porus small with thickened annulus. Includes the genera *Elatostema*, *Debregeasia*, *Laportia* and *Cypholophus* (Urticaceae) and *Maclura* and *Malaisia* (Moraceae).

Pilea T. (Urticaceae) (Plate I.9, 134)
33 PILEA

Grain oval in both polar and equatorial view. Psilate or faintly scabrate. Small, circular porus with annulus. Small proportions of this type are produced by other genera of Urticaceae.

Streblus T. (Moraceae) (Plate I.9, 135)
32 STREB

Grain oval in polar view. Exine scabrate, porus circular without annulus. This type also includes *Antiaris*.

Trema (Ulmaceae) (Plate I.9, 136)
28 TREMA

Grain circular or oval in polar view. Sculpturing unevenly scabrate, with columellae visible in optical cross-section. Porus circular with slightly thickened annulus.

Sphenostemon cf. *papuanum* (Aquifoliaceae) (Plate I.9, 137)
77 SPHEN

Grain diporate or triporate; depressed oval shape in equatorial view. Exine reticulate with two distinct layers. Porus unpatterned, circular, without annulus.

Polyporandra scandens (Icacinaceae) (Plate I.9, 138)
78 POLYP

Oblate grain with sparse echinae. Porus circular with thickened annulus. Size c. 16 x 18 μm .

Alyxia (Apocynaceae) (Plate I.10, 139)
114 ALYXI

Asymmetrical plano-convex grain. Exine reticulate; porus circular, very large.

Unknown 279 (Plate I.10, 140)
161 UK279

Reticulate grain with distinctly two-layered exine. Porus circular with annulus.

Diporate (undifferentiated)
162 DIPOU

12. TRIPORATE

Urticaceae/Moraceae (Triporate) (Plate I.10, 141)
31 URMO3

Grain circular in polar view. Exine psilate or scabrate, porus small with thickened annulus. Type includes *Elatostema*, *Pipturus*, and *Pouzolzia* (Urticaceae) and *Morus* and *Malaisia* (Moraceae).

Stemonurus (Icacinaceae) (Plate I.10, 142)
79 STEMO

Oblate semi-angular grain, psilate or faintly scabrate. Exine thickened around edge of porus in optical section. Equatorial diameter c. 12 μm .

Helicia (Proteaceae) (Plate I.10, 143)
34 HELIC

Oblate angular grain with protruding vestibulate porae. Sculpturing scabrate; size 10 x 19 μm .

Celtis (Ulmaceae) (Plate I.10, 144)
27 CELTI

Grain \pm circular in polar view, oblate. Sculpturing coarsely scabrate, columellae distinctly visible in optical cross-section. Porus circular with thickened annulus, sometimes slightly protruding. Max. diameter typically 15 - 17 μm .

cf. *Engelhardtia* (Juglandaceae) (Plate I.10, 145)
24 ENGEL

Grain oblate \pm circular in polar view with scabrate to faintly microreticulate sculpturing. Porus indistinct, not protruding. Equatorial diameter c. 18 μm .

Casuarina (Casuarinaceae) (Plate I.10, 146)
23 CASUA

Spherical, or oblate grain with protruding porae. Exine generally + scabrate. Equatorial diameter typically 25 μm , and not usually less than 20 μm .

Haloragis (Haloragaceae) (Plate I.10, 147)
103 HALOR

Oblate grain, circular in polar view. Oval or slit-like porus (or colpus), protruding. The *Haloragis* spp. in the ANU reference collection are predominantly 4- or 5-stephanoporate or colpate.

Polyosma (Saxifragaceae) (Plate I.10, 148,149)
45 POLYO

Oblate + circular grain with protruding porae. Exine psilate or faintly scabrate, except around porus where it is unevenly reticulate and thickened. Porus + round, with diffuse margin.

Sonneratia caseolaris (Sonneratiaceae) (Plate I.10, 150,151,
97 SONNE 152)

Prolate grain with protruding porae and dimorphic sculpturing. An equatorial band is finely verrucate, whilst the polar caps are psilate or scabrate. This type corresponds to several of the *S. caseolaris* sub-types proposed by Muller (1969), but is considerably smaller than any, with a polar axis 32 -38 μm in length. The pollen is identical in morphology and size to that of Havel and Kairo's collection from Labu Swamp (NGF 17198).

Stephania japonica T. (Menispermaceae) (Plate I.10, 153)
38 STEPJ

Oblate, semi-angular grain with a thick reticulate exine. Porus not very distinct in equatorial view. Size typically 11 x 13 μm . This type includes *S. hernandifolia*. *S. erecta* is 4-porate.

Kleinhovia hospita (Sterculiaceae) (Plate I.11, 154)
89 KLEIN

Semi-angular, oblate grain, typically 7 x 18 μm in size. Distinctly or faintly reticulate sculpturing, with columellae visible in exine optical section. Porus sometimes protruding, or almost vestibulate.

cf. *Sterculia* (Sterculiaceae) (Plate I.11, 155)
90 STERC

Grain \pm circular, oblate, max. diameter c. 17 - 20 μ m. Exine thick, sculpturing reticulate, with luminae of varying size and shape, often elongated. Porus \pm circular, indistinct in surface focus, without annulus. This type is very similar to the pollen of a *Sterculia* sp. (Craven and Schodde coll. no. 1388) from Morobe Province.

Symplocos (Symplocaceae) (Plate I.11, 156)
111 SYMPL

Semi-angular, oblate grain with slightly protruding porae. Exine sculpturing sparsely echinate. Similar to New Guinea *Symplocos* spp.

Unknown 147 (Plate I.11, 157)
163 UK147

Spherical to oblate grain with thick reticulate exine. Porus \pm circular with thickened annulus.

Triporate (undifferentiated)
164 TRIPU

13. STEPHANOPORATE

cf. *Aphananthe* (Ulmaceae) (Plate I.11, 158)
29 APHAN

Oblate grain c. 20 x 26 μ m. Exine faintly scabrate. Four small, circular porae, unpatterned, with slight annulus.

Stephanoporate (undifferentiated)
165 STEPUP

14. PERIPORATE

Plantago (Plantaginaceae) (Plate I.11, 159,160)
120 PLANT

Spherical grain with 8 to 13 porae. Scabrate to faintly reticulate sculpturing. Porus circular, unpatterned, with a narrow annulus.

cf. *Trimenia* (Monimiaceae) (Plate I.11, 161)
42 TRIME

Grain with about 8 porae. Exine thick, coarsely scabrate. Porus + circular, unpatterned, without annulus.

Unknown 290 (Plate I.11, 162)
166 UK290

Grain *c.* 15 - 18 μm in diameter, with 5 to 7 porae. Exine coarsely scabrate.

15. SYNCOLPATE AND SYNCOLPORATE

15A. Syncolpate

Tinospora (Menispermaceae) (Plate I.11, 163)
40 TINOS

Inter-sub-angular grain with thick, reticulate exine. Circular to prolate in equatorial view, diameter *c.* 20 μm .

Barringtonia T. (Barringtoniaceae) (Plate I.11, 164)
98 BARRI

Grain with thick + psilate exine, often becoming reticulate towards the colpi. Circular to prolate in equatorial view, size variable, typically 40 x 30 μm . *Planchonia* is similar.

Nymphoides (Gentianaceae) (Plate I.11, 165,166)
113 NYMPH

Oblate semi-angular grain, sparsely scabrate, with distinct 'island' at pole. Size variable, typically 20 x 28 μm .

15B. Syncolporate

Tristiropsis T. (Sapindaceae) (Plate I.11, 167)
83 TRIST

Oblate semi-lobate grain. Scabrate or microreticulate with distinct, patterned 'island' at pole. Grain oval in equatorial view, with colpi appearing arcate. Large circular porus.

Myrtaceae (Plate I.11, 168,169)
101 MYRTA

Grains oblate; semi-angular, semi-lobate, or sub-angular. Depressed oval shape in equatorial view. Small transverse colpus. Size and sculpturing very variable.

16. HETEROCOLPORATE

Poikilogyne T. (Melastomataceae) (Plate I.12, 170,171)
102 POIKI

Grain spherical to slightly prolate. Tricolporate with three intervening, less indented 'pseudo-colpi'. Sculpturing psilate to scabrate. Porus \pm rectangular, although not very distinct. This type also includes *Beccarianthus*, *Medinella*, *Everettia*, *Sonerila*, *Marumia*, and probably other melastomataceous genera.

Combretaceae/Melastomataceae (Plate I.12, 172,173)
100 COMEL

Grain prolate, tricolporate with intervening 'pseudo-colpi' as indented as the compound colpi. Porus usually distinct \pm rectangular. Sculpturing psilate to scabrate. This type includes *Combretum* and *Terminalia* (Combretaceae) and also some genera or species of Melastomataceae, notably *Melastoma affine*, and some *Osbeckia* grains.

17. TETRAD

Gardenia (Rubiaceae) (Plate I.12, 174)
122 GARDE

Psilate grain with tetrad diameter of c. 40 μ m. Porus circular with thickened annulus.

Epacridaceae (Plate I.12, 175)
105 EPACR

Exine sculpturing psilate to scabrate. Tetrad diameter usually less than 40 μm . This type may include some genera of Ericaceae such as *Vaccinium* and *Diplocosia*.

Drimys T. (Winteraceae) (Plate I.12, 176)
94 DRIMY

Compact tetrad with a diameter of 20 - 30 μm . Exine thick, with large reticulate sculpturing. *Bubbia* is similar.

Nepenthes (Nepenthaceae) (Plate I.12, 177)
43 NEPEN

Tetrad of sparsely echinate spheroidal monads.

18. MONOLETE SPORES

Monolete psilate spore (smaller than 30 μm)
189 MONLS

Spores without perisporium, or psilate or only faintly sculptured, less than 30 μm in length. This type is found in many Polypodiaceae *sensu lato*, including *Nephrolepis*, *Cystodium*, *Cyclosorus*, *Thelypteris*, *Asplenium*, *Lastreopsis*, *Tectaria* and *Blechnum*.

Monolete psilate spore (larger than 30 μm) (Plate I.12, 178)
190 MONLL

Similar to previous type, but with a max. dimension exceeding 30 μm . Many genera fall into this group, some of the more common being *Hypolepis*, *Nephrolepis*, *Arthropteris*, *Gleichenia*, *Cyclosorus*, *Athyrium*, *Stenolepis*, *Lomariopsis* and *Blechnum*.

Microsorium T. (Polypodiaceae) (Plate I.12, 179)
188 MICSO

Concavo-convex spore with thick exine. Sculpturing is scabrate to faintly reticulate. Size measurements (ANU 21014)
Equatorial: Range 34-54 μm , Mean 44.8 μm , S.D. 4 μm
Polar: Range 20 - 38.5 μm , Mean 28.5 μm , S.D. 3.8 μm .

Nephrolepis (Oleandraceae) (Plate I.13, 180)
176 NEPHR

Slightly concavo-convex, or plano-convex. Thick exine, sculpturing punctate to unevenly reticulate. Size measurements (ANU 21015)

Equatorial: Range 27 - 36.5 μm , Mean 31.5 μm , S.D. 2 μm

Polar: Range 13.5 - 21 μm , Mean 16.5 μm , S.D. 1.7 μm .

Cyclosorus T. (Thelypteridaceae) (Plate I.13, 181)
181 CYCLO

Plano-convex to slightly concavo-convex spore. Max. dimension 35-50 μm . Perisporium sculpturing coarsely scabrate, or verrucate. Similar spores occur in some *Athyrium* spp.

Histiopteris incisa T. (Dennstaedtiaceae) (Plate I.13, 182)
174 HISTI

Plano-convex or concavo-convex spore with large scale, unevenly distributed verrucate sculpturing. Size typically 35 x 25 μm . *Belvisia* is similar, but larger.

Davallia T. (Davalliaceae) (Plate I.13, 183)
175 DAVAL

Large plano- or concavo-convex spore. Thick exine with rounded, discrete, and regularly distributed verrucae. This type includes other Davalliaceae such as *Scyphularia* and *Humata*.

Stenochlaena palustris (Blechnaceae) (Plate I.13, 184)
187 STENO

Biconvex or plano-convex spore. Distinctive sculpturing of sparse, rounded triangular verrucae. Size measurements (ANU 21045)

Equatorial: Range 36 - 47 μm , Mean 42 μm , S.D. 2.5 μm

Polar: Range 20.5 - 30 μm , Mean 25 μm , S.D. 2.2 μm .

cf. *Tectaria* (Aspidaceae) (Plate I.13, 185)
184 TECTA

Small spore, c. 31 x 20 μm . Thick perisporium with verrucate ridges.

Stenochlaena laurifolia (Blechnaceae) (Plate I.13, 186)
186 STENL

Distinctive plano-convex or concavo-convex spore c. 45 x 28 μm .
Sculpturing of large verrucae aligned in ridges, + parallel to
the equatorial axis.

Asplenium T. (Aspleniaceae) (Plate I.13, 187)
183 ASPLE

Spores with a distinct, thin, folded or lightly sculptured
perisporium. A large and diverse type including, as well as
Aspleniaceae, many Dennstaedtiaceae, Aspidaceae, and Blechnaceae.

?*Arthropteris* cf. *tenella* (Oleandraceae) (Plate I.14, 188)
177 ARTHR

Spore with thin perisporium formed into long (15 μm) echinate
projections. This type may also occur in other families, in
particular Aspleniaceae.

cf. *Cyclosorus archboldiana* T. (Thelypteridaceae) (Plate I.14, 189)
180 CYCLA

Concavo-convex spore. Perisporium covered with sparse echinae,
c. 3 μm in length. Similar echinate types occur in *C. unitus*,
Drynaria, and baculate types in *Drynaria* and *Selliguea*.

Cyclosorus truncatus T. (Thelypteridaceae) (Plate I.14, 190)
182 CYCLT

Spore with dense, curved triangular echinae. Slightly similar
types occur in other *Cyclosorus* spp.

cf. *Stenochlaena areolaris* (Blechnaceae) (Plate I.14, 191)
185 STENA

Identification based on descriptions by Holttum (1932) and
Anderson and Muller (1975). Large spore 80 x 45 μm , with sparse
echinae up to 12 μm in length.

Unknown 19 (Plate I.14, 192)
192 UK019

Spore of *Pteris*-like morphology, but bilateral rather than tetra-
hedral in shape. Both Lugardon (1963) and Devi (1974) report the
occurrence of monolete *Pteris* spores.

Monolete spores (undifferentiated)
193 MONLU

19. TRILETE SPORES

cf. *Adiantum diaphanum* T. (Adiantaceae) (Plate I.14, 193)
173 ADIAN

Spore with distinct, but faint, reticulate pattern, and wide, unthickened tri-radiate scar. Max. dimension c. 32 μm . Many other genera produce morphologically very similar spores.

Cyatheaceae 1 (Plate I.14, 194)
178 CYAT1

Psilate spore of diverse shape, thick unpatterned exine. Perisporium absent, or psilate. Equatorial diameter c. 35 - 40 μm .

Cyatheaceae 2 (Plate I.15, 195, 196)
179 CYAT2

Psilate spore with loose, patterned perisporium. Sculpturing often papillate or striate, and denser on the distal surface. Size similar to psilate Cyatheaceae. Spores of this morphology are not well represented in the ANU reference collection, but have been described by Harris (1955), Tindale (1956), and Murillo and Bless (1974).

Lycopodium cernuum T. (Lycopodiaceae) (Plate I.15, 197)
167 LYCOC

Small spore c. 25 x 10 μm . Thin tri-radiate scar. Rugulate sculpturing on distal surface.

Lycopodium squarrosum T. (Lycopodiaceae) (Plate I.15, 198)
169 LYCOS

Spore c. 45 μm equatorial diameter with thin trilete scar. Thick unpatterned exine, psilate on proximal surface, sparsely foveolate on distal surface. Similar spores occur in *L. macgregorii* and *L. apiculata*.

Lycopodium cf. *volubile* T. (Lycopodiaceae) (Plate I.15, 199)
168 LYCOV

Spore circular in polar view. Loose, reticulate perisporium. Similar types are found in other *Lycopodium* spp., including *L. fastigatum* and *L. complanatum*.

Pteris (Pteridaceae) (Plate I.15, 200)
172 PTERI

Spore triangular in polar view, with thick (c. 5 μm) exine. Thickened trilete scar. Psilate on proximal surface, some degree of verrucate patterning on the distal surface. The type occurs in many New Guinea *Pteris* spp., although not in *P. molluccana*.

cf. *Anemia hirsuta* (Schizeaceae) (Plate I.15, 201,202)
171 ANEMI

A very large spore, equatorial diameter c. 100 μm . Thick striations or ridges parallel the scar and the equatorial axis.

Lygodium microphyllum T. (Schizeaceae) (Plate I.16, 203)
170 LYGOD

Spore triangular to circular in polar view, with distinctive foveo-reticulate exine. Size variable, equatorial diameter c. 55 - 90 μm .

Unknown 312 (Plate I.16, 204)
194 UK312

Spore triangular in polar view with sparsely verrucate perisporium. Long, thin trilete scar. Equatorial diameter c. 28 μm .

Unknown 170 (Plate I.16, 205)
195 UK170

Spore triangular in polar view. Perisporium foveo-reticulate. Equatorial diameter c. 25 μm .

Unknown 172 (Plate I.16, 206)
196 UK172

Large spore, triangular in polar view with loose, faintly reticulate perisporium.

Trilete ferns (undifferentiated)
197 TRILU

UNCATAGORISED PALYNOMORPHS
198 UNCAT

Palynomorphs unable to be assigned with certainty to any of the above 19 morphological categories.

INDETERMINABLE PALYNOMORPHS
199 INDET

Pollen or spores too corroded or degraded (*sensu* Cushing, 1964) to describe adequately the morphological features, or those too crumpled, fragmented or obscured by immovable debris to identify.

NOTES ON THE PHOTOMICROGRAPHS

All photomicrographs of pollen and spore taxa are reproduced at a magnification of X 1000. The scale at the foot of each plate represents 50 μm . As all photographs are of sub-fossil specimens, or those from contemporary surface samples, extraneous debris is occasionally visible. Each number represents a different grain, whilst views of the same individual are indicated by the suffix a,b, etc. Also indicated is the sample from which the illustrated grain was recovered.