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Atlas of the tropical West African pollen flora

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Title: **Atlas of the tropical West African pollen flora**

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Abstract

The accurate and consistent identification of fossil pollen is essential to allow robust inferences to be drawn with regard to past climate and vegetation change. Identifications are best achieved through the direct inspection of reference material. Most substantial reference collections are held at prestigious university's in Europe or the United States of America which can restrict access for researchers trying to advance palynology in less developed countries. Digital imaging and fast spreading access to the internet means that it is now possible to produce and disseminate high quality images from pollen reference collections. In this paper we contribute to this growing body of work by presenting images of 364 pollen/spore taxa from West Tropical Africa both as printed plates with a key, and within an associated online searchable database.

Highlights

- 129 plates of 364 pollen/spore taxa
- Coverage of most pollen taxa identified in tropical West African fossil pollen records
- Comprehensive key to pollen identification

Keywords (x6): Africa, identification, key, images, pollen, tropical

1. Introduction

The accurate identification of fossil pollen and spores underpins our ability to reconstruct past vegetation and subsequently infer variation in the Earth's system. Palaeo-palynology can provide, among other things, evidence for past changes in climate (e.g. Davis and Shaw, 2001; Overpeck *et al.*, 1990), biome (e.g. Jolly *et al.*, 1998; Tarasov *et al.*, 1998; Williams *et al.*, 2004) and biodiversity (e.g. Brown, 1999; Odgaard, 1999; Rull, 1987) across the geological record. At one extreme the incredible resilience of pollen/spore chemistry (sporopollenin) allows palynology to provide evidence for the evolution of plants on timescales of millions of years (e.g. Crane *et al.*, 1995; Wikström *et al.*, 2001). Whilst at the other, the influence of human activity upon plants allows the actions of people within the landscape to be traced in the recent past (10-100's years ago) (e.g. Brugam, 1978; Piperno and Flannery, 2001). The integrity of the information supplied by palynologists to all these areas is reliant on consistent typing or, where possible, identification of the specimens found in the fossil record.

Since its inception morphological identification of pollen grains has been standard practice through comparison with modern material (von Post, 1916, reprinted 1967). Subsequently numerous atlases for pollen and spore identification have been produced from across the globe, including: Beug, 2004; Colinvaux *et al.*, 1999; Faegri and Iversen, 1989; Moore *et al.*, 1991; Reille, 1999; Roubik and Moreno, 1991. The proliferation of pollen/spore atlases has facilitated the expansion of the field of palynology and helped with international standardization of identifications. In addition, as computing power has developed, there has been an increase in the number, and sophistication, of online searchable pollen databases (e.g. Bush and Weng, 2007; Lezine, 2005; QPG, 2008). However, geographical coverage and access to images for pollen identification remains patchy.

The most substantial atlases for African pollen and spore identification are: (i) in print (Reille, 1998, 1999), and (ii) online the African pollen database (Lezine, 2005). Both contain thousands of images of species within hundreds of families, and therefore provide good general coverage of taxa likely to be found in the fossil record. In addition, pollen/spore atlases for specific regions have also been produced, e.g. East Africa (Riollet and Bonnefille, 1976), as well as for individual countries: (i) Chad (Maley, 1970), (ii) Ethiopia (Bonnefille, 1971a, b), (iii) Ivory Coast (Ybert, 1979), (iv) Nigeria (Sowunmi, 1973), (v) South Africa (Scott, 1982; van Zinderen Bakker, 1953, 1956; van Zinderen Bakker and Coetzee, 1959), and (vi) Sudan (El Ghazali, 1993). In this paper we contribute to this body of knowledge by presenting c. 3000 images and identification keys for >450 pollen and spore taxa commonly found in tropical West Africa.

2. Materials and methods

2.1 Selection of pollen and spore taxa

Taxa were selected for inclusion within this tropical West African pollen atlas based upon two criteria: (i) they had been previously identified within fossil records obtained from terrestrial and marine settings within the region (Dupont *et al.*, 2000; Elenga *et al.*, 1994; Frédoux, 1994; Leroy and Dupont, 1994; Lezine and Vergnaud-Grazzini, 1993; Maley and Livingstone, 1983; Talbot *et al.*, 1984), and/or (ii) they had been identified as significant in the regional flora (Hall and Swaine, 1981).

2.2 Organisation and presentation of images

Images are presented on 129 plates showing both polar and equatorial views of the grain where it was possible to obtain images. Plates are organised by pollen morphology to allow

ease of reference when examining fossil pollen material; following (Beug, 2004). In addition, to facilitate interrogation of the images based on botanical classification the family, genera and species of the images are listed in Table 1 with reference to plate number. The paper is accompanied by a searchable online database which integrates the images presented here with the c. 6000 images of >1000 taxa from the Neotropical Pollen database (Bush and Weng, 2007). To access a Freeware version of the complete revised Tropical Pollen Database download and unpack the TopicalPollenDB2013.zip file from the supplementary online section of this paper. Please note due to the high number of pictures the file is large (2.77GB) and an Apple Macintosh computer running Mac OS X 10.6 or higher is required to run the software. We hope that the combination of our images with those of Bush and Weng (2007) within a freeware format online will promote further expansion by other research groups which will lead to the eventual development of a comprehensive pan-tropical searchable online pollen and spore identification tool.

2.3 Provenance of specimens and image capture

Images and descriptions of all pollen and spores were obtained from the reference collection of c. 30,000 specimens housed within the Department of Biology at Duke University which has been collected and curated by DAL. Reference material was sourced from herbaria and laboratories around the globe; full details for individual specimens can be found on the accompanying online database.

Images were obtained using QCapture software (v. 3.1.1) with a QImaging Micropublisher 3.3 RTV camera mounted on a Nikon Eclipse 50i microscope. All images were taken through a Nikon Plan Fluor 40x/0.75 DIC M/N2 objective.

3. Terminology

Terminology follows Punt *et al.* (2007).

4. Nomenclature

Taxonomic nomenclature follows conventions of Beug (2004).

5. Polyads

Plates I-III

Key

- | | |
|---|-----------------------------------|
| 1. Comprising eight grains | 2. |
| - Comprising twelve grains | 3. |
| - Comprising more than twelve grains | 5. |
| 2. Surface psilate (Plate I: 1-3) | <i>Calpocalyx brevibracteatus</i> |
| - Surface scabrate (Plate I: 4-6) | <i>Xylia evansii</i> |
| 3. Polyad diameter less than 40µm | 4. |
| - Polyad diameter greater than 40µm (Plate II: 1-3) | <i>Acacia clavigera</i> |
| 4. Surface scabrate (Plate I: 7-9) | <i>Acacia seyal</i> |
| - Surface psilate (Plate I: 10-12) | <i>Acacia eggelingii</i> |
| 5. Polyad arrangement non-uniform | 6. |
| - Polyad arrangement uniform (Plate III: 4-6) | <i>Parkia velutina</i> |
| 6. Polyad diameter less than 110µm (Plate II: 4-6) | <i>Parkia inundabilis</i> |
| - Polyad diameter greater than 110µm (Plate III: 1-3) | <i>Parkia bussei</i> |

6. Tetrads

Plate IV

Key

- | | |
|---------------------------------------|-----------------------------|
| 1. Visible collumnae | 2. |
| - Invisible collumnae (Plate IV: 1-4) | <i>Erica arborea</i> |
| 2. Surface verrucate (Plate IV: 5-7) | <i>Mimosa strigillosa</i> |
| - Surface scabrate (Plate IV: 8-9) | <i>Uvariopsis congensis</i> |

7. Vesiculate

Plate V

Podocarpus milanjanus (Plate V: 1-6)

8. Inaperturate, including Polypodiaceae

Plates VI-XVI

Key

- | | |
|--|---------------------------------|
| 1. Surface reticulate | 2. |
| - Surface echinate | 6. |
| - Surface psilate | 9. |
| - Surface reticulate | 14. |
| - Surface foveolate (Plate VII : 4-7) | <i>Trichomanes mandiocanum</i> |
| - Surface verrucate | 15. |
| - Surface gemmate (Plate VII: 1-3) | <i>Borassus aethiopum</i> |
| - Surface perforate (Plate VI: 5-7) | <i>Acidanthera brevicollis</i> |
| - Surface scabrate | 16. |
| 2. Equatorial grain shape circular | 3. |
| - Equatorial grain shape suboblate (Plate IX: 9-11) | <i>Xyris montana</i> |
| - Equatorial grain shape subprolate (Plate VIII: 10-13) | <i>Scaphopetalum thonneri</i> |
| - Equatorial grain shape rectangular (tall) (Plate IX: 1-8) | <i>Xyris</i> sp. (x2) |
| 3. Equatorial grain diameter ~9-11 μ m (Plate X: 1-4) | <i>Peperomia</i> sp. |
| - Equatorial grain diameter ~12-18 μ m (Plate XI: 8-10) | <i>Tiliacora funifera</i> |
| - Equatorial grain diameter ~27-33 μ m (Plate XI: 11-14) | <i>Scaphopetalum letestui</i> |
| - Equatorial grain diameter ~40-55 μ m | 4. |
| - Equatorial grain diameter ~63-77 μ m | 5. |
| - Equatorial grain diameter ~70-90 μ m (Plate XII: 7-10) | <i>Croton macrostachyus</i> |
| - Equatorial grain diameter ~90-110 (Plate XIII 1-2) | <i>Dicranolepis usambarica</i> |
| 4. Wall thickness ~2 μ m (Plate XII: 1-3) | <i>Psychotria goetzei</i> |
| - Wall thickness ~4 μ m (Plate XII: 4-6) | <i>Croton gratissimus</i> |
| 5. Wall thickness ~2 μ m (Plate XIII 5-7) | <i>Morinda citrifolia</i> |
| - Wall thickness ~6 μ m (Plate XIII: 3-4) | <i>Tribulus terrestris</i> |
| 6. Equatorial grain shape circular | 7. |
| - Equatorial grain shape suboblate (Plate VII: 8-11) | <i>Pycnanthus dinklagei</i> |
| - Equatorial grain shape oblate (Plate VI: 1-4) | <i>Illigera rhodantha</i> |
| - Equatorial grain shape subprolate (Plate VIII: 14-17) | <i>Pandanus livingstonianus</i> |

- | | |
|--|---|
| 7. Equatorial grain diameter ~17-23µm
- Equatorial grain diameter ~36-44µm (Plate XIV: 1-3)
- Equatorial grain diameter ~63-77µm (Plate XIII: 8-10)
- Equatorial grain diameter ~81-99µm (Plate XIV: 4-7) | 8.
<i>Iodes kamerunensis</i>

<i>Barteria acuminata</i>

<i>Illigera appendiculata</i> |
| 8. Wall thickness ~0.5µm (Plate XIV: 8-11)
- Wall thickness ~1.5µm (Plate XV: 1-4) | <i>Lemna gibba</i>
<i>Pandanus kirkii</i> |
| 9. Equatorial grain shape circular
- Equatorial grain shape suboblate
- Equatorial grain shape subprolate | 10.
12.
13. |
| 10. Polar grain shape circular (Plate XI: 1-4)
- Polar grain shape quinquangular
- Polar grain shape triangular (convex) (Plate X: 13-16) | <i>Nymphaea caerulea</i>
11.
<i>Nymphaea lotus</i> |
| 11. Wall thickness ~1µm (Plate VII: 16-19)
- Wall thickness ~2µm (Plate VII: 12-15) | <i>Alternanthera repens</i>
<i>Alternanthera nodiflora</i> |
| 12. Equatorial grain diameter ~35-45µm (Plate XI: 5-7)
- Equatorial grain diameter ~50-70µm (Plate VIII: 1-6) | <i>Uvaria kirkii</i>

<i>Piptostigma mayumbense</i> |
| 13. Equatorial grain diameter ~50-60µm (Plate X: 11-12) | <i>Lonchitis currori</i> |
| 14. Wall thickness ~1µm (Plate X: 8-10)
- Wall thickness ~2µm (Plate X: 5-7) | <i>Nephrolepis biserrata</i>
<i>Nephrolepis exaltata</i> |
| 15. Equatorial grain shape circular (Plate XVI: 4-10)
- Equatorial grain shape suboblate (Plate VIII: 7-9) | <i>Dichrostachys</i> sp. (x2)

<i>Dichrostachys unijuga</i> |
| 16. Equatorial grain diameter ~150-200µm (Plate XV: 5-6)
- Equatorial grain diameter unknown (Plate XVI: 1-3) | <i>Tylophora sylvatica</i>

<i>Artabotrys likimensis</i> |

9. Monoporate

Plate XVII

Key

- | | |
|--|---|
| 1. Surface scabrate (Plate XVII: 1-2)
- Surface reticulate | <i>Guaduella oblonga</i>
2. |
| 2. Pore size ~1.5µm (Plate XVII: 6-8)
- Pore size ~2µm | <i>Typha angustifolia</i>
3. |
| 3. Wall thickness ~1µm (Plate XVII: 3-5)
- Wall thickness ~1.5µm (Plate XVII: 9-11) | <i>Typha australis</i>
<i>Typha capensis</i> |

10. Monocolpate

Plates XVIII-XXI

Key

- | | |
|---|--|
| 1. Surface psilate
- Surface gemmate (Plate XIX: 6-8)
- Surface perforate (Plate XXI: 4-6)
- Surface foveolate
- Surface scabrate
- Surface echinate
- Surface reticulate | 2.
<i>Borassus aethiopum</i>
<i>Acidantha brevicollis</i>
4.
5.
8.
10. |
| 2. Equatorial grain shape rectangular (tall) (Plate XVIII: 1-2)
- Equatorial grain shape rhombic (tall) (Plate XVIII: 6-8)
- Equatorial grain shape circular | <i>Raphia ruffia</i>
<i>Phoenix reclinata</i>
3. |
| 3. Polar grain shape triangular (convex) (Plate XX: 4-6)
- Polar grain shape circular (Plate XX: 1-3) | <i>Nymphaea lotus</i>
<i>Nymphaea caerulea</i> |
| 4. Equatorial grain shape rectangular (tall) (Plate XIX: 9-10)
- Equatorial grain shape rhombic (tall) (Plate XIX: 11-13) | <i>Hyphaene natalensis</i>
<i>Hyphaene ventricosa</i> |
| 5. Equatorial grain shape subprolate
- Equatorial grain shape rectangular (tall) (Plate XVIII: 3-6, Plate XVIII: 17-18, Plate XVIII: 19-21) | 6.
<i>Raphia farinifera</i>
<i>Calamus erectus</i>
<i>Calamus gracilis</i> |
| 6. Polar grain shape triangular (convex) (Plate XVIII: 9-11)
- Polar grain shape circular | <i>Elaeis guineensis</i>
7. |

- | | |
|---|--|
| 7. Collumnae invisible (Plate XX: 7-9)
- Collumnae visible (Plate XX: 10-11) | <i>Chlorophytum floribundum</i>
<i>Asparagus falcatus</i> |
| 8. Wall thinner on pole (Plate XXI: 7-9)
- Wall of even thickness | <i>Aneilema johnstonii</i>
9. |
| 9. Equatorial grain size ~50-60µm (Plate XXI:
10-12)
- Equatorial grain size ~75-85µm (Plate XXI: 13-
15)
- Equatorial grain size ~85-95µm (Plate XXI: 16-
18) | <i>Commelina africana</i>

<i>Crinum powellii</i>

<i>Crinum pauciflorum</i> |
| 10. Colpus length full
- Colpus length 2/3 (Plate XXI: 1-3)
- Colpus length 1/2 (Plate XX: 12-13)
- Colpus length 1/3 | 11.
<i>Dracaena reflexa</i>
<i>Dracaena camerooniana</i>
12. |
| 11. Collumnae invisible (Plate XVIII: 12-14)
- Collumnae visible (Plate XIX: 4-5) | <i>Ancistrophyllum secundiflorum</i>
<i>Borassus machadonis</i> |
| 12. Equatorial grain size ~35-45µm (Plate XIX:
1-3)
- Equatorial grain size ~45-55µm (Plate XVIII:
15-16) | <i>Eremospatha</i> sp.

<i>Ancistrophyllum laurentii</i> |

11. Syncolporate

Plate XXII

Key

- | | |
|--|---|
| 1. Equatorial grain size ~15-20µm (Plate XXII: 7-
10)
- Equatorial grain size ~20-25µm (Plate XXII: 1-
3)
- Equatorial grain size ~30-37µm (Plate XXII: 4-
6) | <i>Syzygium guineense</i>

<i>Eugenia michoacanensis</i>

<i>Myrcia</i> sp. |
|--|---|

12. Diporate

Plates XXIII-XXV

- | | |
|--|--|
| 1. Equatorial grain shape rectangular (tall) (Plate
XXIII: 1-4)
- Equatorial grain shape sub-prolate (Plate XXIII:
5-9) | <i>Musanga smithii</i>

<i>Musanga leo-errerae</i> |
|--|--|

- Equatorial grain shape sub-oblate 2.
- Equatorial grain shape circular 4.
- 2. Pore shape elliptic (tall) (Plate XXIII: 10-15) *Chlorophora excelsa*
- Pore shape circular 3.
- 3. Pore morphology thickened pore (Plate XXIII: 16-17) *Antiaris toxicaria*
- Pore morphology plain (Plate XXIII: 18-19) *Ficus ingens*
- 4. Pore shape irregular (Plate XXIV: 1-5) *Iodes ovalis*
- Pore shape circular with annulus 5.
- Pore shape circular 6.
- 5. Surface psilate (Plate XXIV: 6-9) *Baissea multiflora*
- Surface scabrate (Plate XXIV: 10-12) *Motandra guineensis*
- 6. Pore morphology thickened pore (Plate XXIV: 13-19) *Trema orientalis*
- Pore morphology plain 7.
- 7. Equatorial grain diameter ~18-22µm (Plate XXIV: 20-22) *Trema guinensis*
- Equatorial grain diameter ~63-77 µm (Plate XXV: 1-2) *Morinda citrifolia*

13. Dicolporate

Plate XXVI

Key

- 1. Pore size ~10µm (Plate XXVI: 1-6) *Justicia cordata*
- Pore size ~4µm (Plate XXVI: 7-11) *Justicia flava*

14. Triporate

Plates XXVII-XXXIV

Key

- 1. Surface granulate (Plate XXVII: 1-7) *Allophylus africanus*
- Surface echinate 2.
- Surface psilate 3.
- Surface reticulate 8.
- Surface scabrate 17.
- 2. Polar grain diameter ~18-21µm (Plate XXVII: *Iodes ovalis*

8-11)	
- Polar grain diameter ~35-45µm (Plate XXVII: 12-14)	<i>Piliostigma reticulatum</i>
- Polar grain diameter ~50-70µm (Plate XXVIII: 1-3)	<i>Bombax brevicuspe</i>
3. Polar grain shape circular	4.
- Polar grain shape triangular (convex)	5.
4. Polar grain diameter ~12-16µm (Plate XXVIII: 4-6)	<i>Sesuvium sessile</i>
- Polar grain diameter ~20-30µm (Plate XXVIII: 10-12)	<i>Baissea multiflora</i>
5. Pore size ~1-3µm	6.
- Pore size ~4-5µm (Plate XXVIII: 19-21)	<i>Protea susannae</i>
6. Pore morphology thickened pore (Plate XXVIII: 13-15)	<i>Sabicea floribunda</i>
- Pore morphology thinning sexine	7.
7. Polar grain diameter ~8-12µm (Plate XXVIII: 7-9)	<i>Coula edulis</i>
- Polar grain diameter ~18-22µm (Plate XXVIII: 16-18)	<i>Heisteria parvifolia</i>
8. Pore morphology thickened pore	9.
- Pore morphology slightly extruded	10.
- Pore morphology extruded	11.
- Pore morphology plain	12.
- Pore morphology thinning sexine	15.
9. Polar grain diameter ~25-35µm (Plate XXVIII: 22-24)	<i>Bombax buonopozense</i>
- Polar grain diameter ~40-50µm (Plate XXIX: 1-6)	<i>Plectronia vulgaris</i>
10. Polar grain diameter ~14-16µm (Plate XXIX: 10-15)	<i>Lasianthus africanus</i>
- Polar grain diameter ~45-55µm (Plate XXIX: 16-18)	<i>Kirkea acuminata</i>
- Polar grain diameter ~60-80µm (Plate XXIX: 7-9)	<i>Ceiba pentandra</i>
11. Polar grain diameter ~36-44µm (Plate XXX: 1-7)	<i>Vigna fischeri</i>
- Polar grain diameter ~54-66µm (Plate XXX: 8-10)	<i>Cardiospermum grandiflorum</i>
12. Polar grain shape circular	13.

- Polar grain shape triangular (convex) 14.
13. Pore size ~3µm (Plate XXX: 11-14) *Triplochiton scleroxylon*
 - Pore size ~5µm (Plate XXX: 15-18) *Nesogordonia fertilis*
 - Pore size ~6µm (Plate XXX: 19-21) *Entada umbonata*
14. Pore size ~6µm (Plate XXXI: 1-6) *Nesogordonia parvifolia*
 - Pore size ~8µm (Plate XXXI: 13-15) *Vigna luteola*
 - Pore size ~25µm (Plate XXXI: 16-17) *Psychotria fractinervata*
15. Polar grain diameter ~10-15µm (Plate XXXI: 7-12) *Dichapetalum mossambicense*
 - Polar grain diameter ~36-45µm (Plate XXXII: 1-3) *Paullinia pinnata*
 - Polar grain diameter ~45-55µm 16.
16. Pore shape circular (Plate XXXII: 4-6) *Entada pursaetha*
 - Pore shape elliptic (tall) (Plate XXXII: 7-13) *Protea trichanthera*
17. Polar grain shape circular 18.
 - Polar grain shape triangular (convex) 21.
18. Pore shape rectangular (broad) (Plate XXXII: 14-19) *Leptaulus daphnoides*
 - Pore shape circular 19.
 - Pore shape circular (with annulus) 20.
19. Polar grain diameter ~18-22µm (Plate XXXIII: 1-4) *Celtis zenkeri*
 - Polar grain diameter ~27-33µm (Plate XXXIII: 5-7) *Celtis mildbraedii*
20. Pore morphology sunken pore (Plate XXXIII: 8-13) *Anthocleista grandiflora*
 - Pore morphology slightly extruded (Plate XXXIII: 14-17) *Hymenocardia acida*
21. Polar grain diameter ~10-15µm (Plate XXXIV: 1-3) *Dichapetalum stuhlmannii*
 - Polar grain diameter ~18-24µm 22.
 - Polar grain diameter ~40-60µm (Plate XXXIV: 4-7) *Turraeanthus africana*
22. Wall thickness ~0.25µm (Plate XXXIV: 8-9) *Striga forbesii*
 - Wall thickness ~1.5µm (Plate XXXIV: 10-14) *Celtis integrifolia*

15. Tricolpate

Plates XXXV-XXXIX

Key

- | | |
|--|----------------------------------|
| 1. Surface psilate (Plate XXXV: 1-5) | <i>Gunnera chilensis</i> |
| - Surface clavate/psilate (Plate XXXVI: 6-11) | <i>Vitex amboniensis</i> |
| - Surface scabrate (Plate XXXV: 6-10) | <i>Napoleona imperialis</i> |
| - Surface striate (Plate XXXIX: 6-11) | <i>Berlinia grandiflora</i> |
| - Surface reticulate | 2. |
| 2. Equatorial grain shape rectangular (tall) (Plate XXXVII: 1-6) | <i>Scytopetalum tieghemii</i> |
| - Equatorial grain shape rhombic (tall) (Plate XXXVII: 7-12) | <i>Dichostemma</i> sp. |
| - Equatorial grain shape circular (Plate XXXVIII: 19-20) | <i>Paramacrolobium coeruleum</i> |
| - Equatorial grain shape rhombic (broad) (Plate XXXVIII: 7-12) | <i>Brachystegia leonensis</i> |
| - Equatorial grain shape suboblate (Plate XXXVIII: 1-6) | <i>Brachystegia spiciformis</i> |
| - Equatorial grain shape prolate | 3. |
| - Equatorial grain shape subprolate | 4. |
| 3. Colp length 1 (Plate XXXVI: 1-5) | <i>Leucas calostachys</i> |
| - Colp length 2 (Plate XXXVI: 24-26) | <i>Aneulophus africanus</i> |
| 4. Polar grain shape triangular (convex) | 5. |
| - Polar grain shape circular | 6. |
| - Polar grain shape tri-lobate | 8. |
| 5. Equatorial grain diameter ~15-25µm (Plate XXXVII: 13-18) | <i>Cissampelos mucronata</i> |
| - Equatorial grain diameter ~40-50µm (Plate XXXIX: 1-5) | <i>Petersia africana</i> |
| 6. Wall thickness <2 µm (Plate XXXV: 17-21) | <i>Premna maxima</i> |
| - Wall thickness >2 µm | 7. |
| 7. Equatorial grain diameter ~27-37µm (Plate XXXVI: 18-23) | <i>Tetracera alnifolia</i> |
| - Equatorial grain diameter ~40-50µm (Plate XXXV: 22-27) | <i>Premna resinosa</i> |
| 8. Wall thickness ~2µm (Plate XXXVI: 12-17) | <i>Vitex doniana</i> |
| - Wall thickness ~3µm (Plate XXXV: 11-16) | <i>Farsetia stenoptera</i> |
| - Wall thickness ~10µm (Plate XXXVIII: 13-18) | <i>Afzelia bracteata</i> |

16. Tricolporate

Plates XL-CXIV

Key

1. Equatorial grain shape circular	2.
- Equatorial grain shape oblate (Plate XL: 1-6)	<i>Gerrardina foliosa</i>
- Equatorial grain shape prolate (Plate XL: 7-11)	<i>Thecacoris gymnogyne</i>
- Equatorial grain shape prolate	3.
- Equatorial grain shape rectangular (tall)	4.
- Equatorial grain shape rhombic (broad)	5.
- Equatorial grain shape rhombic (tall)	6.
- Equatorial grain shape sub-oblate	7.
- Equatorial grain shape sub-prolate	8.
- Equatorial grain shape undetermined	87.
2. Surface psilate	11.
- Surface reticulate	12.
- Surface scabrate	13.
- Surface striate (Plate XL: 12-17)	<i>Vepris uguenensis</i>
3. Surface psilate	27.
- Surface reticulate	28.
- Surface striate	37.
4. Surface psilate	9.
- Surface reticulate	10.
- Surface scabrate	40.
5. Surface psilate (Plate XLI: 1-10)	<i>Alchornea floribunda</i>
- Surface clavate/pilate (Plate XLI: 11-16)	<i>Ilex mitis</i>
- Surface reticulate	42.
- Surface scabrate	43.
6. Surface psilate	44.
- Surface striate	46.
- Surface reticulate	49.
- Surface scabrate (Plate LXXVIII: 4-7)	<i>Daniella oliveri</i>
7. Surface psilate	53.
- Surface striate (Plate XLII: 1-7)	<i>Crudia bracteata</i>
- Surface reticulate	54.
- Surface scabrate (Plate XLII: 8-14)	<i>Parinari curatellifolia</i>
8. Surface echinate	60.
- Surface psilate	62.
- Surface reticulate	65.
- Surface scabrate	80.
- Surface striate	85.
9. Pore shape circular (Plate XLIII: 1-6)	<i>Diospyros mespiliformis</i>
- Pore shape elliptic (broad) (Plate XLIII: 7-9)	<i>Lotus chazaliei</i>

- Pore shape lalongate (Plate XLIII: 10-16)	<i>Canarium schweinfurthii</i>
- Pore shape lolongate (Plate XLIV: 1-14)	<i>Heliotropium</i> sp. x2
10. Pore shape circular	39.
- Pore shape elliptic (tall) (Plate XLV: 1-6)	<i>Balanites glaber</i>
11. Pore shape circular	14.
- Pore shape elliptic (broad) (Plate XLV: 7-12)	<i>Centropilacus glaucinus</i>
12. Pore shape circular (Plate XLV: 13-18)	<i>Indigofera leptoclada</i>
- Pore shape circular with annulus	15.
- Pore shape concave	16.
- Pore shape lalongate (Plate XLVI: 1-8)	<i>Millettia psilopetala</i>
- Pore shape rectangular (broad)	18.
- Pore shape lolongate	21.
- Pore shape rhombic (tall) (Plate XLVI: 9-16)	<i>Argomuelleria macrophylla</i>
- Pore shape squared	23.
- Pore shape elliptic (tall) (Plate XLVII: 1-6)	<i>Balanites aegyptiacus</i>
- Pore shape irregular (Plate XLVII: 7-12)	<i>Martretia quadricornis</i>
- Pore shape undetermined (Plate XLVIII: 1-3)	<i>Cliffortia nitidula</i>
13. Pore shape circular	26.
- Pore shape rectangular (broad) (Plate XLVIII: 4-9)	<i>Parinari holstii</i>
- Pore shape lalongate (Plate XLVIII: 10-15)	<i>Macaranga schweinfurt</i>
- Pore shape lolongate (Plate XLVIII: 16-22)	<i>Prunus africana</i>
14. Pore morphology with an operculum (Plate XLIX: 1-8)	<i>Alchornea cordifolia</i>
- Pore morphology sunken pore (Plate XLIX: 9-12)	<i>Medusandra richardsiana</i>
15. Pore morphology thickened pore (Plate XLIX: 14-18)	<i>Commiphora campestris</i>
- Pore morphology sunken pore (Plate L: 1-7)	<i>Commiphora scheffleri</i>
16. Pore morphology thickened pore (Plate L: 8-16)	<i>Erythrococca bongensis</i>
- Pore morphology sunken pore	17.
- Pore morphology slightly extruded (Plate LI: 1-5)	<i>Amanoa strobilacea</i>
- Pore morphology extruded (Plate LI: 6-12)	<i>Discoglyprena caloneura</i>
17. Pore position mid-wall (Plate LII: 1-8)	<i>Entada abyssinica</i>
- Pore position corner (Plate LII: 9-15)	<i>Baphia massaiensis</i>
18. Pore morphology thickened pore	19.
- Pore morphology sunken pore	20.
19. Colpus length full (Plate LIII: 1-6)	<i>Mallotus wrayi</i>

- Colpus length $>2/3$ (Plate LIII: 7-12) *Fagara macrophylla*

- 20. Polar grain shape circular (Plate LIII: 13-18) *Olea hochstetteri*
 - Polar grain shape triangular (convex) (Plate LIV: 1-8) *Ixora aneimenodesma*

- 21. Wall thickness even 22.
 - Wall thinner on pole (Plate LIV: 9-16) *Anthostema aubryanum*

- 22. Polar grain shape tri-lobate (Plate LV: 1-7) *Agelaea heterophylla*
 - Polar grain shape circular (Plate LV: 8-15) *Adenia nicobarica*

- 23. Visible collumnae 24.
 - Invisible collumnae (Plate LVI: 1-3) *Salacia kraussii*

- 24. Polar grain shape tri-lobate (Plate LVI: 4-8) *Maytenus senegalensis*
 - Polar grain shape triangular (convex) 25.

- 25. Equatorial grain diameter $\sim 17-25\mu\text{m}$ (Plate LVI: 9-14) *Hippocratea affinis*
 - Equatorial grain diameter $\sim 25-35\mu\text{m}$ (Plate LVII: 1-8) *Hippocratea africana*

- 26. Pore morphology extruded (Plate LVII: 9-14) *Grandidiera boivinii*
 - Pore morphology slightly extruded (Plate LVIII: 1-8) *Cynometra alexandri*

- 27. Pore shape lalongate (Plate LVIII: 9-13) *Calantica jalbertii*
 - Pore shape rhombic (broad) (Plate LVIII: 14-20) *Blighia wildemania*

- 28. Colpus length full 29.
 - Colpus length $>2/3$ 35.

- 29. Pore shape circular 30.
 - Pore shape concave 31.
 - Pore shape elliptic (tall) 32.
 - Pore shape lalongate 33.
 - Pore shape rhombic (broad) (Plate LIX: 1-6) *Corchorus fascicularis*
 - Pore shape squared (Plate LIX: 7-13) *Strephonema pseudocola*
 - Pore shape undetermined 34.

- 30. Equatorial grain diameter $\sim 18-22\mu\text{m}$ (Plate LX: 1-6) *Crossopteryx febrifuga*
 - Equatorial grain diameter $\sim 45-55\mu\text{m}$ (Plate LX: 7-9) *Cissus petiolata*

- 31. Pore morphology sunken pore (Plate LXI: 1-6) *Ritchiea capparoides*
 - Pore morphology thinning sexine (Plate LX: *Spondianthus preussii*

10-17)

- | | |
|--|---|
| 32. Pore morphology plain (Plate LXI: 7-13)
- Pore morphology slightly extruded (Plate LXII: 1-7) | <i>Blighia unijugata</i>
<i>Cissus quadrangularis</i> |
| 33. Pore morphology plain (Plate LXII: 8-13)
- Pore morphology sunken pore (Plate LXIII: 1-5) | <i>Grewia bicolor</i>
<i>Vepris humbertii</i> |
| 34. Pore morphology plain (Plate LXIII: 6-11)
- Pore morphology slightly extruded (Plate LXIV: 1-6) | <i>Rubus scheffleri</i>
<i>Drypetes gerrardii</i> |
| 35. Pore shape circular (Plate LXIV: 7-11)
- Pore shape concave
- Pore shape elliptic (broad) (Plate LXIV: 12-17)
- Pore shape irregular (Plate LXV: 1-6)
- Pore shape rectangular (broad) (Plate LXV: 7-15)
- Pore shape rhombic (tall) (Plate LXV: 16-21) | <i>Flacourtia indica</i>
36.
<i>Avicennia nitida</i>
<i>Dasylepis assinensis</i>
<i>Hannoa</i> sp. (x2)

<i>Ormocarpum kirkii</i> |
| 36. Pore morphology thickened (Plate LXVI: 1-7)
- Pore morphology extruded (Plate LXVI: 8-14) | <i>Maesobotrya hirtella</i>
<i>Cassipourea flanaganii</i> |
| 37. Pore shape elliptic (tall) (Plate LXVI: 15-20, LXVII: 1-4)
- Pore shape lolongate | <i>Lannea</i> sp. (x2)
38. |
| 38. Pore morphology thinning sexine (Plate LXVII: 5-9)
- Pore morphology plain (Plate LXVIII: 1-5) | <i>Isoberlinia angolensis</i>

<i>Isoberlinia doka</i> |
| 39. Pore morphology thinning sexine (Plate LXVIII: 6-12)
- Pore morphology sunken pore (Plate LXIX: 1-7) | <i>Scytopetalum tieghemii</i>

<i>Euphorbia hypericifolia</i> |
| 40. Pore shape elliptic (tall) (Plate LXIX: 8-13)
- Pore shape lolongate (Plate LXIX: 14-19)
- Pore shape rectangular (broad) | <i>Pterocarpus abyssinicus</i>
<i>Pterocarpus lucens</i>
41. |
| 41. Colpus length 2/3 (Plate LXX: 1-7)
- Colpus length 1/3 LXX: 8-13) | <i>Dodonaea viscosa</i>
<i>Tabernaemontana ventricosa</i> |
| 42. Pore shape circular (Plate LXXI: 1-6)
- Pore shape concave (Plate LXXI: 7-12)
- Pore shape lalongate (Plate LXXII: 1-8)
- Pore shape rectangular (broad) (Plate LXXII: 9-16) | <i>Sterculia tragacantha</i>
<i>Prosopis africana</i>
<i>Hagenia abyssinica</i>
<i>Monotes kerstingii</i> |

43. Visible collumnae (Plate LXXIII: 1-6) *Copaifera gorskiana*
 - Invisible collumnae (Plate LXXIII: 7-12) *Pygeum africanum*
44. Pore shape concave (Plate LXXIII: 13-18) *Acridocarpus macrocalyx*
 - Pore shape lologate 45.
45. Wall thickness even (Plate LXXIV: 1-7) *Guibourtia arnoldiana*
 - Wall thicker on pole (Plate LXXIV: 8-14) *Griffonia simplicifolia*
46. Pore morphology thinning sexine (Plate LXXV: 1-6) *Lannea humilis*
 - Pore morphology sunken pore 47.
 - Pore morphology plain 48.
47. Colpus length full (Plate LXXV: 7-12) *Sclerocarya birrea*
 - Colpus length >2/3 (Plate LXXVI: 1-6) *Spondias mombin*
48. Pore shape elliptic (tall) (Plate LXXVII: 1-6) *Berlinia bifoliolata*
 - Pore shape rhombic (broad) (Plate LXXVII: 7-12) *Teclea villosa*
49. Pore shape circular 50.
 - Pore shape elliptic (broad) 51.
 - Pore shape rhombic (broad) 52.
 - Pore shape zonorate (Plate LXXVIII: 1-3) *Corchorus trilocularis*
50. Pore morphology thinning sexine (Plate LXXIX: 1-6) *Aubrevillea platycarpa*
 - Pore morphology sunken pore (Plate LXXX: 1-6) *Caloncoba angolensis*
51. Pore morphology thinning sexine (Plate LXXX: 7-12) *Avicennia officinalis*
 - Pore morphology sunken pore (Plate LXXXI: 1-7) *Culcasia dinklagei*
52. Pore morphology plain (Plate LXXXI: 8-12) *Hildegardia barteri*
 - Pore morphology sunken pore (Plate LXXXII: 1-7) *Zizyphus mauritiana*
53. Pore morphology plain (Plate XXII: 7-10) *Syzygium guineense*
 - Pore morphology thinning sexine (Plate LXXXII: 8-13) *Dialium guianense*
 - Pore morphology extruded (Plate LXXXII: 14-17) *Irvingia smithii*
54. Pore shape circular 55.
 - Pore shape elliptic (broad) 58.
 - Pore shape elliptic (tall) (Plate LXXXII: 18-23) *Mitragyna inermis*

- Pore shape irregular 59.
- Pore shape lalongate (Plate LXXXIII: 1-7) *Tetrorchidium didymostemon*
- Pore shape squared (Plate LXXXIII: 8-13) *Gaertnera paniculata*
- Pore shape rectangular (broad) (Plate LXXXIV: 1-3) *Uapaca bojeri*

- 55. Pore morphology extruded (Plate LXXIX: 7-10) *Cardiospermum corindum*
- Pore morphology thinning sexine 56.
- Pore morphology sunken pore 57.

- 56. Polar grain shape triangular (convex) (Plate LXXXIV: 4-10) *Pericopsis angolensis*
- Polar grain shape triangular (straight) (Plate LXXXIV: 11-18) *Rhynchosia memnonia*

- 57. Wall thickness even (Plate LXXXV: 1-8) *Piptadenia africana*
- Wall thinner on pole (Plate LXXXV: 9-14) *Brachystegia spiciformis*

- 58. Pore morphology sunken pore (Plate LXXXVI: 1-20) Sapindaceae sp. (x3)
- Pore morphology thinning sexine (Plate LXXXVII: 1-6) *Sesbania goetzei*
- Pore morphology extruded (Plate LXXXVII: 7-14) *Ixora brachypoda*

- 59. Visible collumnae (Plate LXXXVIII: 1-6) *Rhynchosia* sp.
- Invisible collumnae (Plate LXXXVIII: 7-13) *Prosopis alpataco*

- 60. Pore shape concave (Plate LXXXIX: 1-7) *Centaurea perrottetii*
- Pore shape rectangular (broad) (Plate XC: 1-5) *Centaurea dimorpha*
- Pore shape elliptic (tall) 61.

- 61. Wall thickness even (Plate XCI: 1-7) *Artemisia judaica*
- Wall thinner on pole (Plate XCI: 8-13) *Artemisia* sp.

- 62. Pore shape circular 90.
- Pore shape circular with annulus (Plate XCI: 14-19) *Tabernaemontana retusa*
- Pore shape concave 63.
- Pore shape elliptic (broad) 64.
- Pore shape rectangular (broad) (Plate XCII: 1-5) *Lophira alata*
- Pore shape rectangular (tall) (Plate XCII: 6-13) *Trichodesma africanum*
- Pore shape rhombic (broad) (Plate XCII: 14-19) *Diospyros austroafricana*

- 63. Pore morphology sunken pore (Plate XCIII: 1-7) *Diospyros abyssinica*
- Pore morphology thinning sexine (Plate XCIII: 8-13) *Afrolicania elaeosperma*

64. Colpus length 2/3 (Plate XCIII: 14-16)
 - Colpus length 1/2 (Plate XCIV: 1-3) *Casearia engleri*
Neolemonniera clitandrifolia
65. Pore shape circular 66.
 - Pore shape concave 69.
 - Pore shape elliptic (broad) 70.
 - Pore shape elliptic (tall) 72.
 - Pore shape irregular 75.
 - Pore shape lalongate 77.
 - Pore shape lolongate 79.
 - Pore shape rectangular (broad) (Plate XCIV: 4-10) *Elaeodendron buchananii*
 - Pore shape rectangular (tall) (Plate XCV: 1-6) *Euphorbia engleri*
 - Pore shape rhombic (broad) (Plate XCVI: 1-7) *Rhizophora mangle*
 - Pore shape undetermined (Plate XCVI: 8-15) *Euphorbia cussonioides*
66. Pore morphology sunken pore 67.
 - Pore morphology thinning sexine (Plate XCVII: 1-6) *Rhektophyllum congense*
67. Pore position mid-wall (Plate XCVII: 7-13) *Securinega virosa*
 - Pore position corner 68.
68. Equatorial grain diameter ~27-33µm (Plate XCVII: 14-17) *Detarium senegalense*
 - Equatorial grain diameter ~50-60µm (Plate XCVIII: 1-7) *Cola nitida*
69. Pore morphology sunken pore (Plate XCVIII: 8-14) *Rhizophora mucronata*
 - Pore morphology thinning sexine (Plate XCIX: 1-7) *Ritchiea fragariodora*
 - Pore morphology slightly extruded (Plate XCIX: 8-13) *Millettia oblata*
70. Pore morphology sunken pore 71.
 - Pore morphology extruded (Plate C: 1-8) *Cassine parvifolia*
 - Pore morphology slightly extruded (Plate C: 9-15) *Nauclea esculenta*
71. Equatorial grain diameter ~25-30µm (Plate C: 16-23) *Maesobotrya barteri*
 - Equatorial grain diameter ~30-40µm (Plate CI: 1-6) *Cola millenii*
72. Pore morphology thickened (Plate CI: 7-12) *Cola gigantea*
 - Pore morphology extruded (Plate CII: 1-8) *Bridelia micrantha*
 - Pore morphology slightly extruded (Plate CII: 9-14) *Euphorbia grandicornis*
 - Pore morphology plain 73.

73. Pore position mid-wall (Plate CIII: 1-7)
- Pore position corner *Anthostema senegalense* 74.
74. Extine type tectate (Plate CIII: 8-14)
- Extine type semitectate (Plate CIV: 1-7) *Ormocarpum sennoides*
Salacia pyriformis
75. Pore morphology sunken pore 76.
- Pore morphology thickened (Plate CIV: 8-13) *Grewia glandulosa*
76. Polar grain shape circular (Plate CV: 1-6)
- Polar grain shape triangular (convex) (Plate CV: 7-14) *Lotus arabicus*
Uapaca heudelotii
77. Pore position corner (Plate CV: 15-20)
- Pore position mid-wall *Vepris gossweileri* 78.
78. Pore size ~8 μ m (Plate CVI: 1-6)
- Pore size ~2 μ m (Plate CVI: 7-12) *Zanthoxylum procerum*
Odyenda gabunensis
79. Pore morphology sunken pore (Plate CVI: 13-20)
- Pore morphology thinning sexine (Plate CVII: 1-8)
- Pore morphology plain (Plate CVII: 9-15) *Convolvulus trabutianus*
Millettia tanaensis
Oncoba dentata
80. Pore shape concave (Plate CVII: 16-23)
- Pore shape elliptic (broad) 81.
- Pore shape irregular (Plate CVIII: 1-7) *Detarium le-testui*
Kiggelaria africana 83.
- Pore shape lalongate 84.
- Pore shape lolongate
- Pore shape rectangular (broad) (Plate CVIII: 8-12) *Sarcophrynium brachystachyum*
81. Pore morphology extruded 82.
- Pore morphology thinning sexine (Plate CVIII: 13-20) *Cassia longiracemosa*
82. Wall thickness ~3 μ m (Plate CIX: 1-7)
- Wall thickness ~1 μ m (Plate CIX: 8-14) *Tephrosia nana*
Tephrosia elata
83. Pore morphology plain (Plate CIX: 15-19)
- Pore morphology sunken pore (Plate CX: 1-8) *Dissomeria crenata*
Homalium buchholzii
84. Colpi width ~15 μ m (Plate CX: 9-14)
- Colpi width ~35 μ m (Plate CX: 15-20) *Cassia burtii*
Copaifera carrissoana
85. Pore shape circular 86.
- Pore shape lalongate (Plate CXI: 1-7)
- Pore shape lolongate (Plate CXII: 1-6) *Vepris eugeniifolia*
Hymenostegia afzelii

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|--|-------------------------------|
| 86. Equatorial grain diameter ~27-33 μ m (Plate CXI: 8-15) | <i>Cynometra pedicellata</i> |
| - Equatorial grain diameter ~35-50 μ m (Plate CXI: 16-20) | <i>Aphloia theiformis</i> |
| 87. Pore morphology plain | 88. |
| - Pore morphology sunken pore (Plate CXII: 7-9) | <i>Placodiscus amaniensis</i> |
| - Pore morphology thickened | 89. |
| 88. Polar grain shape triangular (convex) (Plate CXII: 10-12) | <i>Nauclea diderrichii</i> |
| - Polar grain shape tri-lobate (Plate CXIII: 1-3) | <i>Microdesmis</i> sp. |
| 89. Visible collumnae (Plate CXIII: 6-7) | <i>Rinorea oblongifolia</i> |
| - Invisible collumnae (Plate CXIII: 4-5) | <i>Rinorea welwitschii</i> |
| 90. Pore morphology sunken pore (Plate CXIII: 8-15) | <i>Pericopsis laxiflora</i> |
| - Pore morphology thinning sexine (Plate CXIV: 1-6) | <i>Baphia obovata</i> |

17. Stephanoporate

Plate CXV

Key

Funtumia latifolia (Plate CXV: 1-3)

18. Stephanocolpate

Plates CXVI-CXX

Key

- | | |
|--|----------------------------|
| 1. Full length of grain | 2. |
| - 2/3 the full length of grain | 3. |
| - 1/2 the full length of grain | 4. |
| - < 1/3 the full length of grain (Plate CXVI: 1-7) | <i>Borreria densiflora</i> |
| - Colpi length undetermined (Plate CXVI: 8-9, Plate CXVI: 10-11) | <i>Borreria ruelliae</i> |
| | <i>Sesamum indicum</i> |
| 2. Equatorial grain shape subprolate (Plate CXVII: 1-4) | <i>Azelia quanzensis</i> |
| - Equatorial grain shape rectangular (broad) | <i>Diodia scandens</i> |

(Plate CXVIII: 1-6)

- | | |
|--|----------------------------------|
| 3. Equatorial grain shape circular (Plate CXIX: 1-5) | <i>Mitracarpus hirtus</i> |
| - Equatorial grain shape suboblate (Plate CXIX: 6-9) | <i>Sesamum angustifolium</i> |
| 4. Surface baculate (Plate CXX: 1-6) | <i>Diodia aulacosperma</i> |
| - Surface reticulate (Plate CXX: 7-14) | <i>Mitracarpus verticillatus</i> |

19. Stephanocolporate

Plates CXXI-CXXII

Key

- | | |
|---|------------------------------------|
| 1. Polar grain shape elliptic (Plate CXXI: 1-7) | <i>Atroxima afzeliana</i> |
| - Polar grain shape circular (Plate CXXII: 1-7) | <i>Securidaca longepedunculata</i> |

20. Heterocolporate

Plate CXXIII

Key

- | | |
|--|----------------------------|
| 1. Pore shape elliptic (tall) (Plate CXXIII: 1-6) | <i>Combretum aculeatum</i> |
| - Pore shape elliptic (broad) (Plate CXXIII: 7-12) | <i>Terminalia brownii</i> |
| - Pore shape rectangular (broad) (Plate CXXIII: 13-17) | <i>Combretum gueinzii</i> |
| - Pore shape concave | 2. |
| - Pore shape squared (Plate CXXIII: 18-23) | <i>Terminalia aemula</i> |
| 2. Pore morphology extruded (Plate CXXIII: 24-29) | <i>Guiera senegalensis</i> |
| - Pore morphology sunken pore (Plate CXXIII: 30-35) | <i>Pteleopsis diptera</i> |

21. Periporate

Plates CXXIV-CXXIX

Key

- | | |
|--|----------------------------|
| 1. Pore shape irregular | 2. |
| - Pore shape circular | 4. |
| - Pore shape circular with annulus | 8. |
| - Pore shape elliptic broad (Plate CXXIV: 1-4) | <i>Plantago lanceolata</i> |

2. Surface pattern reticulate	3.
- Surface pattern scabrate (Plate CXXIV: 5-8)	<i>Celosia stuhlmanniana</i>
- Surface pattern verrucate (Plate CXXV: 1-3)	<i>Calystegia sepium</i>
- Surface pattern psilate (Plate CXXV: 4-6)	<i>Costus spectabilis</i>
3. Pore section plain (Plate CXXIV: 9-14)	<i>Celosia</i> sp. (x2)
- Pore section thinning sexine (Plate CXXIV: 15-18)	<i>Drymaria cordata</i>
4. Surface pattern reticulate	5.
- Surface pattern echinate	6.
5. Equatorial grain diameter ~27-33 μ m (Plate CXXIV: 19-22)	<i>Plantago major</i>
- Equatorial grain diameter ~36-44 μ m (Plate CXXVI: 1-3)	<i>Plantago palmata</i>
- Equatorial grain diameter ~90-110 μ m (Plate CXXVI: 4-7)	<i>Dicranolepis oligantha</i>
6. Equatorial grain diameter ~20-30 μ m (Plate CXXVII: 1-4)	<i>Bosqueia manongarivensis</i>
- Equatorial grain diameter ~60-80 μ m (Plate CXXVII: 5-8)	<i>Ipomoea donaldsonii</i>
- Equatorial grain diameter ~80-120 μ m	7.
7. Wall thickness ~5 μ m (Plate CXXVIII: 5-6)	<i>Hewittia sublobata</i>
- Wall thickness ~12 μ m (Plate CXXIX: 1-2)	<i>Ipomoea ochracea</i>
8. Equatorial grain diameter ~35-45 μ m (Plate CXXVIII: 1-4)	<i>Lynchnis</i> sp.
- Equatorial grain diameter ~45-55 μ m (Plate CXXIX: 3-6)	<i>Cerastium indicum</i>

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Table caption

Table 1: List of pollen species shown on plates ordered alphabetically by family, genus and species.

Plate captions

5. Polyads

Plate I: 1-3 *Calpocalyx brevibracteatus*, 4-6 *Xylia evansii*, 7-9 *Acacia seyal*, 10-12 *Acacia eggelingii*.

Plate II: 1-3 *Acacia clavigera*, 4-6 *Parkia inundabilis*.

Plate III: 1-3 *Parkia bussei*, 4-6 *Parkia velutina*.

6. Tetrads

Plate IV: 1-4 *Erica arborea*, 5-7 *Mimosa strigillosa*, 8-9 *Uvariopsis congensis*.

7. Vesiculate

Plate V: 1-6 *Podocarpus milanjanus*.

8. Inaperturate, including Polypodiaceae

Plate VI: 1-4 *Illigera rhodantha*, 5-7 *Acidanthera brevicollis*.

Plate VII: 1-3 *Borassus aethiopum*, 4-7 *Trichomanes mandiocanum*, 8-11 *Pycnanthus dinklagei*, 12-15 *Alternanthera nodiflora*, 16-19 *Alternanthera repens*.

Plate VIII: 1-6 *Piptostigma mayumbense*, 7-9 *Dichrostachys unijuga*, 10-13 *Scaphopetalum thonneri*, 14-17 *Pandanus livingstonianus*.

Plate IX: 1-4 *Xyris welwitschii*, 5-8 *Xyris aristata*, 9-11 *Xyris montana*.

Plate X: 1-4 *Peperomia* sp., 5-7 *Nephrolepis exaltata*, 8-10 *Nephrolepis biserrata*, 11-12 *Lonchitis currori*, 13-16 *Nymphaea lotus*.

Plate XI: 1-4 *Nymphaea caerulea*, 5-7 *Uvaria kirkii*, 8-10 *Tiliacora funifera*, 11-14 *Scaphopetalum letestui*.

Plate XII: 1-3 *Psychotria goetzei*, 4-6 *Croton gratissimus*, 7-10 *Croton macrostachyus*.

Plate XIII: 1-2 *Dicranolepis usambarica*, 3-4 *Tribulus terrestris*, 5-7 *Morinda citrifolia*, 8-10 *Barteria acuminata*.

Plate XIV: 1-3 *Iodes kamerunensis*, 4-7 *Illigera appendiculata*, 8-11 *Lemna gibba*.

Plate XV: 1-4 *Pandanus kirkii*, 5-6 *Tylophora sylvatica*.

Plate XVI: 1-3 *Artabotrys likimensis*, 4-6 *Dichrostachys cinerea*, 7-10 *Dichrostachys glomerata*.

9. Monoporate

Plate XVII: 1-2 *Guaduella oblonga*, 3-5 *Typha australis*, 6-8 *Typha angustifolia*, 9-11 *Typha capensis*.

10. Monocolpate

Plate XVIII: 1-2 *Raphia ruffia*, 3-6 *Raphia farinifera*, 6-8 *Phoenix reclinata*, 9-11 *Elaeis guineensis*, 12-14 *Ancistrophyllum secundiflorum*, 15-16 *Ancistrophyllum laurentii*, 17-18 *Calamus erectus*, 19-21 *Calamus gracilis*.

Plate XIX: 1-3 *Eremospatha* sp., 4-6 *Borassus machadonis*, 7-8 *Borassus aethiopum*, 10-11 *Hyphaene natalensis*, 12-13 *Hyphaene ventricosa*.

Plate XX: 1-3 *Nymphaea caerulea*, 4-6 *Nymphaea lotus*, 7-9 *Chlorophytum floribundum*, 10-11 *Asparagus falcatus*, 12-13 *Dracaena camerooniana*.

Plate XXI: 1-3 *Dracaena reflexa*, 4-6 *Acidanthera brevicollis*, 7-9 *Aneilema johnstonii*, 10-12 *Commelina africana*, 13-15 *Crinum powellii*, 16-18 *Crinum pauciflorum*.

11. Syncolporate

Plate XXII: 1-3 *Eugenia michoacanensis*, 4-6 *Myrica* sp., 7-10 *Syzygium guineense*.

12. Diporate

Plate XXIII: 1-4 *Musanga smithii*, 5-9 *Musanga leo-errerae*, 10-15 *Chlorophora excelsa*, 16-17 *Antiaris toxicaria*, 18-19 *Ficus ingens*.

Plate XXIV: 1-5 *Iodes ovalis*, 6-9 *Baissea multiflora*, 10-12 *Motandra guineensis*, 13-19 *Trema orientalis*, 20-22 *Trema guineensis*.

Plate XXV: 1-2 *Morinda citrifolia*.

13. Dicolporate

Plate XXVI: 1-6 *Justicia cordata*, 7-11 *Justicia flava*.

14. Triporate

Plate XXVII: 1-7 *Allophylus africanus*, 8-11 *Iodes ovalis*, 12-14 *Piliostigma reticulatum*.

Plate XXVIII: 1-3 *Bombax brevicuspe*, 4-6 *Sesuvium sessile*, 7-9 *Coula edulis*, 10-12 *Baissea multiflora*, 13-15 *Sabicea floribunda*, 16-18 *Heisteria parvifolia*, 19-21 *Protea susannae*, 22-24 *Bombax buonopozense*.

Plate XXIX: 1-6 *Plectronia vulgaris*, 7-9 *Ceiba pentandra*, 10-15 *Lasianthus africanus*, 16-18 *Kirkia acuminata*.

Plate XXX: 1-7 *Vigna fischeri*, 8-10 *Cardiospermum grandiflorum*, 11-14 *Triplochiton scleroxylon*, 15-18 *Nesogordonia fertilis*, 19-21 *Entada umbonata*.

Plate XXXI: 1-6 *Nesogordonia parvifolia*, 7-12 *Dichapetalum mossambicense*, 13-15 *Vigna luteola*, 16-17 *Psychotria fractinervata*.

Plate XXXII: 1-3 *Paullinia pinnata*, 4-6 *Entada pursaetha*, 7-13 *Protea trichanthera*, 14-19 *Leptaulus daphnoides*.

Plate XXXIII: 1-4 *Celtis zenkeri*, 5-7 *Celtis mildbraedii*, 8-13 *Anthocleista grandiflora*, 14-17 *Hymenocardia acida*.

Plate XXXIV: 1-3 *Dichapetalum stuhlmannii*, 4-7 *Turraeanthus africana*, 8-9 *Striga forbesii*, 10-14 *Celtis integrifolia*.

15. Tricolpate

Plate XXXV: 1-5 *Gunnera chilensis*, 6-10 *Napoleona imperialis*, 11-16 *Farsetia stenoptera*, 17-21 *Premna maxima*, 22-27 *Premna resinosa*.

Plate XXXVI: 1-5 *Leucas calostachys*, 6-11 *Vitex amboniensis*, 12-17 *Vitex doniana*, 18-23 *Tetracera alnifolia*, 24-26 *Aneulophus africanus*.

Plate XXXVII: 1-6 *Scytopetalum tieghemii*, 7-12 *Dichostemma* sp., 13-18 *Cissampelos mucronata*.

Plate XXXVIII: 1-6 *Brachystegia spiciformis*, 7-12 *Brachystegia leonensis*, 13-18 *Afzelia bracteata*, 19-20 *Paramacrolobium coeruleum*.

Plate XXXIX: 1-5 *Petersia africana*, 6-11 *Berlinia grandiflora*.

16. Tricolporate

Plate XL: 1-6 *Gerrardina foliosa*, 7-11 *Thecacoris gymnogyne*, 12-17 *Vepris uguenensis*.

Plate XLI: 1-10 *Alchornea floribunda*, 11-16 *Ilex mitis*.

Plate XLII: 1-7 *Crudia bracteata*, 8-14 *Parinari curatellifolia*.

Plate XLIII: 1-6 *Diospyros mespiliformis*, 7-9 *Lotus chazaliei*, 10-16 *Canarium schweinfurthii*.

Plate XLIV: 1-6 *Heliotropium bacciferum*, 7-14 *Heliotropium subulatum*.

Plate XLV: 1-6 *Balanites glaber*, 7-12 *Centroplacus glaucinus*, 13-18 *Indigofera leptoclada*.

Plate XLVI: 1-8 *Millettia psilopetala*, 9-16 *Argomuellera macrophylla*.

Plate XLVII: 1-6 *Balanites aegyptiacus*, 7-12 *Martretia quadricornis*.

Plate XLVIII: 1-3 *Cliffortia nitidula*, 4-9 *Parinari holstii*, 10-15 *Macaranga schweinfurt*, 16-22 *Prunus africana*.

Plate XLIX: 1-8 *Alchornea cordifolia*, 9-12 *Medusandra richardsiana*, 14-18 *Commiphora campestris*.

Plate L: 1-7 *Commiphora scheffleri*, 8-16 *Erythrococca bongensis*.

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Plate LII: 1-8 *Entada abyssinica*, 9-15 *Baphia massaiensis*.

Plate LIII: 1-6 *Mallotus wrayi*, 7-12 *Fagara macrophylla*, 13-18 *Olea hochstetteri*.

Plate LIV: 1-8 *Ixora aneimenodesma*, 9-16 *Anthostema aubryanum*.

Plate LV: 1-6 *Agelaea heterophylla*, 7-14 *Adenia nicobarica*.

Plate LVI: 1-3 *Salacia kraussii*, 4-8 *Maytenus senegalensis*, 9-14 *Hippocratea affinis*.

Plate LVII: 1-8 *Hippocratea africana*, 9-14 *Grandidiera boivinii*.

Plate LVIII: 1-8 *Cynometra alexandri*, 9-13 *Calantica jalbertii*, 14-20 *Blighia wildemaniana*.

Plate LIX: 1-6 *Corchorus fascicularis*, 7-13 *Strephonema pseudocola*.

Plate LX: 1-6 *Crossopteryx febrifuga*, 7-9 *Cissus petiolata*, 10-17 *Spondianthus preussii*.

Plate LXI: 1-6 *Ritchiea capparoides*, 7-13 *Blighia unijugata*.

Plate LXII: 1-7 *Cissus quadrangularis*, 8-13 *Grewia bicolor*.

Plate LXIII: 1-5 *Vepris humbertii*, 6-11 *Rubus scheffleri*.

Plate LXIV: 1-6 *Drypetes gerrardii*, 7-11 *Flacourtia indica*, 12-17 *Avicennia nitida*.

Plate LXV: 1-6 *Dasylepis assinensis*, 7-9 *Hannoa klaineana*, 10-15 *Hannoa undulata*, 16-21 *Ormocarpum kirkii*.

Plate LXXVI: 1-7 *Maesobotrya hirtella*, 8-14 *Cassipourea flanaganii*, 15-20 *Lannea stuhlmannii*.

Plate LXXVII: 1-4 *Lannea triphylla*, 5-9 *Isoberlinia angolensis*.

Plate LXXVIII: 1-5 *Isoberlinia doka*, 6-12 *Scytopetalum tieghemii*.

Plate LXXIX: 1-7 *Euphorbia hypericifolia*, 8-13 *Pterocarpus abyssinicus*, 14-19 *Pterocarpus lucens*.

Plate LXXX: 1-7 *Dodonaea viscosa*, 8-13 *Tabernaemontana ventricosa*.

Plate LXXXI: 1-6 *Sterculia tragacantha*, 7-12 *Prosopis africana*.

Plate LXXXII: 1-8 *Hagenia abyssinica*, 9-16 *Monotes kerstingii*.

Plate LXXXIII: 1-6 *Copaifera gorskiana*, 7-12 *Pygeum africanum*, 13-18 *Acridocarpus macrocalyx*.

Plate LXXXIV: 1-7 *Guibourtia arnoldiana*, 8-14 *Griffonia simplicifolia*.

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Plate LXXXVI: 1-6 *Spondias mombin*.

Plate LXXXVII: 1-6 *Berlinia bifoliolata*, 7-12 *Teclea villosa*.

Plate LXXXVIII: 1-3 *Corchorus trilocularis*, 4-7 *Daniella oliveri*.

Plate LXXXIX: 1-6 *Aubrevillea platycarpa*, 7-10 *Cardiospermum corindum*.

Plate LXXX: 1-6 *Caloncoba angolensis*, 7-12 *Avicennia officinalis*.

Plate LXXXI: 1-7 *Culcasia dinklagei*, 8-12 *Hildegardia barteri*.

Plate LXXXII: 1-7 *Zizyphus mauritiana*, 8-13 *Dialium guianense*, 14-17 *Irvingia smithii*, 18-23 *Mitragyna inermis*.

Plate LXXXIII: 1-7 *Tetrorchidium didymostemon*, 8-13 *Gaertnera paniculata*.

Plate LXXXIV: 1-3 *Uapaca bojeri*, 4-10 *Pericopsis angolensis*, 11-18 *Rhynchosia memnonia*.

Plate LXXXV: 1-8 *Piptadenia africana*, 9-14 *Brachystegia spiciformis*.

Plate LXXXVI: 1-8 *Lecaniodiscus cupanioides*, 9-15 *Chytranthus obliquinervis*, 16-20 *Chytranthus sacleuxii*.

Plate LXXXVII: 1-6 *Sesbania goetzei*, 7-14 *Ixora brachypoda*.

Plate LXXXVIII: 1-6 *Rhynchosia* sp., 7-13 *Prosopis alata*.

Plate LXXXIX: 1-7 *Centaurea perrottetii*.

Plate XC: 1-5 *Centaurea dimorpha*.

Plate XCI: 1-7 *Artemisia judaica*, 8-13 *Artemisia* sp., 14-19 *Tabernaemontana retusa*.

Plate XCII: 1-5 *Lophira alata*, 6-13 *Trichodesma africanum*, 14-19 *Diospyros austroafricana*.

Plate XCIII: 1-7 *Diospyros abyssinica*, 8-13 *Afrolicania elaeosperma*, 14-16 *Casearia engleri*.

Plate XCIV: 1-3 *Neolemonniera clatandrifolia*, 4-10 *Elaeodendron buchananii*.

Plate XCV: 1-6 *Euphorbia engleri*.

Plate XCVI: 1-7 *Rhizophora mangle*, 8-15 *Euphorbia cussonioides*.

Plate XCVII: 1-6 *Rhektophyllum congense*, 7-13 *Securinega virosa*, 14-17 *Detarium senegalense*.

Plate XCVIII: 1-7 *Cola nitida*, 8-14 *Rhizophora mucronata*.

Plate XCIX: 1-7 *Ritchiea fragariodora*, 8-13 *Millettia oblate*.

Plate C: 1-8 *Cassine parvifolia*, 9-15 *Nauclea esculenta*, 16-23 *Maesobotrya barteri*.

Plate CI: 1-6 *Cola millenii*, 7-12 *Cola gigantea*.

Plate CII: 1-8 *Bridelia micrantha*, 9-14 *Euphorbia grandicornis*.

Plate CIII: 1-7 *Anthostema senegalense*, 8-14 *Ormocarpum sennooides*.

Plate CIV: 1-7 *Salacia pyriformis*, 8-13 *Grewia glandulosa*.

Plate CV: 1-6 *Lotus arabicus*, 7-14 *Uapaca heudelotii*, 15-20 *Vepris gossweileri*.

Plate CVI: 1-6 *Zanthoxylum procerum*, 7-12 *Odyndea gabunensis*, 13-20 *Convolvulus trabutianus*.

Plate CVII: 1-8 *Millettia tanaensis*, 9-15 *Oncoba dentata*, 16-23 *Detarium le-testui*.

Plate CVIII: 1-7 *Kiggelaria africana*, 8-12 *Sarcophrynium brachystachyum*, 13-20 *Cassia longiracemosa*.

Plate CIX: 1-7 *Tephrosia nana*, 8-14 *Tephrosia elata*, 15-19 *Dissomeria crenata*.

Plate CX: 1-8 *Homalium buchholzii*, 9-14 *Cassia burttii*, 15-20 *Copaifera carrissoana*.

Plate CXI: 1-7 *Vepris eugeniifolia*, 8-15 *Cynometra pedicellata*, 16-20 *Aphloia theiformis*.

Plate CXII: 1-6 *Hymenostegia afzelii*, 7-9 *Placodiscus amaniensis*, 10-12 *Nauclea diderrichii*.

Plate CXIII: 1-3 *Microdesmis* sp., 4-5 *Rinorea welwitschii*, 6-7 *Rinorea oblongifolia*, 8-15 *Pericopsis laxiflora*.

Plate CXIV: 1-6 *Baphia obovata*.

17. Stephanoporate

Plate CXV: 1-3 *Funtumia latifolia*.

18. Stephanocolpate

Plate CXVI: 1-7 *Borreria densiflora*, 8-9 *Borreria ruelliae*, 10-11 *Sesamum indicum*.

Plate CXVII: 1-4 *Afzelia quanzensis*.

Plate CXVIII: 1-6 *Diodia scandens*.

Plate CXIX: 1-5 *Mitracarpus hirtus*, 6-9 *Sesamum angustifolium*.

Plate CXX: 1-6 *Diodia aulacosperma*, 7-14 *Mitracarpus verticillatus*.

19. Stephanocolporate

Plate CXXI: 1-7 *Atroxima afzeliana*.

Plate CXXII: 1-7 *Securidaca longepedunculata*.

20. Heterocolporate

Plate CXXIII: 1-6 *Combretum aculeatum*, 7-12 *Terminalia brownii*, 13-17 *Combretum gueinzii*, 18-23 *Terminalia aemula*, 24-29 *Guiera senegalensis*, 30-35 *Pteleopsis diptera*.

21. Periporate

Plate CXXIV: 1-4 *Plantago lanceolata*, 5-8 *Celosia stuhlmanniana*, 9-11 *Celosia patentiloba*, 12-14 *Celosia trigyna*, 15-18 *Drymaria cordata*, 19-22 *Plantago major*.

Plate CXXV: 1-3 *Calystegia sepium*, 4-5 *Costus spectabilis*.

Plate CXXVI: 1-3 *Plantago palmata*, 4-7 *Dicranolepis oligantha*.

Plate CXXVII: 1-4 *Bosqueia manongarivensis*, 5-8 *Ipomoea donaldsonii*.

Plate CXXVIII: 1-4 *Lychnis* sp., 5-6 *Hewittia sublobata*.

Plate CXXIX: 1-2 *Ipomoea ochracea*, 3-6 *Cerastium indicum*.

Table 1: List of pollen species shown on plates ordered alphabetically by family, genus and species.

Family	Species	Plate
Acanthaceae	<i>Avicennia nitida</i>	LXIV
Acanthaceae	<i>Avicennia officinalis</i>	LXXX
Acanthaceae	<i>Justicia cordata</i>	XXVI
Acanthaceae	<i>Justicia flava</i>	XXVI
Achariaceae	<i>Caloncoba angolensis</i>	LXXX
Achariaceae	<i>Dasylepis assinensis</i>	LXV
Achariaceae	<i>Grandidiera boivinii</i>	LVII
Achariaceae	<i>Kiggelaria africana</i>	CVIII
Aizoaceae	<i>Sesuvium sessile</i>	XXVIII
Amaranthaceae	<i>Alternanthera nodiflora</i>	VII
Amaranthaceae	<i>Alternanthera repens</i>	VII
Amaranthaceae	<i>Celosia patentiloba</i>	CXXIV
Amaranthaceae	<i>Celosia stuhlmanniana</i>	CXXIV
Amaranthaceae	<i>Celosia trigyna</i>	CXXIV
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Vitaceae	<i>Cissus petiolata</i>	LX
Vitaceae	<i>Cissus quadrangularis</i>	LXII
Xyridaceae	<i>Xyris aristata</i>	IX
Xyridaceae	<i>Xyris montana</i>	IX
Xyridaceae	<i>Xyris welwitschii</i>	IX
Zygophyllaceae	<i>Balanites aegyptiacus</i>	XLVII
Zygophyllaceae	<i>Balanites glaber</i>	XLV
Zygophyllaceae	<i>Tribulus terrestris</i>	XIII