This also varies considerably in size, from eleven-sixteenths to less than one-fourth of an inch.

	Cor. Crag.	Red Crag.	Mam. Crag.	Recent.
6. <i>Trivia retusa</i> (<i>Cypræa retusa</i> , <i>Min. Con.</i> t. 378. f. 2).	Sutton.	Sutton.		
7. — <i>globulosa</i> , n. s.		Sutton.		
1. <i>Erato lævis</i> , <i>Gray</i> (<i>Erato cypræola</i> , <i>Risso, Hist. Nat. des prin. prod. de l'Eur.</i> vol. iv. p. 240. pl. 7. f. 85. <i>Marginella voluta</i> , <i>Flem. Brit. An.</i> p. 335. <i>Cypræa voluta</i> , <i>Mont. Test. Brit.</i> t. 6. f. 7. <i>Voluta lævis</i> , <i>Don. Brit. Shells</i> , t. 145).				
2. — <i>Maugeriæ</i> , <i>Gray</i> (<i>Sow. Conch. Illust.</i> f. 47).	Sutton.	Sutton.		West Indies.
- The West Indian specimens are generally a little smaller and rather more delicately formed than the crag shell.
1. <i>Ovulum Leathesii</i> , <i>Sow.</i> (<i>Min. Con.</i> t. 478. <i>Calpurna Leathesii</i> , <i>Flem. Brit. An.</i> p. 331).	Sutton.	Walton Naze.		

Corrigenda.

- Vol. vi. page 245. Note § refers to *Cultellus*, and not to *Solen siliqua*.
 Do. do. *Sphenia cylindrica* is the young of *Panopæa*.
 Do. page 251. *Cardium nodulosum* is *Cardium nodosum*, *Turt.*
 Do. do. *Nucula tenera* is *Arca tenuis* of *Mont.*

LVII.—*Observations on the Structure of the Pollen Granule, considered principally with reference to its eligibility as a means of Classification.* By ARTHUR HILL HASSALL, Esq., M.R.C.S.L., Corresponding Member of the Natural History Society of Dublin.

[Continued from vol. viii. p. 108.]

[With 6 Plates.]

THE second portion of this communication comprises a particular description of the principal forms of pollen granules met with by the author during his investigations, together with the names of all the plants examined, arranged according to Lindley's 'Natural System,' which is followed in every particular, save that the order of arrangement is reversed, the lower tribes of Phanerogamic plants being first enumerated.

VASCULARES.

ENDOGENS OR MONOCOTYLEDONS.

GLUMOSÆ.

CYPERACEÆ.

CHAR.—Outline of pollen grain ovate-lanceolate; extine covering only a portion of the intine, being deficient on either side, and at the

Utinia Nolcken
Amelia Hunter } fecerunt.
A.H. Hassall

Structure of Pollen.

J.D.C. Sowerby, sc.

Utinia Nolcken
Amelia Hunter } fecerunt.
A.H. Hassall

Structure of Pollen.

J.D.C. Sowerby, sc.

Pinia Nölcken
 Amelia Hunter fecerunt.
 J. H. Hassall

Structure of Pollen.

J.D.C. Sowerby fecit.

HERBARIUM
MUSEUM
OF
NATURAL HISTORY

113

116

114

112

115

121

117

119

118

125

122

120

123

127

124

126

129

134

136

131

130

133

132

128

135

137

Structure of Pollen.

J.D.C. Sowerby fec.

Utinia Nölcken
Amelia Hunter } fecerunt.
A.H. Hassall

Utinia Nolcken
Amelia Hunter } fecerunt.
A.H. Hassall

Structure of Pollen.

J.D.C. Sowerby sc

smaller end of the figure; but one pollen tube, which issues from the larger extremity of the granule. The entire figure bears a rude resemblance to an acorn when in its cup. Pl. XIII. fig. 1.

Isolepis Holoschoenus.

Scirpus capitatus.

I. romana.

Carex tomentosa.

Cyperus longus.

C. Oederi.

Scirpus atrovirens.

C. præcox.

S. carinatus.

C. acuta.

S. triqueter.

The pollen grain of the following plant resembles that of the next order in every particular but size. See fig. 2.

Papyrus Antiquorum.

GRAMINACEÆ.

Pollen granules separate, circular at first, but on the emission of the single pollen tube with which each grain is furnished generally becoming ovoid, the larger end corresponding to that from which the pollen tube issues; extine containing a distinct circular aperture for the escape of the pollen tube, which aperture is said by Fritzsche to be provided with a valve, of which I have not been able to detect the smallest trace. Pl. XIII. fig. 4.

Dactylis glomerata.

Triticum hibernum.

Zea Mays.

D. abbreviata.

Lolium perenne.

Zizania aquatica.

Sesleria elongata.

Avena fatua.

Andropogon furcatus.

Poa fertilis.

Aira vaginata.

Panicum palmifolium.

Elymus striatus.

Spartina juncea.

Phragmitis communis.

E. sabulosus.

S. cynosuroides.

Arundo littorea.

Triticum rigidum.

SPADICOSÆ.

TYPHACEÆ.

Pollen grains united in fours, generally disposed upon the same plane, and each emitting a single pollen tube. See fig. 5.

Typha latifolia.

ARACEÆ.

CALLEÆ.

Pollen grain, when dry, in outline describing a parallelogram, very flat; in water it changes to an ellipse, emitting a pollen tube from each extremity. See fig. 6.

Calla palustris.

Pollen grain of an elongated ovoid form, bearing some resemblance to a flask. Extine apparently without any provision for the pollen tube, which escapes from the small end of the figure by the rupture of that membrane. See fig. 7.

Calla æthiopica.

HYPOGYNOSÆ.

JUNCEÆ.

Pollen granules united in fours, three being placed upon the

same plane and one resting upon these; each granule emits a single pollen tube. Pl. XIII. fig. 8.

Juncus articulatus.

OBS.—The plants examined in the following orders of the groups *Hypogynosæ* and *Epigynosæ*, commencing with the *Butomaceæ* and going up to *Musaceæ*, are with two exceptions characterized by the possession of a pollen grain of the same form and structure as indicated below. The first exception occurs in *Limnocharis Humboldtii*, and is very remarkable, inasmuch as its pollen granule presents a more complicated structure than that of any other endogenous plant hitherto met with, while the second is seen in *Anigozanthus coccineus*.

CHAR.—Granules of an elongated form, tapering towards either extremity, sometimes slightly curved, each having on one side down its long axis a fissure through which the pollen tube quits the extine; this fissure is sometimes covered by an oval piece of membrane which curls up and falls off the extine when placed in water; extine either plain or reticulated. The whole granule may be very aptly compared to a grain of wheat while it remains dry; but as soon as it is immersed in fluid, and before the emission of the pollen tube, it becomes nearly circular. Extine often reticulated, and presenting a very beautiful appearance under the microscope. See fig. 10 and the following ones up to fig. 26.

BUTOMACEÆ.

Butomus umbellatus.

1st Exception.

Pollen grain of *Limnocharis Humboldtii* circular; extine reticulated, perforated with six or seven apertures for the escape of pollen tubes. See fig. 9.

COMMELINACEÆ.

Pollen grain somewhat curved. See fig. 10.

Tradescantia virginica. *Tradescantia discolor*.

LILIACEÆ. Pl. XIII. fig. 11, 12.

Haworthia radula.

Arthropodium cirrhatum.

Aloe obscura.

Hyacinthus orientalis.

A. saponaria.

Bessera elegans.

Yucca filamentosa.

Eucomis striata.

Asparagus officinalis.

Albuca minor.

Peliosanthes Teta.

Ornithogalum speciosum.

Convallaria majalis.

Allium fragrans.

Czackia Liliastrum.

Scilla maritima.

Pollen granules of most of the following genera reticulated, and furnished with an oval appendage; (two of the genera enumerated above, *Yucca filamentosa* and *Czackia Liliastrum*, have their pollen grains provided with a similar appendage). See fig. 13, 14, 15.

Polianthes tuberosa.

Tulipa Gesneriana.

Agapanthus umbellatus.

Lilium longiflorum.

Funkia Sieboldiana.

L. album.

Hemerocallis flava.

L. tigrinum.

MELANTHACEÆ.

Pollen granule reticulated.

Colchicum autumnale.

PALMACEÆ.

Kunthia speciosa.

EPIGYNOSÆ.

BROMELIACEÆ.

Billbergia amoena.

IRIDACEÆ.

Iris florentina.

Ixia florida.

Antholyza æthiopica.

Moræa racemosa.

Crocus vernus.

Pollen granule reticulate. See fig. 16.

Watsonia irioides.

Gladiolus florabundus.

XÆMODORACEÆ.

2nd Exception.

Pollen grain of an elongated form, expanding into a bulb at either extremity, from an aperture in each of which a pollen tube issues; it may be compared to a dumb-bell, in which the cross bar connecting the two globes is somewhat curved. See fig. 17, 18, 19.

Anigozanthus coccineus.

AMARYLLIDACEÆ. See Pl. XIII. fig. 23, 24, 25, 26.

OBS.—An *apparent* exception to the usual form occurs in the pollen granule of *Crinum amabile*, which possesses two furrows instead of one. See fig. 20, 21, 22.

Galanthus nivalis.

Narcissus Jonquilla.

Amaryllis purpurea.

Zephyranthes grandiflora.

Hæmanthus tigrinus.

Alströmeria ovata.

Griffinia hyacinthina.

A. psittacina.

Imatophyllum Aitoni.

Hypoxis stellata.

Pancratium declinatum.

OBS.—The closely allied orders *Musaceæ*, *Marantaceæ*, *Zingiberaceæ* or *Scitamineæ* possess a pollen granule of the same form and structure, which is thus characterized.

CHAR.—Circular; extine of considerable thickness, either smooth or spinous, not provided with apertures or fissures for the escape of pollen tubes, but bursting irregularly, and so exposing the intine, which elongates into a pollen tube wherever thus denuded. Plate XIV. fig. 30, 31, 32, 33.

MUSACEÆ.

Extine smooth. See Pl. XIV. fig. 30, 31.

Strelitzia humilis.

Strelitzia Reginae.

MARANTACEÆ.

Extine covered with spines, having their summits perforated, which disappear on the immersion of the pollen in water, leaving

only small apertures in the surface of the now smooth extine, but the pollen tubes do not pass through these. See fig. 32, 33.

Canna Occidentalis.

C. Indica.

ZINGIBERACEÆ.

Extine covered with spines, which are permanent.

Roscoeæ purpurea.

Extine smooth.

Hedychium Gardnerianum. *H. flavescens.* *H. coronarium.*

VASCULARES.

EXOGENS OR DICOTYLEDONS.

GYMNOSPERMS.

CONIFERÆ OR PINACEÆ.

Pollen grain kidney-shaped, and according to Fritzsche furnished with three membranes; extine cracking to admit of the emission of the pollen tubes. See fig. 34, 35.

Pinus sylvestris.

Pinus Nova Zealandica.

P. Pinaster.

P. Tæda.

Pollen granule circular, furnished with three membranes and pollen tubes escaping by the rupture of the extine, as in the previous instance.

Juniperus communis.

J. Sabina.

TAXACEÆ.

Pollen granule similar to that of *Juniperus*.

Taxus baccata.

ANGIOSPERMS.

DICARPOSEÆ.

JASMINACEÆ, OLEACEÆ, AND LOGANIACEÆ.

Pollen grain in its dry state of an elongated form, trilobate, each lobe being separated from the others by a fissure passing through the extine; in water becoming spherical or triangular and emitting three pollen tubes; this change of form results from the approximation of each end of the granule, occasioned by the imbibition of the fluid surrounding it.

OBS.—As the above type of pollen granule occurs hereafter in families not allied to the above, in order to avoid the repetition of its characters, just enumerated, the term cylindrical will be employed to designate it when again met with. Although the same *type* of granule is of frequent occurrence, it is not to be inferred that it agrees either with that of the above orders or any others in its exact form or size, which varies considerably. It is to be regretted that the size of all granules of the above form has not been ascertained.

Jasminum odoratissimum.

Olea europæa.

Ornus europæa.

Gærtnera racemosa.

Syringa vulgaris.

APOCYNACEÆ.

Primary form of pollen granule cylindrical, very large, but when

taken from the stigma spherical, from the imbibition of the abundant secretion furnished by that organ.

Allamanda cathartica.

Vinca herbacea.

Plumeria conspicua.

V. rosea.

Pollen grain spherical when removed from the stigma and furnished with four pollen tubes. Pl. XIV. fig. 37.

Nerium Oleander.

GENTIANACEÆ.

Pollen grain cylindrical, three-lobed.

Chironia pubescens. Gentianella cruciata. Gentiana asclepiadea.

SOLANACEÆ.

Cylindrical, three-lobed. Pl. XIV. fig. 38, 39, 40, 41, 42.

Hyoscyamus niger.

Saracha viscosa.

H. pallidus.

Atropa belladonna.

Petunia atropurpurea.

Physalis oxalidifolia.

P. violacea.

P. Alkekengi.

P. rosea.

Solanum Dulcamara.

Lycopersicum erythrocarpum.

S. stramonifolium.

Datura Stramonium.

Capsicum annuum.

Many of the granules of the two following species are four-lobed.

Nicotiana Tabacum.

Solanum tuberosum.

SCROPHULARIACEÆ.

Pollen grain cylindrical, three-lobed. See fig. 43.

Buddleia globosa.

Franciscea mutabilis.

Veronica longifolia.

Schizanthus pinnatus.

V. Chamædrys.

Rhodochiton volubile.

Gratiola officinalis.

Antirrhinum majus.

Mimulus guttatus.

Linaria pilosa.

M. elatus.

L. genistoides.

M. roseus.

L. purpurea.

Digitalis purpurea.

L. dalmatica.

Russelia juncea.

Scrophularia nodosa.

Penstemon pubescens.

S. aquatica.

P. pentaphyllum.

Alonsoa urticifolia.

P. speciosum.

Calceolaria elegans.

P. diffusum.

Celsia Cretica.

Anthocercis albicans.

Verbascum Phœniceum.

Franciscea Hopeana.

V. Thapsium.

Exception.

Pollen granules united in fours, three upon the same plane and one resting on these; the three lower granules appear to emit but two pollen tubes, the third being most probably suppressed by the union of the granules, while the upper one sends off three tubes; those in the lower grains issue opposite to each other near the point of juncture of the granules, while those of the upper one are given off at equal distances round the circumference, alternating with the

others. See fig. 44. This form seems to result from the union of four of the preceding granules.

Salpiglossis atropurpurea.

GESNERACEÆ.

Gloxinia speciosa.

Gesnera bulbosa.

Trevirania coccinea.

G. Douglassii.

ACANTHACEÆ.

Pollen granules cylindrical, not diminishing in size towards either extremity; ends rounded; extine perforated apparently with minute apertures. Pollen tubes three, issuing through longitudinal fissures. Pl. XIV. fig. 45.

Justicia variabilis.

Pollen grain of an oval form, with but one longitudinal fissure and one pollen tube issuing from the smaller end. The comparison of pollen of this form to a *Pholas* is not inapt. See fig. 46.

Acanthus spinosa.

Circular, surface presenting a lobulated appearance, the lobes being separated by lines which cross each other, in some of which fissures are placed for the escape of the pollen tubes. See fig. 47.

Thunbergia alata.

Pollen grain in its dry state cylindrical; when moist nearly circular, reticulated, reticulation apparently formed in the same way as that of *Cobæa scandens*. See fig. 48.

Eranthemum pulchellum.

BIGNONIACEÆ.

Pollen grain cylindrical, three-lobed.

Eccremocarpus scaber.

Bignonia radicans.

DUCAMENTOSÆ.

MYOPORACEÆ.

Pollen grain cylindrical, three-lobed.

Myoporum parviflorum.

VERBENACEÆ.

Pollen grain cylindrical, three-lobed.

Lantana Sellowii.

Clerodendrum florabundum.

Verbena teucroides.

Aloysia citriodora.

Pollen grain of considerable size, triangular, sides of triangle much incurved, furnished with three membranes, the second of which, or exintine, protrudes through the apertures in the extine, forming at each angle of the figure a prominent rounded projection; a pollen tube of large dimensions issues from each angle. Extine covered with a number of oval-looking bodies. See fig. 49, which exhibits an abnormal form of the pollen granule of *Stachytarpheta mutabilis*.

Stachytarpheta mutabilis.

S. Jamaicensis.

LABIATÆ OR LIMARIACEÆ.

Pollen grain cylindrical, three-lobed.

Teucrium lucidum.

T. pyrenaicum.

Molluccella lævis.	Stachys coccinea.
Marrubium vulgare.	Galeobdolon luteum.
Ballota nigra.	Physostegia virginica.
Sideritis foetida.	Dracocephalum speciosum.
S. taurica.	Westringia ermicola.
Stachys iberica.	Scutellaria galericulata.
S. setifera.	S. lupulina.

Many of the granules of *Sideritis scordioides* are four-lobed.

Pollen grain oval, six-lobed, resembling a melon, changing its form in water and emitting six pollen tubes. See fig. 51, 52.

Gardoquia multiflora.	Salvia splendens.
Origanum heracleoticum.	S. Sclarea.
Glechoma hederacea.	Ocimum basilicum.
Monarda didyma.	

Cylindrical, three-lobed.

Lycopus europæus.

BORAGINACEÆ.

Pollen granule of an elongated form with either rounded or truncated extremities, centre constricted in its dry state. See Pl. XIV. fig. 53, 54, and Pl. XV. fig. 55, 56, 57, 58.

Pollen tubes two, opposite each other, issuing from longitudinal fissures placed near the centre of the figure. See fig. 53, 54.

Symphytum officinale. Cerinthe aspera. C. major.

Pollen tubes ten; pollen granule before the emission of the tubes becoming circular. Pl. XV. fig. 55, 56, 57, 58.

Borago officinalis.

Number of pollen tubes not known.

Myosotis palustris.

Pollen tubes four.

Anchusa semperflorens. Cynoglossum pictum?

Pollen granule three-lobed, pyramidal.

Onosma echinoides. Echium fruticosum.

HYDROPHYLLACEÆ.

Cylindrical, three-lobed. See fig. 59.

Phacelia bipinnatifida. Eutoca multiflora.

Eutoca viscosa. E. Wrangelana.

Pollen granule small, triangular, sides of triangle straight; pollen tubes three. See fig. 60.

Nemophila phacelioides. N. atomaria. N. insignis.

AGGREGOSÆ.

PLUMBAGINACEÆ.

Pollen granule reticulated, in its dry state cylindrical, when moist somewhat triangular, with the sides of the triangle curved outwards to some extent; pollen tubes three, issuing from the angles of the grain. See fig. 61.

Armeria vulgaris. Statice latifolia. S. tartarica.

Statice sinuata. S. speciosa.

Pollen granule of large size, not reticulated, cylindrical, three-lobed in its dry state, when moist nearly circular; between each lobe

is a fissure, in connexion with which is a small strip of membrane. Pl. XV. fig. 62, 63.

Plumbago rosea.

P. cærulea.

PLANTAGINACEÆ.

Pollen granule small, circular, perforated with about ten apertures for the escape of pollen tubes. It is probable that the number of apertures in each granule is determinate, but it is no easy matter to ascertain what that is exactly. See fig. 64.

Plantago lancifolia.

P. oblongifolia.

DIPSACEÆ.

Pollen granule three-lobed in its dry state, extremities not tapering and nearly truncate; in connexion with each of the fissures is almost invariably a piece of membrane of not any very defined form; extine spinous, with traces of reticulation; in water becoming nearly triangular and emitting three pollen tubes.

Scabiosa caucasica.

Dipsacus fullonum.

S. atropurpurea.

D. sylvestris.

COMPOSITÆ.

Pollen granule of the following species of *Cynaraceæ* does not differ materially from that of the preceding order *Dipsaceæ*; the spines are however more strongly marked. See fig. 65, 66.

Centaurea scabiosa.

Arctium Lappa.

Cnicus Marianus.

Echinops sphærocephalus.

C. nutans.

Cynara scolymus.

C. tenuiflorus.

Pollen granule polyhedral, emitting three pollen tubes; extine covered with a raised hexagonal reticulation of some breadth, on which are placed a number of spines touching each other. See fig. 67.

Scorzonera hispanica.

Pollen grain small, if examined in a sufficiently early stage of its formation trilobate; subsequently becoming spherical or triangular and emitting three pollen tubes; extine covered with strong spines. No pieces of membrane in connexion with the fissures. See fig. 68, 69.

Leontodon Taraxacum.

Pascalina glauca.

Siegesbeckia orientalis.

Silphium cornutum.

Catananche cærulea.

Helianthus annuus.

Relbania pungens.

Dahlia glabrata.

Senecio nemorensis.

Inula Helenium.

Ozothamnus cinereus.

Solidago Virgaurea.

Tanacetum vulgare.

Tussilago Farfara.

Artemisia vulgaris.

Eupatorium purpureum.

Chrysanthemum viscosum.

Chrysocoma coma-aurea.

Anthemis nobilis.

Cineraria Andersonii.

Bellis perennis.

EPIGYNOSÆ.

STELLATÆ OR GALIACEÆ.

Pollen granule oval, extine containing about eight longitudinal fissures. See fig. 70, 71.

Crucianella stylosa.

Galium porrigens.

CAPRIFOLIACEÆ.

Pollen granule large, cylindrical, three-lobed; extine of *Leycesteria formosa* dotted with a few small spines.

Viburnum Lantana. Sambucus Ebulus. Leycesteria formosa.

CINCHONACEÆ.

Pollen granule cylindrical, three-lobed in its dry condition. See fig. 73, 74.

Serissa foetida. Pavetta Caffra. Burchellia capensis.

Pollen granules of *Oxyanthus speciosus* united in fours in the same manner as those of *Salpiglossis atropurpurea*, from which I cannot discover that they differ in any more material respect than size. See fig. 72.

GOODENIACEÆ.

Pollen grain flattish, somewhat triangular, united in fours, the union of which forms an oval figure; each of the two lateral granules, which are somewhat larger and more in contact with each other than those which form the ends of the oval figure, contain eight apertures for the passage of pollen tubes, one placed at each free angle of the granule, and three on either surface, while the end ones have each but six apertures, one at each free angle and two on either surface. See fig. 75.

Lechenaultia formosa.

CAMPANULACEÆ.

Pollen granule spherical; pollen tubes varying from three to five, and issuing from apertures placed upon the equator of the granule. Extine slightly spinous. See fig. 76, 77.

Campanula pyramidalis. Campanula Speculum.

C. pumila alba. C. rotundifolia.

C. patula.

LOBELIACEÆ.

Cylindrical, three-lobed. See fig. 78.

Siphocampylus bicolor. Lobelia decumbens. L. erinus.

Lobelia teucroides. L. ignea.

MONOPETALÆ.

POLYCARPOSÆ.

COBÆACEÆ, Don.

Pollen granule globular, covered with an elevated hexagonal reticulation, which is apparently formed by the apposition of a number of elongated cells placed vertically in reference to the circumference of the granule; apertures amounting to about forty, each being situated in one of the hexagonal spaces formed by the reticulation, and surrounded by a circle of six hexagonal spaces not perforated with apertures. The sides of those hexagons in which apertures are placed are all of equal length, while the unperforated ones have three short and three long sides. Pl. XV. fig. 79.

Cobæa stipularis.

Cobæa scandens.

POLEMONIACEÆ.

Pollen granule describing a circular flattened disc; pollen tubes

eight, issuing from apertures placed upon the equator of the granule. Pl. XVI. fig. 80.

Collomia grandiflora.

Collomia coccinea.

C. rosea.

C. lateritia.

Pollen granule spherical; extine perforated with about sixteen apertures, which are scattered irregularly over its surface. See fig. 81.

Gilia achilleæfolia.

Leptosiphon densiflorus.

G. tricolor.

L. androsaceus.

G. capitata.

Polemonium cæruleum.

Pollen granule reticulated, spherical, apertures about fourteen. See fig. 82.

Phlox acuminata.

Phlox Drummondii.

P. paniculata.

P. undulata.

Pollen granule reticulated; pollen tubes six or seven, issuing from apertures placed upon the equator of the granule. See fig. 83, 84.

Ipomopsis elegans.

CONVOLVULACEÆ.

Pollen granule cylindrical, three-lobed, but quite characteristic. See fig. 85, 86.

Convolvulus farinosus.

Convolvulus pentanthus.

C. arvensis.

C. Scammonia.

Pollen granule spherical, extine perforated with very large apertures. See fig. 87.

Calystegia arvensis.

Extine covered with spines; in other respects the pollen granule same as that of the preceding species. See fig. 88.

Ipomæa Sellowii.

Ipomæa purpurea.

Convolvulus major.

I. Horsfalliæ.

I. insignis.

NOLANACEÆ.

Pollen granule cylindrical, three-lobed. See fig. 89.

Nolana paradoxa.

AQUIFOLIACEÆ.

Pollen granule cylindrical, three-lobed.

Ilex Aquifolium.

EBENEACEÆ.

Pollen granule cylindrical, three-lobed.

Cargillia australis.

PRIMULACEÆ.

Pollen granule cylindrical, three-lobed. See fig. 90.

Anagallis arvensis.

Primula vulgaris.

Primula Sinensis.

Cyclamen autumnale.

EPACRIDACEÆ.

Pollen granules permanently united in fours, three being placed upon the same plane and one upon these; three pollen tubes (the emission of which is produced artificially with great difficulty) in

each granule, which issue in pairs opposite to each other. See Pl. XVI. fig. 91.

Epacris grandiflora.

ERICACEÆ.

Pollen granule resembling that of the preceding order.

<i>Kalmia latifolia.</i>	<i>Gaultheria Shallon.</i>
<i>Azalia indica.</i>	<i>Arbutus Unedo.</i>
<i>Rhododendron ponticum.</i>	<i>Andromeda multiflora.</i>
<i>R. maximum.</i>	<i>Menziesia Daboeci.</i>
<i>R. caucasicum.</i>	<i>Erica multiflora.</i>
<i>Sedum latifolium.</i>	<i>E. vulgaris.</i>
<i>Gaultheria procumbens.</i>	

Pollen granule cylindrical, three-lobed.

Clethra ferruginea.

BREXICEÆ.

Pollen granule cylindrical, three-lobed.

Brexia spinosa.

CURVEMBROSÆ.

NYCTAGINACEÆ.

Pollen granule very large, spherical; extine perforated with from forty to fifty apertures. See fig. 92.

Mirabilis Jalapa.

TUBIFEROSÆ.

PROTEACEÆ.

Pollen granule elongated, curved, furnished with three membranes; pollen tubes two, one from each extremity of the granule. See fig. 93.

<i>Dryandra formosa.</i>	<i>Banksia verticillata.</i>
<i>D. longifolia.</i>	<i>B. speciosa.</i>
<i>D. armata.</i>	

Pollen granule furnished with three membranes; triangular pollen tubes three, one from each angle. See fig. 94, 95, 96, 97, 98.

<i>Lambertia formosa.</i>	<i>Grevillea sulphurea.</i>
<i>Hakea pedunculata.</i>	<i>Anadenia Manglesii.</i>
<i>H. pugniformis.</i>	<i>Isopogon anemonifolium.</i>
<i>Grevillea linearis.</i>	

THYMELACEÆ.

Cylindrical, three-lobed.

<i>Pimelea hispida.</i>	<i>Daphne Mezereum.</i>
<i>P. decussata.</i>	<i>D. Laureola.</i>

ACHLAMYDOSÆ.

SALICACEÆ.

Cylindrical, three-lobed.

Salix viminea.

RECTEMBRYOSÆ.

JUGLANDACEÆ.

Pollen granule spherical; pollen tubes seven, usually issuing

through apertures placed in a line round the centre of the granule. See fig. 99.

Juglans regia.

ULMACEÆ.

Pollen granule spherical, emitting five pollen tubes.

Ulmus campestris.

URTICACEÆ.

Pollen granule spherical, emitting three pollen tubes. See fig. 100.

Parietaria officinalis.

Urtica dioica.

BETULACEÆ.

Pollen granule either circular or quadrangular, according as three or four pollen tubes are emitted from it.

Alnus glutinosa.

Betula alba.

CUPULIFERÆ OR CORYLACEÆ.

Pollen granule cylindrical, three-lobed.

Quercus robur.

Castanea vesca.

Ostrya vulgaris.

The majority of granules in *Ostrya vulgaris* are four-lobed.

Pollen granule nearly spherical, furnished with three membranes, and emitting three pollen tubes.

Corylus Avellana.

APOCARPOSÆ.

CRASSULACEÆ.

Pollen granule cylindrical, three-lobed. See fig. 102.

Sedum glaucum.

Crassula coccinea.

SAXIFRAGACEÆ.

Pollen granule cylindrical, three-lobed.

Heuchera americana.

Adamia cyanea.

Saxifraga longifolia.

Hydrangea nivea.

S. umbrosa.

BAUERACEÆ.

Pollen granule cylindrical, three-lobed. See fig. 103.

Bauera rubioides.

LEGUMINOSÆ OR FABACEÆ.

RECTEMBRIÆ.

Tribe MIMOSÆ.

Pollen granules very small, united in fours or multiples of four up to sixteen. See fig. 104, 105, 106, 107.

Pollen granules united in fours, spherical, three upon the same plane and one resting on these. See fig. 104.

Mimosa Mexicana.

Mimosa marginata.

Pollen granules cohering in eights, each emitting two pollen tubes, the third being suppressed by the union of the granules. See fig. 105.

Acacia rigens.

Pollen granules cohering in twelves. See fig. 106.

Acacia decipiens.

Acacia ciliata.

A. nigricans.

A. pulchella.

Pollen granules cohering in sixteens. See fig. 107.

Acacia undulæfolia.

Acacia trigonocarpa.

Acacia sulcata.

A. marginata.

A. Lophantha.

A. linearis.

A. decurrens glauca.

A. flavescens.

A. ruscifolia.

CÆSALPINIÆ.

Pollen granule cylindrical, three-lobed.

Cassia australis.

PAPILIONACEÆ.

Pollen granule elongated, more or less prismatic, with three fissures for the escape of pollen tubes. See fig. 108.

Pterocarpus erinaceus.

Trifolium pratense.

P. echinatus.

Medicago arborea.

Faba vulgaris.

Anthyllis polycephalus.

Pisum sativum.

Ononis hircina.

Hedysarum Onobrychis.

Cytisus capitatus.

Astragalus virescens.

Genista tinctoria.

Swainsonia alba.

Spartium scoparium.

Colutea arborescens.

Lupinus luteus.

Indigofera psoraloides.

Viminaria denudata.

Psoralea glandulosa.

Virgilia capensis.

Callistachys ovata.

Sophora racemosa.

Lotus corniculatus.

Pollen granule provided with three membranes, triangular, sides nearly straight. See fig. 109.

Erythrina laurifolia.

AMYGDALÆ.

Pollen granule cylindrical, three-lobed.

Amygdalus persica.

Prunus Cerasus.

Armeniaca vulgaris.

A. lævis.

P. domestica.

POMEÆ.

Pyrus Malus.

P. communis.

ROSACEÆ.

Spiræa ulmifolia.

Agrimonia nepalensis.

Fragaria vesca.

S. ariæfolia.

Geum sinense.

Rosa bracteata.

S. Ulmaria.

Potentilla anserina.

Rubus fruticosus.

Agrimonia Eupatoria. *P. argentea.*

Many of the granules in *Rosa bracteata*, and nearly all of *Rubus fruticosus*, are four-lobate.

GYNOBASEOSÆ.

LIMNANTHACEÆ.

Pollen granule reticulated, bent twice nearly at right angles; pollen tubes three, one issuing from each end and one from the centre of the granule. Pl. XVI. fig. 110, 111.

Limnanthus Douglassii.

SURIANACEÆ.

Pollen granule cylindrical, three-lobed.

Cneorum tricoccum.

TROPÆOLEÆ.

Pollen granule cylindrical, three-lobed.

Tropæolum peregrinum. Tropæolum majus.

BALSAMINACEÆ.

Pollen granule elongated, quadrilateral, and emitting a pollen tube at each angle. Pl. XVII. fig. 112.

Impatiens noli me tangere. I. glandulifera. I. parviflora.

GERANIACEÆ.

Pollen granule very large, somewhat spheroid in its moist condition, emitting three pollen tubes. See fig. 113.

Geranium sylvaticum. Pelargonium peltatum.

RUTACEÆ.

Pollen granule cylindrical, three-lobed.

Correa alba. Ruta graveolens.

ALSINACEÆ.

Pollen granule spherical; extine perforated with about ten apertures, placed nearly at equal distances from each other. See fig. 114.

Dianthus barbatus. D. deltoides. Gypsophila elegans.

SILENACEÆ.

Pollen granule same as the preceding.

Silene Armeria. Silene vespertina. Saponaria officinalis.
S. inflata. Saponaria viscida.

PORTULACACEÆ.

Pollen granule cylindrical, three-lobed. See fig. 115.

Calandrinia speciosa. C. discolor.

MALPIGHIACEÆ.

Pollen granule spherical, pollen tubes about sixteen. See fig. 116.

Malpighia punicea.

CELASTRACEÆ.

Pollen granule cylindrical, three-lobed.

Celastrus Pyracanthus.

EUPHORBIACEÆ.

Pollen granule cylindrical, with three lobes.

Ricinus communis.

RHAMNACEÆ.

Pollen granule small, triangular, furnished with three membranes. Pl. XVII. fig. 117.

Zizyphus Paliurus.

Pollen granule cylindrical, three-lobed.

Ceanothus pallidus.

AURANTIACEÆ.

Pollen granule, in its primary condition, four-lobate; subsequently it becomes circular, and emits four pollen tubes. See fig. 118.

Citrus Aurantium.

C. Limonium.

LYTHRACEÆ.

Pollen tube cylindrical, three-lobed.

Lythrum Salicaria.

Cuphea viscosa.

TILIACEÆ.

Pollen granule spherical, furnished with three membranes; extine not covering entirely the exintine. See fig. 119.

Tilia europæa.

Tilia americana.

MALVACEÆ.

Pollen granule globular; extine reticulated, spinous, and perforated with apertures, fitting into which, in many species, are circular detached pieces of membrane; apertures very numerous, amounting in some genera to between fifty and sixty; each reticulum is the seat of either a spine or an aperture. See fig. 120.

Hibiscus liliflorus.

Althæa officinalis.

H. syriacus.

Malva sylvestris.

H. annuus.

M. fragrans.

Pavonia præmorsa.

M. virgata.

Lavatera acerifolia.

Kitaibelia vitifolia.

Pollen granule with but three pollen tubes. See fig. 121.

Aubutylon striatum.

CISTACEÆ.

Pollen granule cylindrical, three-lobed.

Cistus Helianthemum.

LINACEÆ.

Pollen granule somewhat square, emitting six pollen tubes, one from each angle of the figure, and one on either surface. See fig. 122.

Linum usitatissimum.

Cylindrical, three-lobed.

Linum africanum.

ÆSCULACEÆ.

Pollen granule cylindrical, three-lobed.

Æsculus hippocastanus.

ACERACEÆ.

Pollen granule cylindrical, three-lobed.

Acer Pseudo-platanus.

POLYGALACEÆ.

Primary form of pollen granule cylindrical, fluted; extremities truncate, in water becoming spherical and emitting about twenty pollen tubes. Pl. XVII. fig. 123, 124, 125.

Muraltia filiformis.

Polygala myrtifolia.

M. Myxta.

P. speciosa.

Polygala grandiflora.

P. Chamæbuxus.

PARIETOSÆ.

HYPERICACEÆ.

Cylindrical, three-lobed. See fig. 126.

Hypericum hircinum.

TURNERACEÆ.

Pollen granule cylindrical, three-lobed.

Turnera elegans.

PASSIFLORACEÆ.

Pollen granule spherical, reticulated, and provided with three large valves, first noticed by Purkinje. See fig. 127.

Passiflora cærulea. *P. cærulea*, var. *racemosa*. *P. alata*.

VIOLACEÆ.

Pollen granule of an elongated form, four-sided, with square truncate extremities; in water it changes its shape and becomes square in outline, emitting four pollen tubes which issue from fissures concealed in the dry granule, one in each of the lines which separate the four sides of the figure. The change of form arises from the approximation of the ends of the granule occasioned by the water which it imbibes, which stretches the membrane, which can only yield in one direction. See fig. 128, 129.

Viola tricolor.

Pollen granule cylindrical, three-lobed. See fig. 130, 131.

Viola montana.

RESEDACEÆ.

Cylindrical, three-lobed.

Reseda odorata.

CAPPARIDACEÆ.

Pollen granule cylindrical, three-lobed.

Cleome spinosa.

CRUCIFERÆ OR BRASSICACEÆ.

Pollen granule three-lobed, cylindrical. See fig. 132, 133.

Heliophila arabioides. *Alyssum maritimum*.

Sinapis alba. *Cheiranthus Cheiri*.

Brassica oleracea. *C. mutabilis*.

Iberis alba. *Matthiola incana*.

EPIGYNOSÆ.

BEGONIACEÆ.

Pollen granule same as the preceding.

Begonia glabrata.

FICOIDEÆ OR MESEMBRYACEÆ.

Pollen granule cylindrical, three-lobed.

Mesembryanthemum reflexum.

CACTACEÆ.

Pollen granule same as the preceding.

Opuntia vulgaris.

LOASACEÆ.

Pollen granule cylindrical, three-lobed.
Bartonia aurea.

CUCURBITACEÆ.

Pollen granule cylindrical, three-lobed. See fig. 134.
Momordica Elaterium.

HAMAMELACEÆ.

Pollen granule cylindrical, three-lobed.
Trichocladus crinitus.

CORNACEÆ.

Pollen granule cylindrical, three-lobed.
Cornus canadensis. *Aucuba japonica*.

MYRTACEÆ.

Pollen granule cylindrical, three-lobed.
Punica Granatum. *Leptospermum ambiguum*.
 Pollen granule triangular, that of *Calothamnus villosus* possessing
 three membranes, and the extine of *Angophora racemosa* exhibiting
 three radiating lines upon its surface. Pl. XVII. fig. 135, 136, 137.
Melaleuca hypericifolia. *Angophora cordata*.
Calothamnus villosus. *Tristania neriifolia*.
Angophora racemosa.

MELASTOMACEÆ.

Pollen granule cylindrical, three-lobed.
Melastoma corymbosa. *M. heteromalla*. *Arthrostemma lineata*.

ONAGRACEÆ.

Pollen granule furnished with four membranes ; either triangular,
 and emitting three pollen tubes, one from each angle ; or cylindrical,
 and sending forth two pollen tubes ; this difference of form arising
 merely from the suppression of one of the pollen tubes. Generally
 separate, but sometimes united in threes or fours.

Pollen granule triangular, separate.

Lopezia coronata. *L. racemosa*. *Gaura biennis*.

Pollen granule united in threes.

Epilobium hirsutum.

Pollen granule united in fours. Pl. XVIII. fig. 138.

Epilobium roseum.

Pollen granule triangular, separate. See fig. 139, 140, 141.

Epilobium angustifolium. *Oenothera biennis*.

Clarkia elegans. *Oe. quadrivalva*.

C. pulchella. *Oe. suffruticosa*.

Godetia rubicunda. *Oe. Drummondii*

Oenothera serotina.

Pollen granule triangular, separate. See fig. 142.

Fuchsia coccinea. *Fuchsia globosa major*.

F. gracilis. *F. conica*.

F. grandiflora. *F. lycioides*.

F. longipedunculata.

OBS.—Many of the pollen granules of some hybrid *Fuchsia* appear

Hassall, Arthur Hill. 1842. "LVII.—Observations on the Structure of the Pollen Granule, considered principally with reference to its eligibility as a means of Classification." *The Annals and magazine of natural history; zoology, botany, and geology* 9, 544–573. <https://doi.org/10.1080/03745484209442811>.

View This Item Online: <https://www.biodiversitylibrary.org/item/19543>

DOI: <https://doi.org/10.1080/03745484209442811>

Permalink: <https://www.biodiversitylibrary.org/partpdf/8859>

Holding Institution

Natural History Museum Library, London

Sponsored by

Natural History Museum Library, London

Copyright & Reuse

Copyright Status: Public domain. The BHL considers that this work is no longer under copyright protection.

This document was created from content at the **Biodiversity Heritage Library**, the world's largest open access digital library for biodiversity literature and archives. Visit BHL at <https://www.biodiversitylibrary.org>.