

# **Annotated catalogue of pollen and pteridophyte spore types of the British Isles**

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## Introduction

This document is a list of pollen types that might be identifiable in mid- and late-Quaternary sediments of the British Isles. For a thorough interpretation of pollen data, it is necessary to have a firm understanding of the range of types that could reasonably occur in a pollen preparation, and to make pollen identifications at a level which is as fine as possible. It is also necessary that different pollen analysts in different laboratories should use the same nomenclature to achieve consistency of identification, and to enable communication about pollen identification categories without having to append a list of which species are included in each type. Ideally, consensus on pollen identification categories will involve cross-checking with fossil pollen, but a first step could be agreement of a nomenclature. The purpose of producing this catalogue is thus:

- 1) to place possible palynological distinctions in a modern taxonomic framework;
- 2) to make clear exactly which species are in which pollen-morphological category;
- 3) to show how all native species fit into the pollen-morphological scheme;
- 3) to promote dialogue amongst palynologists about realistic levels of pollen identification (perhaps with allowance for quality of preservation);
- 4) to establish a set of names for labelling pollen diagrams and discussing palynological results.

Scope: pollen of all native plants of the British Isles, together with pollen of recent introductions (including crop plants) and pollen of a few types found in pre-Holocene mid- to late-Quaternary sediments. I define 'British Isles' as the islands of Great Britain, Ireland, the archipelagoes of the Western Isles, Orkney, and Shetland, and all offshore islands of these, but not the Channel Islands. For work in a part of the British Isles, it may be possible to reduce this list for local use, and simplify it. For example, at the British Isles scale, we have 'Jasione montana-type' and 'Lobelia'. For work in Shetland, these could be replaced by 'Jasione montana' and 'Lobelia dortmanna' because the other members of these categories (*Wahlenbergia hederacea* and *Lobelia urens*) are extremely unlikely to have occurred. The full list below enables other pollen-analysts to see that these types will arise as geographical subsets of the categories with wider applicability. At the other end of the scale, many of the pollen types listed here are subsets of wider types that would be necessary where a larger flora is being considered. For example, I suggest use of '*Ilex aquifolium*' in the British Isles for the category designated 'Ilex-type' by Moore et al. (1989), taking into account the morphological resemblance between pollen of *Ilex* spp. and North American *Nemopanthus* spp. If we seek truly cosmopolitan applicability of nomenclature, the result will be a list of names that would be unnecessarily complex, and meaningless to most palynologists in most places.

Nomenclature follows Stace (1991), warts and all, and *Flora Europaea* (Tutin et al. (1964-1980) for plants not included by Stace (1991). I use these works simply because they are the most recent floras of the region, and not because I necessarily approve (or even understand) the taxonomic principles behind some of the changes from earlier works. Notes on pre-Holocene occurrence are derived largely from Godwin (1975).

This catalogue is intended to be provisional. If it generates sufficient interest, I hope to modify and adapt it in the light of the experience and comments and others. I assume that users of the catalogue will have access to reference material, and can check the limits of pollen morphological categories themselves.

## Material

All reference pollen examined by me is mounted in silicone oil, from a collection given to the Sub-department of Quaternary Research (SDQR) by Prof. A.G. Smith, and all additions to the SDQR reference collection since 1979.

## Conventions

Identifiable taxa are ordered within the plant taxonomic hierarchy, and presented in the taxonomic order of Stace (1991). Identification units are 'pollen types', each of equivalent status in pollen morphological terms although different pollen types may be equivalent to different categories in the plant taxonomic hierarchy (e.g., family, genus, or species).

Unqualified names of genera and families mean pollen of all native species within the type concerned. Pollen of non-native species may be distinct.

Names followed by 'undiff.' (for 'undifferentiated') mean all pollen of all native species in the type concerned except a small number (usually one or two) listed separately. I consider that the term 'undiff.' should have absolute meaning, and not be relative to a particular pollen-analytical investigation (cf. Birks 1973). Thus, use of the term 'Poaceae undiff.' means that the grains found were all recognised as grains of Poaceae, and none of them could be placed within any of the possible types that are (potentially) recognisable. This will be true whether or not any grains of those other types are also found.

A pollen category might be followed by 'indeterminable' (or 'indet') where it has not been possible to make finer distinctions because of the degree of preservation of the grain. Thus 'Poaceae indet.' would mean a pollen grain is certainly from a member of the Poaceae, but where it was not possible to tell whether the grain belonged to any of the categories within the Poaceae. The catalogue is, in part, arranged hierarchically to facilitate use of higher categories where identification at the lowest level is not possible.

A name followed by '-type' is the suggested title of a group of two or more species or genera (or families) with similar pollen morphology: the term is thus used where the limits of pollen morphology do not coincide with taxonomic categories. A '-type' designation is followed by a list of taxonomic categories included within the type, enclosed in []. Where pollen types cut across plant families, the type is listed with the family of the species or genus used to define the type, and categories within other families are cross-referenced to it. The name of the type is normally chosen from among the taxa within the type, at either species or genus level. Exceptions are occasionally made, for brevity or clarity. Birks (1973) used the designation '-type' to refer to groups of three or more species, using paired names (e.g., *Cirsium/Carduus*). I avoid this in order to designate a single species as the type for any category.

Rarely, {} are used to enclose a group of types with some special pollen morphological significance.

The annotations (numbers enclosed by <>) cover references, and points where I have differed from published work. I have made an especial effort to cover the terms used by Birks (1973) and Moore et al. (1989), and to note differences. Most of these arise through nomenclatural changes between Clapham et al. (1987), used by Moore et al. (1989), and Stace (1991), and through the smaller geographical scope of my list. Faegri & Iversen (1989) do not, unfortunately, list the species within their types, making comparison more difficult.

I thank John Birks, Kevin Edwards, and Graeme Whittington for helpful and positive criticism of earlier drafts of this catalogue.

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- Pteridium aquilinum

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- Phegopteris connectilis
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- Asplenium onopteris
- Asplenium obovatum
- Asplenium trichomanes
- Asplenium trichomanes-ramosum
- Asplenium ruta-muraria
- Asplenium septentrionale
- Ceterach officinale

]

- Asplenium marinum

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- Gymnocarpium dryopteris
- Gymnocarpium robertianum -> Dryopteris filix-mas-type

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Cystopteris dickieana -> Dryopteris filix-mas-type  
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Saxifraga cespitosa  
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Saxifraga stellaris-type

[ Saxifraga nivalis

Saxifraga stellaris

]

Saxifraga hirsuta-type

[ Saxifraga spathularis

Saxifraga hirsuta

]

Saxifraga oppositifolia-type

[ Saxifraga oppositifolia

Saxifraga aizoides

]

Chrysosplenium

Parnassia palustris

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Filipendula

Rubus undiff.

Rubus chamaemorus

Potentilla-type

[ Potentilla

Sibbaldia procumbens

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Geum

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  Echium  
  Pulmonaria<118>  
  Symphytum

Anchusa arvensis  
Myosotis arvensis-type  
[ Mertensia maritima  
Myosotis undiff.  
]  
Myosotis discolor  
Cynoglossum  
Verbenaceae<119>  
Verbena officinalis  
Lamiaceae<120>  
Stachys-type<121>  
[ Stachys  
Ballota nigra  
Lamiaeum galeobdolon  
Lamium purpureum  
Lamium hybridum  
Lamium amplexicaule  
Galeopsis  
Melittis melissophyllum  
]  
Lamium album  
Marrubium vulgare  
Scutellaria-type  
[ Scutellaria  
Ajuga  
]  
Teucrium  
Prunella vulgaris-type<122>  
[ Nepeta cataria  
Glechoma hederacea  
Prunella vulgaris  
]  
Mentha-type<123>  
[ Clinopodium  
Origanum vulgare  
Thymus  
Lycopus europaeus  
Mentha  
Salvia  
]  
Hippuridaceae<124>  
Hippuris vulgaris  
Callitrichaceae  
Callitriche  
Plantaginaceae<125>  
Plantago coronopus  
Plantago maritima<126>  
Plantago major  
Plantago media  
Plantago lanceolata<127>  
Littorella uniflora  
Oleaceae<128>  
Fraxinus excelsior  
Ligustrum vulgare  
Scrophulariaceae<129>  
Scrophularia-type

- [ Verbascum
- Scrophularia
- Misopates orontium
- Linaria (some)
- ]
- Digitalis purpurea-type
- [ Limosella aquatica
- Chaenorhinum minus
- Kickxia
- Linaria (some)
- Digitalis purpurea
- Sibthorpia europaea
- ]
- Veronica<130>
- Melampyrum
- Rhinanthus-type
- [ Euphrasia
- Odontites vernus<131>
- Bartsia alpina
- Parentucellia viscosa
- Rhinanthus
- + Lathraea squamaria (Orobanchaceae)
- + Orobranche purpurea (Orobanchaceae)
- ]
- Pedicularis<132>
- Orobanchaceae
- Lathraea squamaria -> Rhinanthus-type (Scrophulariaceae)
- Orobranche undiff.
- Orobranche purpurea -> Rhinanthus-type (Scrophulariaceae)
- Lentibulariaceae
- Pinguicula
- Utricularia
- Campanulaceae
- Campanula-type<133>
- [ Campanula
- Phyteuma
- Legousia hybrida
- ]
- Jasione montana-type<134>
- [ Jasione montana
- Wahlenbergia hederacea
- ]
- Lobelia
- Rubiaceae<135>
- Caprifoliaceae<136>
- Sambucus nigra<137>
- Sambucus ebulus
- Viburnum opulus<138>
- Viburnum lantana
- Linnaea borealis
- Lonicera xylosteum<139>
- Lonicera periclymenum<140>
- Adoxaceae<141>
- Adoxa moschatellina
- Valerianaceae<142>
- Valerianella

Valeriana officinalis  
Valeriana dioica  
Dipsacaceae<143>  
Dipsacus  
Knautia arvensis  
Succisa pratensis  
Scabiosa columbaria  
Asteraceae<144>  
{ Cardueae  
Arctium-type<145>  
[ Carlina vulgaris  
Arctium  
Saussaurea alpina  
Serratula tinctoria  
]  
Cirsium-type<146>  
[ Carduus  
Cirsium  
]  
Centaurea scabiosa  
Centaurea cyanus<147>  
Centaurea nigra<148>  
}  
{ Lactuceae  
Cichorium intybus-type  
[ Cichorium intybus  
Lapsana communis  
Hypochaeris  
Leontodon  
Picris hieracioides  
Lactuca (some spp)  
Cicerbita alpina  
Taraxacum  
Crepis  
Pilosella  
Hieracium  
]  
Arnoseris minima  
Scorzonera humilis  
Tragopogon pratensis<149>  
Sonchus<150>  
Mycelis muralis-type<151>  
[ Lactuca serriola  
Mycelis muralis  
]  
}  
{ Asteroideae  
Solidago virgaurea-type<152>  
[ Filago  
Antennaria dioica  
Gnaphalium  
Inula  
Pulicaria  
Solidago virgaurea  
Aster  
Erigeron

- Bellis perennis
- Senecio
- Tephrosieris
- Tussilago farfara
- Petasites hybridus
- Bidens
- Eupatorium cannabinum
- ]
- Artemisia-type<153>
- [ Seriphidium maritimum
- Artemisia
- ]
- Achillea-type<154>
- [ Tanacetum vulgare
- Otanthus maritimus
- Achillea
- Anthemis
- Leucanthemum vulgare
- Matricaria recutita
- Tripleurospermum
- ]
- }
- Butomaceae
- Butomus umbellatus
- Alismataceae<155>
- Sagittaria sagittifolia
- Alisma-type
- [ Baldellia ranunculoides
- Luronium natans
- Alisma
- ]
- Damasonium alisma<156>
- Hydrocharitaceae<157>
- Hydrocharis morsus-ranae
- Stratiotes aloides
- Scheuchzeriaceae
- Scheuchzeria palustris
- Juncaginaceae
- Triglochin -> Potamogeton natans-type (Potamogetonaceae)
- Potamogetonaceae
- Potamogeton natans-type<158>
- [ Potamogeton subgenus Potamogeton
- Groenlandia densa
- + Triglochin (Juncaginaceae)
- ]
- Potamogeton filiformis-type<159>
- [ Potamogeton filiformis
- Potamogeton pectinatus
- ]
- Ruppiaceae
- Ruppia maritima
- Najadaceae
- Najas
- Zannichelliaceae
- Zannichellia palustris
- Zosteraceae

- Zostera
- Araceae
  - Arum
- Lemnaceae<160>
- Eriocaulaceae<161>
  - Eriocaulon aquaticum
- Juncaceae
- Cyperaceae
  - Cyperaceae undiff.<162>
  - Cladium mariscus
- Poaceae<163>
  - Poaceae undiff.
  - Avena-type
    - [ Avena strigosa
    - Avena fatua
    - Avena sativa
    - Triticum aestivum
    - Triticum turgidum
    - Spartina anglica<164>
  - ]
    - Hordeum-type<165>
    - [ Glyceria fluitans
    - Aira caryophyllea
    - Ammophila arenaria
    - Elytrigia repens
    - Elytrigia juncea
    - Leymus arenarius
    - Hordeum vulgare
    - Hordeum murinum
    - Hordeum secalinum
    - Triticum monococcum<166>
  - ]
    - Secale cereale
- Sparganiaceae<167>
  - Sparganium erectum
  - Sparganium emersum-type<168>
  - [ Sparganium undiff.
  - + Typha angustifolia (Typhaceae)
  - ]
- Typhaceae<169>
  - Typha latifolia<170>
  - Typha angustifolia -> Sparganium emersum-type  
(Sparganiaceae)
- Liliaceae
  - Tofieldia pusilla
  - Narthecium ossifragum
  - Simethis planifolia
  - Colchicum autumnale
  - Fritillaria meleagris-type<171>
  - [ Lloydia serotina<172>
  - Fritillaria meleagris
  - Ornithogalum
  - Muscari neglectum
  - ]
    - Convallaria majalis-type<173>
    - [ Convallaria majalis

Asparagus officinalis  
 ]  
 Paris quadrifolia-type<174>  
 [ Gagea  
   Paris quadrifolia  
 ]  
 Scilla-type  
 [ Maianthemum bifolium  
   Scilla  
   Hyacinthoides non-scripta  
 ]  
 Allium-type  
 [ Polygonatum<175>  
   Allium  
   Narcissus pseudonarcissus  
   Ruscus aculeatus  
 ]  
 Galanthus nivalis-type<176>  
 [ Leucojum aestivum  
   Galanthus nivalis  
 ]  
 Iridaceae  
   Sisyrinchium bermudiana  
   Iris<177>  
   Gladiolus illyricus-type<178>  
   [ Romulea columnae  
     Gladiolus illyricus  
   ]  
 Dioscoreaceae<179>  
   Tamus communis  
 Orchidaceae<180>  
   Cypripedium calceolus<181>  
   Cephalanthera<182>  
   Listera-type<183>  
   [ Epipactis  
     Neottia nidus-avis  
     Listera  
     Spiranthes  
     Goodyera repens  
     Platanthera chlorantha  
   ]  
   Dactylorhiza-type<184>  
   [ Hammarbya paludosa  
     Platanthera bifolia  
     Anacamptis pyramidalis  
     Gymnadenia conopsea  
     Coeloglossum viride  
     Dactylorhiza  
     Orchis  
     Ophrys  
   ]  
 ]

## Notes

1 See Birks (1973); Jones & Blackmore (1988).

2 Included in *Lycopodium annotinum*-type by Moore et al. (1989), but is the only species of the type found in the British Isles.

3 See Stafford (1991).

4 See Birks (1973) for separation of *Isoetes lacustris* and *Isoetes echinospora*. *Isoetes histrix* has a spiny perine.

5 Spores in the families Polypodiaceae, Thelypteridaceae, Athyriaceae, Woodsiaceae, Dryopteridaceae, and Blechnaceae are monolete. All these except Polypodiaceae may lose their perine, and are then indistinguishable from each other. Spores in the other families are trilete, and will normally be recognisable at the levels given. Even if all other features are lost, a spore will always have a scar that can be seen to be monolete or trilete. Therefore, the appropriate indeterminable categories might be 'Pteropsida (trilete) indet.' and 'Pteropsida (monolete) indet.'

6 Moore et al. (1989) describe two *Ophioglossum vulgatum* types, on criteria that cut across species. Since this does not help to narrow the identification, the distinction is not included here.

7 Included in *Botrychium lunaria*-type by Moore et al. (1989), but is the only species of the type found in the British Isles.

8 Equivalent to *Polypodium vulgare*-type of Moore et al. (1989).

9 No reference material or descriptions seen for *Athyrium flexile*.

10 Equivalent to *Athyrium alpestre*-type of Birks (1973).

11 Distinctions within the family differ from those of Birks (1973).

12 Included in *Polystichum*-type in Moore et al. (1989), but is the only genus of the type found in the British Isles.

13 Not native today, but has occurred (megaspores and massulae) in pre-Holocene Quaternary warm stages.

14 Not native today, but has occurred (megasporangia) in the pre-Holocene Quaternary.

15 Not native today, but has occurred (macrofossils and pollen) in the pre-Holocene Quaternary.

16 Not native today, but has occurred (macrofossils and pollen) in the pre-Holocene Quaternary.

17 Included in *Juniperus*-type by Moore et al. (1989), but is the only species of the type found in the British Isles.

18 See Birks (1973) and Moore et al. (1991) for description of the types within this family. Pollen of *Ephedra* may be dispersed over considerable distances (see, for example, Maher 1964), and it is frequently found in Quaternary sediments of the British Isles, but is not known to have ever grown here.

19 See Jones & Clarke (1981).

20 Included in *Nymphaea alba*-type by Moore et al. (1989), but is the only species of the type found in the British Isles.

21 Not native in Europe today, but has occurred in pre-Holocene warm-stages of Ireland (pollen) and continental Europe (macrofossils).

22 See Clarke et al. (1991). *Adonis annua* is of uncertain status in the British Isles.

23 Equivalent to *Caltha*-type of Moore et al. (1989).

24 Equivalent to *Ranunculus*-type of Moore et al. (1989), and to a combination of *Anemone*-type, *Ranunculus acris*-type, and *Ranunculus trichophyllus*-type of Birks (1973).

25 Including *Ranunculus hyperboreus* and *R. aconitifolius*, which are not native today, but have occurred (macrofossils) in Quaternary cold-stages.

26 See Blackmore & Heath (1984a). *Berberis vulgaris* is of uncertain status in the British Isles.

27 See Kalis (1980).

28 Probably not native, but has occurred (macrofossils) in archaeological deposits.

29 Included in *Papaver argemone*-type by Moore et al. (1989), but is the only species of the type found in the British Isles.

30 Includes pollen of two distinct types: see Kalis (1980). Refers to species of the *Papaver radicatum* group, widespread in the arctic. None are native to the British Isles today, but the pollen may be found in full-glacial and Devensian late-glacial deposits.

31 Included in *Glaucium flavum*-type by Moore et al. (1989), but is the only species of the type found in the British Isles.

32 Possibly native, and known from macrofossil remains in archaeological deposits and one interglacial deposit.

33 See Kalis (1980).

34 See Punt & Malotau (1984).

35 Introduced: common medieval crop plant.

36 See Punt & Malotau (1984).

37 See Bos & Punt (1991).

38 Introduced, and pollen may be found in post-Roman deposits.

39 Not native today, but has been recorded (pollen) in a mid-Quaternary warm-stage.

40 See van Benthem et al. (1984).

41 *Alnus incana* may have occurred in the pre-Holocene Quaternary: its pollen is not distinguishable from *Alnus glutinosa*.

42 This is the pollen type variously given as '*Corylus/Myrica*' or '*Coryloid*'. In western Europe, it may be possible to identify some grains of *Myrica gale*, but the ranges of variation of pollen of the two species in the type have considerable overlap. I suggest using the type nomenclature for most identifications, and separately using '*Myrica gale*' for those grains that are certainly derived from that species. In this way, a

minimum curve for *Myrica gale* can be achieved while the bulk of the grains will be included in a type whose name reflects the likely taxonomic origin of most of them.

43 *Corispermum* has occurred (macrofossils) in late Quaternary cold-stage sediment. Its pollen appears to be identical to native Holocene members of the family.

44 Included in *Montia fontana*-type by Moore et al. (1989), but is the only species of the type found in the British Isles.

45 Pollen of the Caryophyllaceae falls into two morphological categories. Grains of *Spergula*-type are tri- or hexa-colpate, while the others are periporate. Care needs to be taken that a category used for undifferentiated Caryophyllaceae periporate grains does not also imply the possibility that *Spergula*-type could be represented. *Holosteum umbellatum* may also be native in the British Isles: its pollen is within *Cerastium*-type. *Stellaria crassifolia* and *Silene furcata* have occurred as macrofossils in Quaternary cold-stage sediments: I have not seen pollen or descriptions of the pollen of either. Birks (1973) has different pollen types from those listed here.

46 Included in *Herniaria*-type by Moore et al. (1989), but is the only genus of the type found in the British Isles.

47 Introduced: pollen has been found in late Holocene sediments.

48 See van Leeuwen et al. (1988). The types used here for *Rumex* and *Oxyria digyna* follow Moore et al. (1989) more closely, but there is some overlap between types because of morphological variability of the grains.

49 Equivalent to *Polygonum persicaria*-type of Moore et al. (1989).

50 Introduced and formerly cultivated: pollen has been found in late Holocene sediments.

51 Equivalent to *Polygonum aviculare*-type of Moore et al. (1989).

52 Equivalent to *Fallopia convolvulus*-type of Moore et al. (1989).

53 *Rumex acetosa*-type of van Leeuwen et al. (1988) and Moore et al. (1989). The other species in the type do not occur in the British Isles.

54 This type plus *Rumex sanguineus*-type is equivalent to *Rumex crispus*-type of Birks (1973).

55 This type plus *Rumex obtusifolius*-type is equivalent to *Rumex crispus*-type of Birks (1973).

56 See Turner & Blackmore (1984). Both native genera in the Plumbaginaceae have dimorphic pollen. Type-A pollen can be identified to generic level on morphological criteria, but not Type-B (Moore et al. 1991). In SDQR reference material, sizes of Type-B grains in *Limonium* overlap too much with the size of Type-B *Armeria maritima* pollen to enable separation on size criteria (in silicone oil, at least). Grains should therefore be identified to either family or generic level, as appropriate for the type concerned.

57 Equivalent to two *Limonium vulgare* types of Moore et al. (1989), not included here because they cut across species, and therefore do not contribute to the precision of identification.

58 See Clarke (1976).

59 Included in *Hypericum androsaemum*-type by Moore et al. (1989), but is the only species of the type found in the British Isles.

60 See Christensen & Blackmore (1988).

61 Christensen & Blackmore (1988) place *Tilia x vulgaris* with *Tilia platyphyllos* as *Tilia platyphyllos*-type (cf. Andrew 1971).

62 See Culhane & Blackmore (1988). All species in the family are included as *Malva*-type by Moore et al. (1989).

63 No reference material or descriptions seen for *Viola rupestris*.

64 Including pollen of *Salix polaris*, known from macrofossils in Quaternary cold-stage deposits.

65 Moore et al. (1991) separate the Brassicaceae into two groups on the basis of size of lumina. There is certainly considerable variation in size between species, but also within species depending on factors that include mounting medium. Species of several genera can fall into either group. Taking these factors together, there is little useful purpose in attempting to separate fossil material into these groups.

66 Included in *Reseda lutea*-type by Moore et al. (1989), but is the only genus of the type found in the British Isles.

67 The characteristic pollen tetrads of the 'Ericales' occur in all species of Empetraceae, Ericaceae, and Pyrolaceae occurring in the British Isles during the Quaternary, except *Orthilia secunda* and *Bruckenthalia spiculifolia* (which have monads).

68 Introduced in the late Holocene, but has occurred (macrofossils) in pre-Holocene Quaternary warm-stages in Ireland.

69 Finer distinctions may be possible within this type: see Moore et al. (1989).

70 *Erica scoparia* macrofossils have occurred in the pre-Holocene Quaternary. It has tetrad pollen, but I do not know whether the grains are distinguishable from other members of *Vaccinium*-type.

71 Not native today, but has occurred (pollen and macrofossils) in the pre-Holocene Quaternary.

72 See Punt et al. (1976a).

73 Not native today, but has occurred (macrofossil) in a pre-Holocene Quaternary cold-stage.

74 Also includes *Lysimachia punctata*, not native today but which has occurred (macrofossil) in a pre-Holocene Quaternary warm-stage of Ireland.

75 See Verbreek-Reuvers (1980b).

76 Included in *Ribes rubrum*-type by Moore et al. (1989), but is the only species of the type found in the British Isles.

77 *Sedum*-type in Moore et al. (1989), but is the only species of the type found in the British Isles.

78 See Verbreek-Reuvers (1980a, 1980c).

79 Includes *Saxifraga granulata*-type and *Saxifraga cernua*-type of Moore et al. (1989).

80 All native taxa of the subfamilies Prunoideae and Maloideae: this is a rather heterogenous group, and some distinctions are probably possible, especially for *Sorbus aucuparia* and *Prunus padus* (Faegri & Iversen 1989; Moore et al. 1991). However, available reference material is varied between collections of the same species, and I am uncertain about the validity of most smaller divisions.

81 Included in *Onobrychis*-type by Moore et al. (1989), but is the only species of the type found in the British Isles.

82 *Lotus*-type in Moore et al. (1989), but is the only species of the type found in the British Isles.

83 The main element of *Vicia cracca*-type in Moore et al. (1989).

84 Includes pollen of the introduced and cultivated *Vicia faba*.

85 Included in *Ononis*-type by Moore et al. (1989), but is the only genus of the type found in the British Isles.

86 See Engel (1980b).

87 Not native today, but has occurred (pollen and macrofossils) in the mid-Holocene (Flenley et al. 1975) and earlier in the Quaternary.

88 Note need to use this designation, as suggested by Birks (1973), given the acceptance by Stace (1991) that *Epilobium angustifolium* L. should be placed in the genus *Chamerion*. Moore et al. (1989) argue that *Chamerion angustifolium* can be separately recognised because its grains are dispersed singly rather than in tetrads. I have included it with *Epilobium* because of the possibility that tetrads may break up.

89 See Stafford & Heath (1991).

90 Included in *Cornus sanguinea*-type by Moore et al. (1989), but is the only species of the type found in the British Isles.

91 Included in *Cornus suecica*-type by Moore et al. (1989), but is the only species of the type found in the British Isles.

92 See Punt & Schmitz (1981).

93 Included in *Ilex*-type by Moore et al. (1989), but is the only species of the type found in the British Isles.

94 See Punt & Marks (1991).

95 Introduced today, but has occurred (pollen and macrofossils) in pre-Holocene Quaternary warm-stages.

96 See Punt & den Breejen (1981).

97 Introduced and formerly cultivated abundantly.

98 See Heath (1984).

99 Introduced: pollen has been found in late Holocene sediments.

100 See Clarke & Jones (1980c). Note that pollen of *Acer monspessulanum* (found as macrofossils in late Quaternary warm-stages), *A. platanoides*, and *A. pseudoplatanus* (both introduced to the British Isles in the late-Holocene) is indistinguishable from *A. campestre*. These types are grouped by Moore et al. (1989) as *Acer campestre*-type.

101 See Stafford & Blackmore (1991).

102 See van Helvoort & Punt (1984).

103 See Punt (1984). The account here differs from that in Birks (1973), and maybe oversplit.

104 Included within *Pleurospermum*-type in Moore et al. (1989), but is the only species of the type found in the British Isles.

105 *Trinia glauca* included in the type because of its closeness to pollen of *Apium* (cf. Punt [1984]).

106 All four native species of *Apium* fall in this type, not just the three listed by Punt (1984) and Moore et al. (1991), and termed *Apium inundatum*-type by them.

107 See Punt & Nienhuis (1976).

108 Included in *Gentiana verna*-type by Moore et al. (1989), but is the only species of the type found in the British Isles.

109 Included in *Gentianella amarella*-type by Moore et al. (1989), but is the only species of the type found in the British Isles.

110 See Punt & Monna-Brands (1980).

111 Moore et al. (1991) define a *Solanum nigrum*-type, of which *Solanum nigrum* is the only native species. Introduced members of the type include potato (*Solanum tuberosum*), tomato (*Lycopersicon esculentum*), and sweet pepper (*Capsicum annuum*). These three often have aberrant pollen grains.

112 See Cronk & Clarke (1981).

113 See Cronk & Clarke (1981).

114 Included in *Cuscuta europaea*-type by Moore et al. (1989), but is the only genus of the type found in the British Isles.

115 See Blackmore & Heath (1984b).

116 See Clarke (1980).

117 Included in *Lithospermum arvense*-type by Moore et al. (1989), but is the only species of the type found in the British Isles.

118 Included in *Pulmonaria obscura*-type in Moore et al. (1989), but is the only genus of the type found in the British Isles.

119 See Punt & Langewis (1988).

120 No reference material or descriptions seen for *Lamium confertum*.

121 Equivalent to *Stachys sylvatica*-type of Moore et al. (1989).

122 Equivalent to *Prunella*-type of Moore et al. (1989).

123 Equivalent to *Thymus*-type of Birks (1973).

124 See Engel (1980a).

125 See Clarke & Jones (1980a).

126 Included in *Plantago maritima*-type by Moore et al. (1989), but is the only species of the type found in the British Isles.

127 Included in *Plantago lanceolata*-type by Moore et al. (1989), but is the only species of the type found in the British Isles.

128 See Punt et al. (1991).

129 No reference material seen for *Limosella australis*.

130 The pollen of all native *Veronica* species that I have examined (*V. serpyllifolia*, *V. alpina*, *V. fruticans*, *V. officinalis*, *V. chamaedrys*, *V. montana*, *V. scutellata*, *V. beccabunga*, *V. anagallis-aquatica*, *V. catenata*) appears to belong here. Moore et al. (1991) suggest that some *Veronica* spp. have pollen of the *Rhinanthus*-type. I have not seen reference material for *V. praecox*, *V. triphyllos*, *V. arvensis*, *V. verna*, *V. agrestis*, *V. polita*, *V. hederifolia*, or *V. spicata*.

131 I follow Faegri & Iversen (1989) in considering that *Odontites vernus* pollen belongs with *Rhinanthus*-type rather than with *Veronica* (cf. Moore et al. 1991).

132 Equivalent to *Pedicularis palustris*-type of Moore et al. (1989).

133 This usage follows Birks (1973) and Faegri & Iversen (1989), but is equivalent to *Campanula*-type (3-pored grains) plus *Phyteuma*-type (4-pored grains) of Moore et al. (1989), combined here because pore number varies within species.

134 Equivalent to *Jasione*-type of Moore et al. (1989).

135 Equivalent to *Galium*-type of Moore et al. (1989).

136 See Punt et al. (1976b).

137 Included in *Sambucus nigra*-type by Moore et al. (1989), but is the only species of the type found in the British Isles.

138 Included in *Viburnum opulus*-type by Moore et al. (1989), but is the only species of the type found in the British Isles.

139 Included in *Lonicera xylosteum*-type by Moore et al. (1989), but is the only species of the type found in the British Isles.

140 Included in *Lonicera periclymenum*-type by Moore et al. (1989), but is the only species of the type found in the British Isles.

141 See Reitsma & Reuvers (1976).

142 See Clarke & Jones (1980b).

143 See Clarke & Jones (1981a).

144 The Asteraceae has been traditionally divided by palynologists into two broad categories: 'Tubuliflorae', for tricolporate echinate grains, and 'Liguliflorae' for fenestrate echinate grains. This separation does not, however, completely cover the family. Asteraceae are divided into two subfamilies, Lactucoideae and Asteroideae. The Lactucoideae are divided into tribes, of which two, Cardueae and Lactuceae, have members in the native flora of the British Isles. All Lactuceae have fenestrate echinate grains, so this name is available for any grains of this type that cannot be identified more precisely. I suspect that it may be possible to distinguish pollen of the tribe Cardueae and the subfamily Asteroideae routinely in even damaged material (but I have not checked yet). Accordingly, I suggest that the two old terms be replaced by three newer ones (Cardueae, Lactuceae, and Asteroideae) for grains recognisable as being within these types. If

there are grains where it is not possible to see whether they are Cardueae or Asteroideae, the best recourse might be to combine the names: 'Cardueae / Asteroideae'. The only alternative is to invent an informal name that cuts across the taxonomic hierarchy. See Blackmore (1984) for distinctions within the Lactuceae.

145 Equivalent to *Serratula*-type of Moore et al. (1989). Birks (1973) noted the resemblance of the members of this type under his description of the pollen of *Saussaurea alpina*.

146 Equivalent to *Cirsium/Carduus* of Birks (1973). *Carduus* is included in *Solidago virgaurea*-type by Moore et al. (1989) (their *Aster*-type).

147 Included in *Centaurea cyanus*-type by Moore et al. (1989), but is the only species of the type found in the British Isles.

148 Included in *Centaurea nigra*-type by Moore et al. (1989), but is the only species of the type found in the British Isles.

149 Included in *Tragopogon pratensis*-type by Moore et al. (1989), but is the only species of the type in the British Isles.

150 Included in *Sonchus oleraceus*-type in Moore et al. (1989), but is the only genus of the type found in the British Isles.

151 Equivalent to *Lactuca sativa*-type of Moore et al. (1991). *Mycelis muralis* used here for the type because *Lactuca sativa* is not a native species of the British Isles.

152 Equivalent to *Solidago*-type of Birks (1973) and Faegri & Iversen (1989), and to *Aster*-type of Moore et al. (1989). Some distinctions may be possible within the type on the basis of spine height.

153 Note need to use a type (as Faegri & Iversen 1989) given the acceptance by Stace (1991) that *Artemisia maritima* L. should be placed in the genus *Seriphidium*.

154 Name of the type follows Birks (1973) and Faegri & Iversen (1989). Equivalent to *Anthemis*-type of Moore et al. (1989).

155 See Punt & Reumer (1981).

156 Included in *Damasonium*-type by Moore et al. (1989), but is the only species of the type found in the British Isles.

157 No reference material or descriptions seen for *Hydrilla verticillata*.

158 Equivalent to *Potamogeton*-type of Birks (1973) and Faegri & Iversen (1989), and to *Potamogeton* subgenus *Potamogeton* type of Moore et al. (1989).

159 Equivalent to *Coleogeton*-type of Faegri & Iversen (1989), and to *Potamogeton* subgenus *Coleogeton* type of Birks (1973) and Moore et al. (1989).

160 No reference material seen for *Spirodela polyrhiza* or *Wolffia arrhiza*.

161 See Furness (1988).

162 Some distinctions may be possible within this grouping (see Birks 1973). Pollen of *Dulichium arundinaceum*, found as macrofossils in pre-Holocene warm-stage sediments, resembles *Cyperaceae* undiff. pollen.

163 Separation into types based on Andersen (1979), with additional observations from the SDQR reference collection. All native British species have been covered, except *Vulpia ciliata*, *Puccinellia rupestris*, *Poa infirma*, *Agrostis vinealis*, *Calamagrostis purpurea*, *Gastridium ventricosum*, *Bromus commutatus*, *Hordeum marinum*, and *Danthonia decumbens*. At least one native species has been covered from all native genera except *Gastridium* and *Danthonia*. Pollen of the many interspecific or intergeneric hybrids has not been examined. Note that value for 'pollen size' given in Andersen (1979) is a mean of the largest diameter, and the diameter perpendicular to that, standardized for a constant control size of *Corylus* pollen. Andrew (1984) does not mention what her measurements refer to, but they appear to be maximum sizes.

164 This species arose c. 1890 as an amphidiploid of a hybrid between native *Spartina maritima* and introduced *Spartina alterniflora*. Its pollen is placed in this group because of its large size and pore diameter, but is unlikely to occur in any sediments except surface sediments from tidal mud-flats.

165 Some grains of *Helictotrichon pratense* may be included in this group.

166 Einkorn wheat: occurred as a crop grown by prehistoric people (Zohary & Hopf 1988).

167 See Punt (1976), whose nomenclature on types is followed. 168 *Typha angustifolia*-type of Moore et al. (1991).

169 See Punt (1976).

170 Included in *Typha latifolia*-type by Moore et al. (1989), but is the only species of the type found in the British Isles.

171 Equivalent to *Fritillaria*-type of Moore et al. (1989).

172 SDQR reference material indicates that *Lloydia serotina* belongs in the *Fritillaria meleagris*-type, not *Scilla*-type (cf. Moore et al. 1991).

173 Equivalent to *Convallaria*-type of Moore et al. (1989).

174 Equivalent to *Paris*-type of Moore et al. (1989).

175 Size variation between native species of *Polygonatum* suggests that the distinction between *Polygonatum* and *Allium*-type in Moore et al. (1991) cannot be maintained.

176 Equivalent to *Galanthus*-type of Moore et al. (1989).

177 Equivalent to *Iris*-type of Moore et al. (1989).

178 Equivalent to *Gladiolus*-type of Moore et al. (1989).

179 See Clarke & Jones (1981b).

180 I have not seen reference material or descriptions for *Epipogium aphyllum*, *Liparis loeselii*, *Coralorrhiza trifida*, *Herminium monorchis*, *Pseudorchis albida*, *Dactylorhiza praetermissa*, *D. majalis*, *D. traunsteineri*, *D. lapponica*, *Neotinea maculata*, *Orchis militaris*, *Aceras anthropophorum*, and *Himantoglossum hircinum*. The split into types thus does not take into account pollen of these species.

181 Dispersed as single grains, psilate, di- or tri-colpate.

182 Dispersed as single grains, monoporate, coarsely reticulate. All species in the genus appear to be similar, as Moore et al. (1989) suggest.

183 Dispersed as tetrads, monoporate, coarsely reticulate. Includes all examined species of the Tribe Neottieae (except Cephalanthera) plus Platanthera chlorantha. Tetrads of *Goodyera repens* may remain clumped in pollinia.

184 Dispersed as pollinia, which are often 0.2 mm long, or more (and hence excluded from most pollen preparations by sieving). Grains adhere tightly, and will break rather than separate. Sculpturing varies from psilate to coarsely reticulate. Includes all examined species of the Tribes Epidendreae and Orchideae, except *Platanthera chlorantha*.

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