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'WEED' POLLEN IN GREAT BRITAIN

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1. INTRODUCTION

Allergy to the so-called weed pollens, i.e. to the pollens of herbaceous plants other than grasses, seems to be rare in Great Britain, but since some of these kinds of pollen are very prevalent, and much information on their frequency has now accumulated, it would seem reasonable to summarise the relevant data and so to complete the sketch of the botanical background to pollen allergy begun in earlier papers (*Hyde, 1952, 1956*). The present contribution, like its predecessors, is based

on a pollen census which was begun in 1942 and is still in operation.

2. THE DISTRIBUTION OF HERBACEOUS HAYFEVER PLANTS

Great Britain, notwithstanding its geographical situation within the zone of deciduous summer forest, has been intensively settled by man for so long that little purely natural vegetation now remains. The place of forest has been taken by arable land, grass meadows, pastures, rough grazings, industry etc., the total extent and the relative proportions of which in the several countries concerned and in Great Britain as a whole are indicated in Table I. All of these categories of land use except those included under D allow of the existence of a numerous herbaceous flora (other than crops or grass), from which the bulk of the weed pollen in the air is derived. The plant communities principally concerned and their contained hayfever plants are listed below; they have been correlated as far as possible with the types of land use referred to. The lists of species are not exhaustive. The Latin name of each species is followed (in brackets) by the English name and that of the corresponding pollen type where this differs from that of the genus.

1. *Arable land* (Table I, A) in England and Wales forms about half the total area (woodlands (C) and urban areas etc. (D) excluded); in Scotland much less.

Sources of atmospheric pollen:

Beta vulgaris (beet, mangold: a crop plant; *Chenopodiaceae*).

Cirsium arvense (creeping thistle, and other thistles; *Compositae* B).

Chenopodium album (fat hen; *Chenopodiaceae*).

Rumex crispus (curled dock).

Sinapis arvensis (charlock, and other *Cruciferae*).

Tussilago farfara (coltsfoot; *Compositae* B).

Urtica urens (small nettle); local.

2. *Grassland* (Ab, B) as here understood includes the various upland types of vegetation comprised under the head-

TABLE I
Land use in Great Britain 1948.

	England		Wales		England and Wales		Scotland		Great Britain	
	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%
A. Crops and fallow.										
a. Arable	13,010,963	41	1,098,383	22	14,109,346	38	3,283,252	17	17,392,598	31
b. Permanent grass	8,813,741	27	1,449,443	28	10,263,184	28	1,133,500	6	11,396,684	20
B. Rough grazing	3,690,579	12	1,868,748	37	5,559,327	15	10,940,024	57	16,499,351	30
C. Woods and forests (1947-49)	1,865,046	6	316,478	6	2,181,524	6	1,266,838	7	3,448,362	6
D. Urban areas, militarised areas, industry, roads etc.	4,652,468	14	365,826	7	5,018,294	13	2,445,111	13	7,463,405	13
Total land area	32,032,797	100	5,098,878	100	37,131,675	100	19,068,725	100	56,200,400	100

Figures for categories A and B from Ministry of Agriculture (1952); for category C and total land area from Forestry Commission (1952); for D arrived at by difference.

ing of rough grazing as well as the lowland meadows and pastures; the former are widespread in Wales and even more so in Scotland. The weed flora is most abundant in Lowland areas and thins out higher up.

Sources of atmospheric pollen:

- Achillea millefolium* (yarrow; *Compositae* B).
- Anthriscus sylvestris* (cow parsley; *Umbelliferae*).
- Cirsium arvense* (creeping thistle) other thistles and other *Compositae* B.
- Heracleum sphondylium* (hogweed; *Umbelliferae*).
- Luzula campestris* (common wood-rush; *Juncaceae*).
- L. sylvatica* (greater wood-rush); uplands, local.
- Plantago lanceolata* (ribwort plantain).
- Ranunculus* spp. (buttercups).
- Rumex acetosa* (common sorrel).
- R. acetosella* (sheep's sorrel); on acid soils.
- R. crispus* (curled dock).
- R. obtusifolius* (broadleaved dock) and other docks.
- Senecio jacobaea* (ragwort; *Compositae* B).
- Urtica dioica* (common nettle).

3. *Marshes* and marshy ground occur in the lowlands and mostly come under (Ab); sources of pollen:

- Carex caryophylllea* and other sedges (*Carex* spp.; *Cyperaceae*).
- Filipendula ulmaria* (meadowsweet; *Spiraea*).
- Juncus* spp. (rushes); waterlogged and undergrazed pastures.
- Typha latifolia* and *T. angustifolia* (reed mace); swamps, local.

4. *Woodland* (C) contains a few herbaceous sources of atmospheric pollen, viz.:

- Luzula sylvatica* (greater wood-rush; *Juncaceae*).
- Mercurialis perennis* (dog's mercury).
- Urtica dioica* (common nettle).

5. *Hedgebanks, waysides and waste ground* are scattered throughout A, B, C and D but mostly lowland.

- Anthriscus sylvestris* (cow parsley; *Umbelliferae*).
- Artemisia vulgaris* (mugwort).
- Chaerophyllum temulum* (rough chervil; *Umbelliferae*).

Cirsium vulgare (spear thistle; *Compositae* B).

C. arvense (creeping thistle).

Heracleum sphondylium (hogweed; *Umbelliferae*).

Parietaria diffusa (pellitory-of-the-wall; *Urtica*): local.

Plantago major (greater plantain).

P. media (hoary plantain).

Rumex crispus (curled dock).

R. obtusifolius (broadleaved dock) and other species of *Rumex*.

Taraxacum officinale (dandelion; *Compositae* A).

Torilis japonica (upright hedge parsley; *Umbelliferae*).

Tussilago farfara (coltsfoot; *Compositae* B).

Urtica dioica (common nettle).

6. *Maritime communities* such as saltmarshes and sand dunes are included under (B). Sources of atmospheric pollen:

Beta maritima (sea beet; *Chenopodiaceae*).

Juncus maritimus (sea rush) and other *Juncus* spp. *Juncaceae*).

7. *Bogs* (accumulations of acid peat) occur mainly in upland areas and come under (B); sources of pollen:

Eriophorum spp. (cotton grass; *Cyperaceae*).

As the above lists clearly show, not all herbaceous hayfever plants are weeds in the narrow sense: they are much more widely distributed throughout Great Britain than the word 'weed' would suggest. The weed flora (as here broadly understood) is most abundant in lowland areas and thins out, in both species and individuals, with increasing altitude. The mountainous parts of Wales, northern Ireland and Scotland are floristically poorer than the lowlands and in general also less productive of hayfever plants: the risk of inhaling significant quantities of weed pollen must be correspondingly less in those areas than it is in southern and midland England.

3. 'WEED' POLLEN INCIDENCE IN RELATION TO GEOGRAPHICAL SITUATION

The pollen census referred to above has been carried out by daily trapping throughout one or more seasons at the various

stations listed in Table II (cf. Fig. 1) and at the Derbyshire Sanatorium, Chesterfield (1943), and in addition for longer or shorter periods during the years stated at Rothamsted Experimental Station, Harpenden, Herts. (1951-55) and on the islands of Skokholm (1947-48, 1956-58) and Skomer (1946) Pembrokeshire¹. Except at Cardiff the horizontal slide method has been used throughout; all exposed slides have been sent to Cardiff for analysis. Counts made on 5 sq. cm. of such slides exposed continuously but changed and counted daily form the main basis of this report. At Cardiff a Hirst Automatic Volumetric Spore Trap (AVST) (*Hirst*, 1952) has also been operated continuously from April 1954; counts so obtained, which are expressed as mean daily average concentration in grains per cubic metre, have been described in detail elsewhere (*Hyde*, 1959); they are here drawn on only to supplement the 'gravity' counts.

Consideration of the data set out in Table II in the light of detailed knowledge of the vegetation of the areas concerned shows that weed pollen catches at the land stations are related one to another much as might be expected on the assumptions (a) that they were mainly derived from sources situated within a few miles of the respective stations and (b) that pollen output of the kinds here concerned was greater in rural (but not upland) Wales than on the drier (eastern) side of Britain. This close relationship between average pollen concentration and local vegetation, which accords with general conclusions on the relation between pollen incidence and locality already stated (*Hyde*, 1956), evidently does not apply to the station on the Bishop Rock Lighthouse, where despite its remoteness from land, larger numbers of weed pollen grains were caught than at any other station listed in Table II except Cardiff and Aberystwyth. The explanation for this is probably

¹ I am indebted to Mr. John Barrett, Warden of Dale Fort Field Station for facilities for exposing slides on Skokholm and to successive Subwardens on the island for their kind cooperation during the seasons concerned, viz. 1947 (Mr. John Fursdon), 1948 (Mr. Peter Conder), 1956 (Mr. Peter Davis), 1957 (Mr. George Edwards), 1958 (Mrs. Kate Barham).

TABLE II
Weed pollen catches at 9 stations in Great Britain.
 (Grains caught on 5 sq. cm. of horizontal adhesive surface exposed continuously and changed
 24 hourly throughout the year unless otherwise stated).

Station	Altitude O. D.	Surroundings	Height of apparatus above ground	Year(s)	Weed pollen catch (average to nearest hundred)	Weed pollen as % of total pol- len catch
Cardiff	45 ft.	Town with parks and gardens	60 ft.	1943-56	3200	11
Aberystwyth	20 ft.	Small town; beside sea	60 ft.	1943	2300	21
Bishop Rock, Isles of Scilly	0 ft.	Sea: 32 miles from Land's End	125 ft.	1953-56	1900	21
Cambridge	40 ft.	Town with parks	60 ft.	1943	1800	9
Edinburgh	250 ft.	Betwixt suburb and cultivated land	24 ft.	1943	1200	5
Aberdeen	25 ft.	Large town; sea at ¼ mile	15 ft.	1943	1100	12
Paddington	90 ft.	Central London	80 ft.	1943	1000	9
Black Mountains, Brecs	1750 ft.	Upland valley among mountains	5 ft.	1945-49	1000	14
Brecknock Beacons, Brecs	1440 ft.	Open moorland with rough grazing	5 ft.	1945-49	900	10

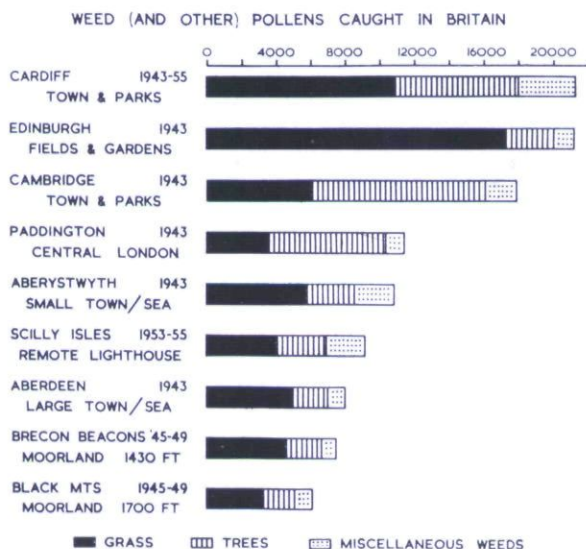


Fig. 1.

Weed (and other) pollens caught in Britain 1943-55: showing the magnitude of the weed catch and its relationship to the total catch at nine stations. Weed pollens are most abundant at Cardiff, but at several other stations they form a larger proportion of the total. For further explanation see text.

to be sought in an important difference, hitherto unrecognised in this context, between the conditions of particulate dispersal over land and those over the sea (Hyde, unpublished).

4. BOTANICAL COMPOSITION OF WEED POLLEN

Weed pollen is very miscellaneous, but more than a half, and at most stations the great bulk (up to nearly 90 per cent) of it belongs to the three types *Plantago* (plantain), *Urtica* (nettle) and *Rumex* (sorrel and dock), in that order. Other less important but still significant types include entomophilous Compositae, Juncaceae (rushes), chenopods, *Ranunculus* (buttercup), *Artemisia* (mugwort), Umbelliferae, Cyperaceae (sedges), Cruciferae (wallflower family) and *Spiraea* -meadow-sweet). An annotated list of these types is given in a later section and a complete list of all types of pollen and the

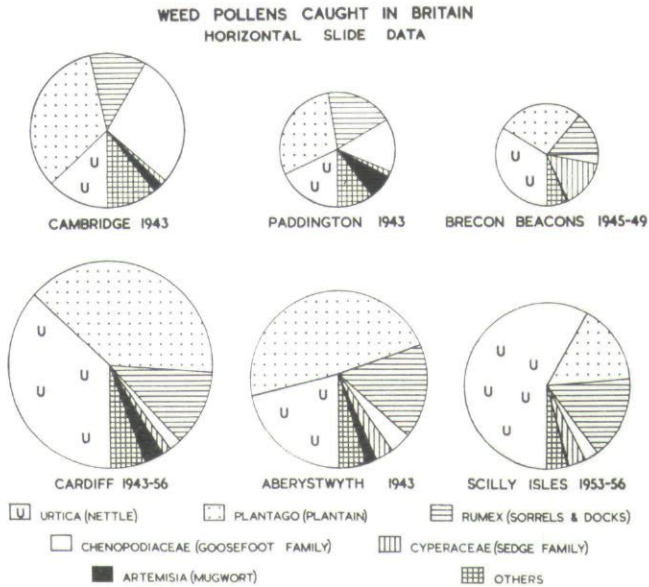


Fig. 2.

Weed pollen spectra from six centres, as determined by horizontal slides. The areas of the circles are in proportion to the average annual weed pollen catches. For further explanation see text.

numbers in which they have been caught at any station in Great Britain 1942-57 is included as an appendix. The great majority of the types listed have been described and figured in a photographic atlas (*Hyde and Adams, 1958*).

The average incidence of the principal individual kinds of weed pollen on horizontal slides exposed at six centres is illustrated in Fig. 2. At all but two centres plantain, nettle and *Rumex* are the first three in order of abundance; at Cambridge the chenopods occupy second place (this indicating the high proportion of arable land in the surrounding area); on the Welsh mountains sedge pollen comes third (indicating the regional abundance of Cyperaceae). Experience at Cardiff with the Hirst Automatic Volumetric Spore Trap has shown that *Urtica* (nettle) pollen is greatly under-estimated on horizontal slides: in all probability this type is the most abundant

WEED POLLEN AT CARDIFF 1954-57
VOLUMETRIC DATA

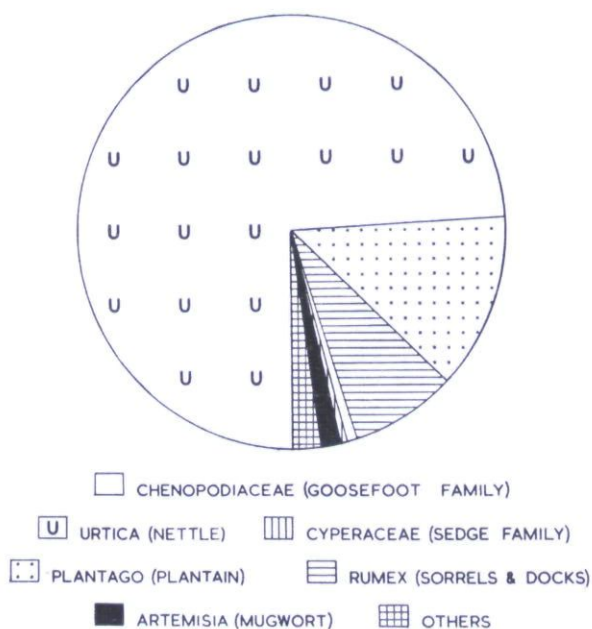


Fig. 3.

Weed pollen spectrum based on Hirst trap catches at Cardiff 1954-7.
For further explanation see text.

at all stations (*Hyde*, 1959). The weed pollen spectrum as determined by volumetric counts at Cardiff is depicted in Fig. 3.

5. PHENOLOGY

The course of events in the herbaceous pollen year is summarised in the herbaceous pollen calendar (Fig. 4) in which the average dates between which the various kinds are present, or abundant or (in grasses only, here included for comparison) very abundant in the air. The herbaceous pollen calendar differs greatly from the tree pollen calendar in that the principal pollens concerned are present in the air over much longer

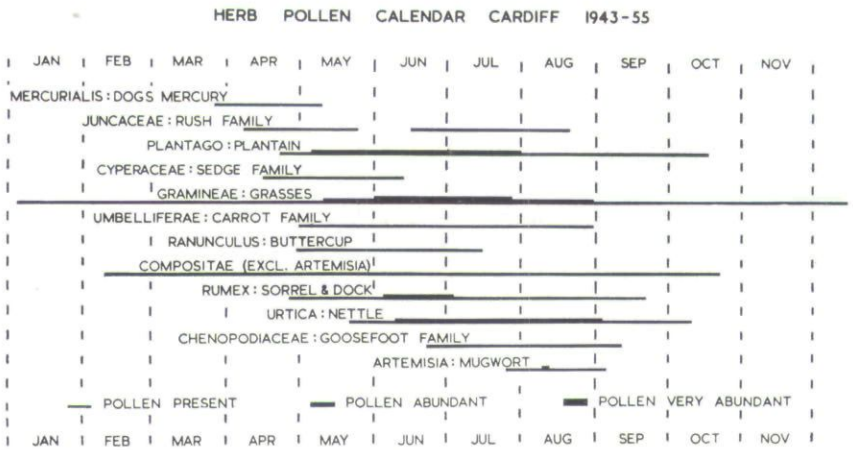


Fig. 4.

Herbaceous pollen calendar for Great Britain.

For further explanation see text.

periods. This fact is related to differences in flowering habit: most trees flower from buds formed in the preceding year whilst herbs flower in part at least from shoots formed during the current season. Given sufficient rainfall, common nettle (*Urtica dioica*) and ribwort plantain (*Plantago lanceolata*) continue to form new inflorescences over several months: hence their long pollen seasons, which are finally brought to an end presumably either by the seasonal fall in temperature or by shortening of day. The common docks, whose pollen make up the bulk of *Rumex* pollen from mid-June onwards, virtually cease to flower early in August: the trickle of *Rumex* into September is due to other less common species which flower later. Entomophilous Compositae are a very mixed assemblage consisting of species which flower variously from early spring (coltsfoot, *Tussilago farfara*) to autumn (ragwort, *Senecio jacobaea*): the long season for this heterogeneous pollen type has not for allergists the same significance as have those for the homogeneous or nearly homogeneous types already mentioned.

The order of events set out in the calendar is nearly fixed,

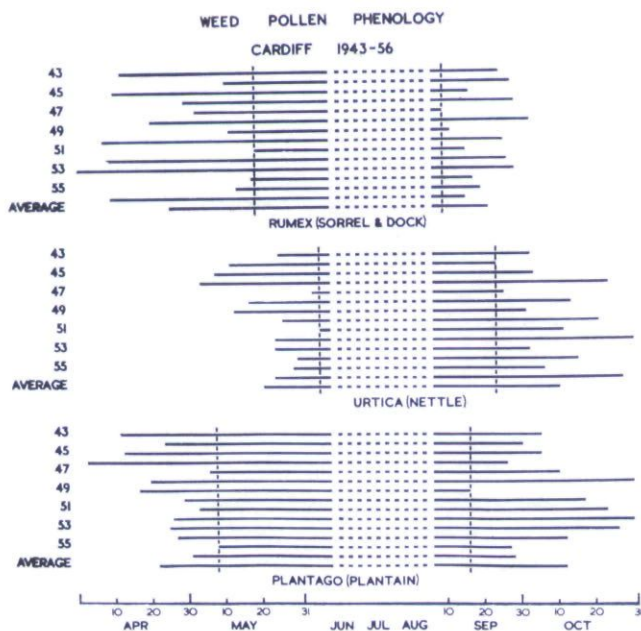


Fig. 5.

Weed pollen phenology, Cardiff 1943-56. The constant period for each type, i.e. the period during which it was present in every year, is indicated by the vertical barred lines. For further explanation see text.

but as shown in Fig. 5 the actual dates of their occurrence vary considerably from year to year. The constant periods (during which the pollens concerned are present every year) viz. *Rumex* (114 days), *Urtica* (111 days), *Plantago* (132 days), are very long compared with those of most trees, but all types may, in a favourable year, be present for several weeks before the constant period and may continue though in very diminished numbers for some weeks after it. Thus *Rumex* has been registered 48 days before the constant period, nettle 32; and plantain 35; and, similarly, *Rumex* has been caught as many as 23 days after the constant period; nettle 37; and plantain 44.

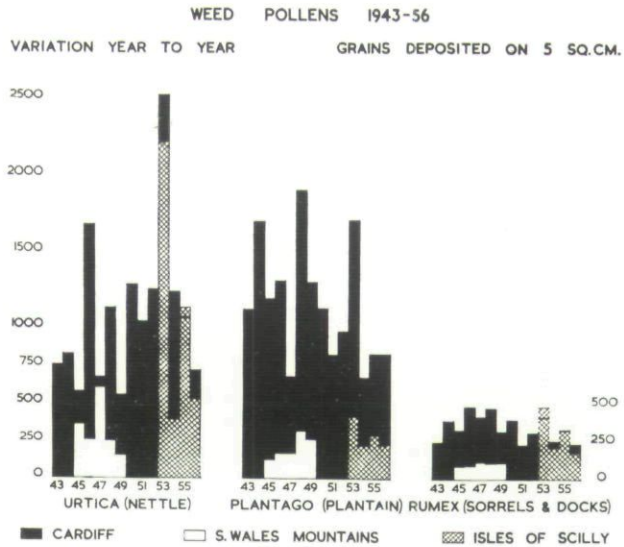


Fig. 6.

Year to year variation in annual catches of three types of herbaceous pollen at Cardiff 1943-56 and of the same types on the Brecknockshire Mountains 1945-9, and off the Isles of Scilly 1953-6. In 1953 the total catch of *Rumex* pollen off the Isles of Scilly exceeded that at Cardiff (indicated by the black horizontal line); the same applies to the total catch of *Urtica* pollen in 1955. For further explanation see text.

6. VARIATION IN INCIDENCE FROM YEAR TO YEAR

The variation from year to year in the abundance of three important types of weed pollen at Cardiff 1943-56, on the mountains of Brecknockshire 1945-9, and on Bishop Rock, Isles of Scilly 1953-6 is shown in Fig. 6. The annual catches at the mountain stations are usually around 25-33 per cent of those at Cardiff, and the catches in these two areas vary from year to year to about the same degree, though during the comparatively short run of years the changes were not always in unison. It is noteworthy that during the period 1945-9 the highest annual abundance of *Urtica* on the Brecon Beacons (1947) exceeded the lowest annual abundance at Cardiff (1949). As already indicated, pollen abundance on Bishop

PLANTAGO (PLANTAIN) POLLEN CARDIFF 1952-56

GRAINS CAUGHT ON 5 SQ. CM.

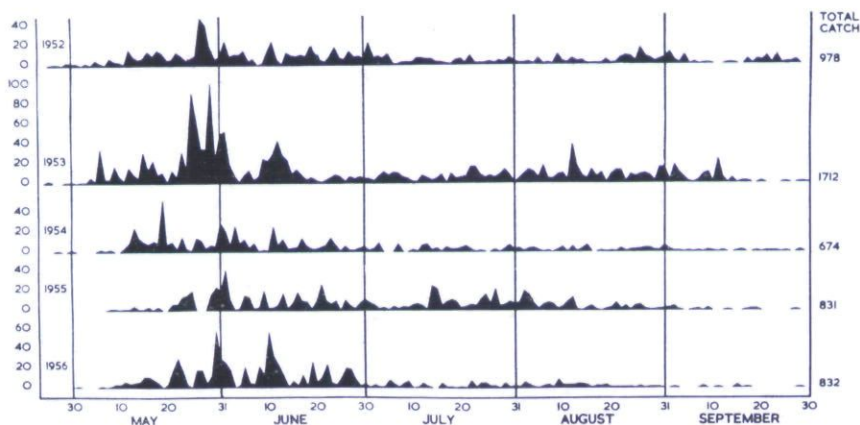


Fig. 7.

Daily frequency diagrams for plantain (*Plantago*). The figures on the left refer to daily catches on 5 sq. cm. of exposed surface, those on the right to total catch during the season. For further explanation see text.

Rock was distinctly higher relative to that at Cardiff than it was on the mountains of South Wales: in fact two types in different years (*Rumex*, 1953; *Urtica*, 1955) were on the average more abundant on Bishop Rock than at Cardiff.

A preliminary consideration of the annual counts of nettle and *Rumex* pollen in relation to weather at Cardiff during the years 1943-8 showed that spring rainfall very significantly favoured pollen release in summer (Hyde, 1952). Later observations on *Urtica* have confirmed this and have also indicated the importance of co-seasonal rainfall (Hyde, 1959). In general the annual incidence of weed pollens varies much less widely than that of tree pollens, but *Urtica* at least varies more widely than does grass pollen.

7. DAY TO DAY VARIATION IN INCIDENCE OF PARTICULAR TYPES OF POLLEN

Day to day variation in pollen incidence is exemplified by the frequency diagrams for plantain (Figs. 7 and 8). These

PLANTAIN POLLEN AT 8 STATIONS 1943

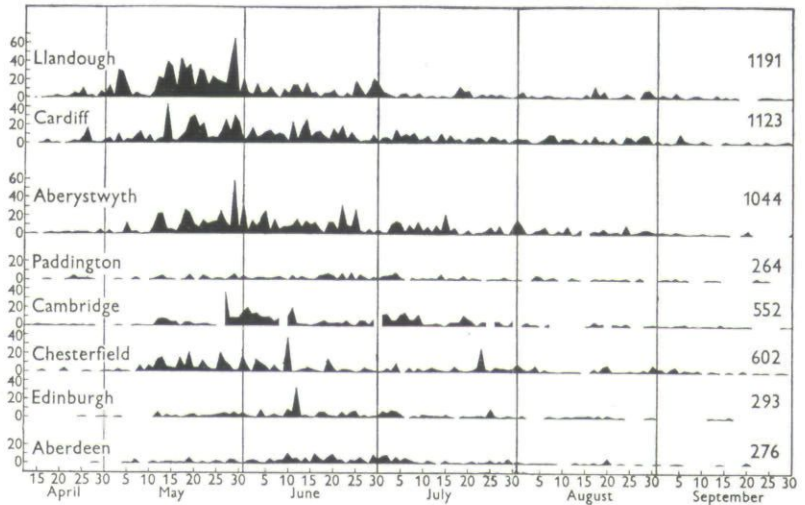


Fig. 8.

Daily frequency diagrams for plantain (*Plantago*) pollen at eight stations in Britain, 1943. (Reproduced by permission from Hyde (1950). *New Phytologist*. 49, 3). For further explanation see text.

diagrams, like almost all such diagrams for gravity slide catches of weed pollens, are of the diffuse type, in which (unlike the compact type as exemplified by most trees: Hyde 1956) there is no maximum phase regularly occurring about mid season, but various sub-maxima occur and the highest counts may be registered on any date over a relatively long period. During the years 1952, 1954 and 1956 the bulk of the plantain pollen came during May and June but in 1953 and 1955 a large proportion came in July and August. In the course of the years 1943 to 1957 the peak date for plantain at Cardiff varied between May 14 and August 17; that for nettle between June 7 and August 21; and *Rumex* between June 5 and July 4. In general—indeed almost invariably—the higher the seasonal incidence the greater also the highest daily catch.

In the year 1943 a pollen census was carried out simultaneously at eight stations up and down Great Britain. The frequency diagrams for plantain (Fig. 8), here used by way of

example, show that incidence throughout the season was higher at some and lower at others but that the season pursued a similar course at all of them. The bulk of the catch was made in May and June, though at all stations it was distributed, albeit unevenly, throughout the season. The higher the total incidence at a particular station the larger was the maximum daily catch; and the lower the total incidence the more attenuated is the tail of the frequency diagram.

8. ANNOTATED LIST OF WEED POLLENS KNOWN OR PRESUMED TO BE ANTIGENIC

The following information is given here in regard to each type:

(a) the name(s) of the source plants (all of which, unless otherwise stated, may be presumed to be native to Great Britain), their ecological preferences and their mode of pollination if not wholly or mainly by the wind (anemophilous);

(b) the type of pollen season, (as deduced from frequency diagrams), i.e. whether compact, diffuse, or in this respect indeterminate;

(c) the earliest and latest observed dates on which pollen has been caught from the air (constant period if any in italics);

(d) numerical indices of incidence (all stated as percentages of grass pollen incidence, in order to facilitate comparison with data already published (*Hyde*, 1952), viz. average annual incidence (A.A.I.) at Cardiff, as a percentage of the A.A.I. of grass pollen at Cardiff (c. 11,000 grains/5 cm²), highest annual incidence (H.A.I.) at any station, as a percentage of the H.A.I. of grass pollen at any station (c. 17,250 grains/5 cm² at Edinburgh, 1943; catches made near ground level in grass fields being excluded as not comparable) and highest daily incidence (H.D.I.) at any station as a percentage of the H.D.I. of grass pollen recorded at any station (1679 grains/5 cm² on Bishop Rock, 29 June 1953; catches in grass fields excluded as above): where the highest counts, either seasonal or daily, have been obtained other than at Cardiff the name

of the station is stated. In addition, the highest mean daily volumetric concentration (H.V.C.) as determined directly by means of the Hirst AVST in grains per cubic metre during the period 1954-7 (Hyde 1959) is stated: these figures range from 205 grains per cu.m. for *Urtica* to 0.7 grains per cu.m. for *Cichorieae* (Compositae A); the corresponding figure for grass pollen being 594 grains per cu.m.

(e) reference is made to antigenicity as observed in Great Britain or North America.

Artemisia (mugwort). Source: *Artemisia vulgaris*. Season compact: (13 July-) 4-21 August (-27 September). A.A.I. 0.8 %; H.A.I. 0.9 % (1947); H.D.I. 3.5 % (1947); H.V.C. 11 grains/m³. Antigenic (Wodehouse, 1945; Freeman, 1950; Frankland, 1956).

Chenopodiaceae (goosefoot family). Sources: goosefoot (*Chenopodium album*) and other *Chenopodium* spp.; beet or mangold (*Beta vulgaris*) a crop plant which is grown for its roots but a larger or smaller proportion of the plants 'bolt' and flower in autumn. Season diffuse (3 June-) 13 July-19 August (-29 September). A.A.I. 0.6 %; H.A.I. 2.7 % (Cambridge, 1943); H.D.I. 1.7 % (Cambridge, 1943). H.V.C. 7 grains/m³. Antigenic (Wodehouse, 1935; Wodehouse, 1945; Frankland, 1956).

Compositae A (*Cichorieae*). Sources: dandelion (*Taraxacum officinale*) and between 20 and 30 species belonging to 10 other genera (all widely distributed). Pollination chiefly by insects. Season: indeterminate: 7 April-6 October. A.A.I. 0.3 %; H.A.I. 0.4 % (Llandough, Cardiff, 1943); H.D.I. 2.4 % (Llandough, Cardiff, 1943). H.V.C. 0.7 grains/m³. Antigenic (Freeman, 1950).

Compositae B (excluding *Artemisia* and *Cichorieae*). Sources: various. Pollination chiefly by insects. Season indeterminate: 1 January-31 October. A.A.I. 0.8 %; H.A.I. 3.5 % (Skomer Is., 1946); H.D.I. 3.4 % (Skomer Is., 1946). H.V.C. 8 grains/m³. Antigenic (Freeman, 1950).

Cruciferae (cabbage family). Sources: mainly charlock (*Si-*

napis arvensis) and other related species (arable weeds). Pollination chiefly by insects. Season indeterminate: 10 April–8 October. A.A.I. 0.1 %; H.A.I. 1.4 % (Llandough, 1942); H.D.I. 5.3 % (Llandough, 1942). H.V.C. 2 grains/m³. Antigenic (*Colldahl*, 1954).

Cyperaceae (sedge family). Sources: sedges (*Carex* spp.), cottongrass (*Eriophorum* spp.). Marshes and wet ground. Season diffuse: (5 April–) 1–16 May (–30 June). A.A.I. 0.4 %; H.A.I. 1.5 % (Black Mountains, 1948); H.D.I. 2.8 % (Black Mountains, 1948). H.V.C. 5 grains/m³. Antigenic?

Juncaceae (rush family). Sources: woodrushes (*Luzula campestris* and other spp.); rushes (*Juncus* spp.). Damp ground chiefly lowland. Season diffuse: 23 March–11 June (*Luzula*); 11 June–30 August (*Juncus*). A.A.I. 0.8 %; H.A.I. 1.0 % (Brecon Beacons, 1949); H.D.I. 3.2 % (Brecon Beacons, 1949). H.V.C. 8 grains/m³. Antigenic?

Mercurialis (mercury). Sources: dog's mercury (*M. perennis*), woodlands; annual mercury (*M. annua*), arable land, local. Season indeterminate: 22 February–5 June (*M. perennis*); 2 August–5 November (few grains, some years, *M. annua*). A.A.I. 0.2 %; H.A.I. 0.3 % (Llandough, 1943); H.D.I. 1.0 % (Llandough, 1943); H.V.C. 2 grains/m³. Antigenic?

Plantago (plantain). Sources: ribwort plantain (*P. lanceolata*), grassland; greater plantain, *P. major* and hoary plantain (*P. media*), waste ground. Season diffuse: (3 April–) 8 May–16 September (–30 October). A.A.I. 11.1 %; H.A.I. 11.1 % (1948); H.D.I. 7.6 % (1948). H.V.C. 29 grains/m³. Antigenic (*Bernton*, 1925; *Wodehouse*, 1935; *Blumstein & Tuft*, 1937).

Ranunculus (buttercup). Sources: buttercups, chiefly *R. acris*, *R. bulbosus* and *R. repens* (all grassland). Pollination chiefly by insects. Season diffuse: 8 April–15 August. A.A.I. 1.0 %; H.A.I. 1.5 % (Llandough, 1948); H.D.I. 5.0 % (Llandough, 1948). H.V.C. 5 grains/m³. Antigenic?

Rumex (sorrel and dock). Sources: sorrels, viz. *Rumex*

acetosa, common sorrel (grassland) and *R. acetosella* (grassy places with acid soil); docks, including *R. Crispus* (curled dock) and *R. obtusifolius* (broadleaved dock) (cultivated land, waste ground etc.) and other species. Season diffuse (1 April–) 19 May–9 September (–2 October). A.A.I. 3.3 %; H.A.I. 11.3 % (Skokholm, 1947); H.D.I. 16.0 % (Skokholm, 1947); H.V.C. 50 grains/m³. Antigenic, 'a minor cause of hayfever' (Wodehouse, 1935).

Spiraea. Source: meadowsweet (*Filipendula ulmaria* = *Spiraea ulmaria*) (marshes), and cultivated *Spiraea* spp. Pollination chiefly by insects. Season: indeterminate, 13 June–13 October. A.A.I. 0.09 %; H.A.I. 0.2 % (Bishop Rock Lighthouse, 1955); H.D.I. 0.6 % (Cardiff, 1946). H.V.C. 4 grains/m³. Antigenic?

Typha. Sources: reed mace (*Typha latifolia* and *T. angustifolia*) (reed swamps). Season: indeterminate: 6 July–12 September. A.A.I. 0.005 %; H.A.I. 0.03 % (Skokholm Is., 1956). H.D.I. 0.1 % (Cardiff, 1953). H.V.C. 0.7 grains/m³. Antigenic (Durham, 1951).

Umbelliferae (carrot family). Sources: hedge parsley (*Anthriscus sylvestris*), (hedgerows); hogweed (*Heracleum sphondylium*) (grassland and cultivated ground) and other spp. All chiefly insect pollinated. Season indeterminate: 8 April–19 October. A.A.I. 0.3 %; H.A.I. 1.0 % (Chesterfield, 1943); H.D.I. 2.9 % (Chesterfield, 1943). H.V.C. 2 grains/m³. Antigenic?

Urtica (nettle). Sources: stinging nettle (*U. dioica*), (waysides, hedgerows, woods); small nettle (*U. urens*) (cultivated ground, rare; pellitory-of-the-wall (*Parietaria diffusa*) hedgebanks etc., local). Season diffuse: (4 May–) 5 June–23 September (–30 October). A.A.I. 10.5 %; H.A.I. 14.6 % (1953); H.D.I. 26 % (Bishop Rock Lighthouse, 1953). H.V.C. 205 grains/m³. Greatly under-estimated on horizontal slides (Hyde, 1959): probably the most abundant weed pollen throughout Great Britain. Antigenic: Frankland, 1958 (personal communication); Alemany Vall, 1956.

9. DISCUSSION

i. *Application of Thommen's postulates.*

No kinds of weed pollen other than those listed in Section 8 have any claim to meet the requirements of Thommen's postulates (Thommen 1931). Among these, five types are commonly regarded as insect pollinated, viz. *Compositae* (excluding *Artemisia*), *Cruciferae*, *Ranunculus*, *Spiraea* and *Umbelliferae*, but the mere fact that their pollen is regularly airborne in significant quantity shows that they are at least potentially wind pollinated. When the numerical indices of incidence are considered it is clear that three types are outstanding viz. plantain, *Rumex* and nettle. All three of these types have had, at at least one station, a H.A.I. exceeding 10 per cent that of grasses at any station; plantain and nettle have an A.A.I. at Cardiff of over 10 per cent that of grasses.

Even allowing for the fact that the A.A.I. of *Rumex* is only 3.3 per cent there is still a wide gap between the three chief types mentioned and the remainder, which all have an A.A.I. at Cardiff not exceeding 1 per cent that of grass pollen, and only five of which have a H.A.I. at any station equal to 1 % of grasses recorded anywhere viz. *Compositae* (excluding *Artemisia* and *Cichorieae*) 3.5 %, *Chenopodiaceae* 2.7 %, *Cyperaceae* 1.5 %, *Umbelliferae* 1.0 %, and *Juncaceae* 1.0 %. The *Compositae* (though doubtless most of them have antigens in common, Freeman 1950) are taxonomically very heterogeneous and have a very long combined season: and their pollens are always oily and clumped and relatively non-buoyant: atmospheric concentrations even of the very modest magnitude indicated by the figures from Skomer (1946) are probably rare or local. The figures for *Umbelliferae* from Chesterfield (1943) are to be explained by the situation of the apparatus at only 12 ft above ground in a grass orchard with umbelliferous plants growing all round. The figures for *Cyperaceae* and *Juncaceae* suggest moderate concentrations in damp areas, but no more. The H.D.I.'s of these various types are almost all rather higher in relation to that of grass than

are the H.A.I.'s, and indicate an occasional uprush at the places concerned but nowhere comparable with the concentrations of plantain, *Rumex* and nettle.

ii. *Effect of prolonged exposure.*

Only plantain, *Rumex* and nettle seem likely, by reason of the prolonged and relatively high concentrations of their pollen which occur every year, to induce sensitisation in any considerable number of subjects. Volumetric counts indicate that nettle pollen is numerically more abundant than any other type (Hyde, 1958) and therefore, if its antigenicity be assumed, uniquely likely among weeds to cause allergic symptoms.

iii. *Difficulties of diagnosis.*

The application of the time postulate (Hyde, 1956) is a little less difficult with weeds than with trees: the incidence of weed pollen does not in general vary so much from year to year. It is, however, liable to considerable changes resulting from concurrent weather in the course of a particular season: such unexpected falls and rises in the count are liable seriously to complicate clinical consideration.

10. SUMMARY

1. Land use and non-arboreal vegetation in Great Britain are briefly described from the point of view of allergy, and herbaceous hayfever plants occurring in various kinds of plant habitat are listed.

2. The incidence of 14 kinds of herbaceous ('weed') pollen is described and it is shown that three of these are liberated in large quantities over a wide area, viz. *Plantago* (plantain), *Rumex* (dock and sorrel), and *Urtica* (nettle). Of these only *Urtica* has a recorded numerical incidence which may at times approach that of grasses. The incidence of the other two may reach ten per cent that of the grasses, while that of the remaining eleven seldom exceeds three per cent.

3. The quantitative annual incidence of most kinds of weed pollen varies much less than does that of trees.

4. Variable phenology and changes in incidence during the course of the season may both complicate diagnosis and assessment of the results of treatment.

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APPENDIX

to this and the author's two previous papers on hayfever plants and pollen in Great Britain (Hyde 1952, 1956).

Complete list of pollens caught from the air in Great Britain.

The following list is a complete but summary record of all the pollen grains caught and recognised at all or any of the fifteen stations which have been operated (in most instances for the whole of at least one year) between the years 1942 and 1957 inclusive. It is arranged alphabetically under families (Coniferae being here regarded as one family).

Aceraceae		Campanulaceae	6
Acer	2444	Cannabaceae	
Aquifoliaceae		Humulus	35
Ilex	113	Caprifoliaceae	
Araliaceae		Sambucus	4170
Hedera	168	Caryophyllaceae	84
Balsaminaceae		Chenopodiaceae	3081
Impatiens	52	Compositae	
Betulaceae		Artemisia	2041
Alnus	9421	Cichorieae (A)	1106
Betula	29,260	Others (B)	3128
Carpinus	2927	Coniferae	
Corylus	9795	Abies	8
Boraginaceae		Cedrus	173
Symphytum	6	Larix	114
Buxaceae		Picea	110
Buxus	1	Pinus	15,048

Taxus	7,580	Ligustrum	724
Taxoid	1,468	Syringa	5
Cornaceae		Others	221
Aucuba japonica	2	Onagraceae	
Cruciferae	1137	Chamaenerion	7
Cyperaceae	2822	Papaveraceae	
Dipsacaceae	2	Papaver	19
Empetraceae		Plantaginaceae	
Empetrum	7	Plantago	36,454
Ericaceae	3087	Platanaceae	
Euphorbiaceae		Platanus	4429
Mercurialis	776	Plumbaginaceae	
Fagaceae		Limonium	1
Castanea	2856	Polygonaceae	
Fagus	7540	Rheum	9
Quercus	64,360	Rumex	17,678
Garryaceae		Primulaceae	4
Garrya	321	Ranunculaceae	
Gramineae	374,301	Clematis	113
Grossulariaceae		Ranunculus	3423
Ribes	16	Thalictrum	69
Haloragaceae		Rosaceae	
Myriophyllum	1	Potentilla	103
Hippocastanaceae		Poterium	33
Aesculus	1769	Spiraea	366
Iridaceae		Others (arboreal)	1864
Crocsmia	1	Rubiaceae	
Juglandaceae		Galium	153
Juglans	383	Salicaceae	
Juncaceae	3482	Populus	3308
Juncaginaceae		Salix	3818
Triglochin	20	Sparganiaceae	
Leguminosae		Sparganium	29
Acacia	1	Tiliaceae	
Others	310	Tilia	5318
Liliaceae	64	Typhaceae	
Lythraceae		Typha	24
Lythrum	2	Ulmaceae	
Moraceae		Ulmus	71,897
Morus	160	Umbelliferae	1701
Oleaceae		Urticaceae	
Forsythia	1	Urtica	35,690
Fraxinus	31,471	Others	753

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