The Weeds of Arable Land. III.

BY

WINIFRED E. BRENCHLEY, D.Sc., F.L.S.

Rothamsted Experimental Station (Lawes Agricultural Trust).

INITIAL investigations carried on in parts of Bedfordshire and the West Country¹ have shown that while definite relations exist between the weeds and soils of arable lands, these relations are partly local and partly general in extent. It is evident that in some cases a weed that is symptomatic of a certain soil in one district is not so exclusively associated with it in another, but there are also indications that certain species are symptomatic or characteristic of the same type of soil in different districts. Naturally, the 'general' relations will need more exhaustive proof than the 'local', and a true estimate will only emerge gradually as the field of investigation is enlarged, since each fresh observation ratifies or discounts the previous deductions.

In the earlier work special care was taken to select districts in which drift deposits were conspicuous by their absence, so that the soils dealt with might be regarded in the main as derived from the geological formations immediately underlying them. In Bedfordshire, Wiltshire, and the Bath district large tracts of land exist overlying one particular formation, such as Greensand, Chalk, or Gault, so that one can feel some confidence as to the origin of the soil. It was found, however, that the geological derivation apparently has little to do with determining the weed flora, the texture being a far more potent factor. Chalk forms the great exception to this rule on account of its very peculiar nature. To verify this still further, in 1912 the scene of operations was transferred to Norfolk, where drift soils are dominant. Geologists aver that the soils in Norfolk are derived from glacial deposits, the supposition being that at two distinct glacial periods the country was invested by ice sheets, which on melting left the drift deposits known as 'North Sea Drift' and 'Boulder Clay'.² These drift deposits are

¹ Brenchley, W. E.: Weeds of Arable Land. I. *Ann. Bot.*, xxv, No. xcvi, Jan. 1911, pp. 155-65. *Ibid.*, II. *Ann. Bot.*, xxvi, No. ci, Jan. 1912, pp. 95-109.

² See Harmer, F. W.: The Glacial Deposits of Norfolk and Suffolk. *Trans. Norfolk and Norwich Naturalists' Soc.*, vol. ix, pp. 108-33.

very variable in nature and texture even within very circumscribed areas, gravel, sand, loam, and clay occurring in close proximity in many places. In some districts the Boulder Clay is very chalky in nature owing to the grinding up and mixing of the underlying chalk strata with the glacial deposits. In some parts of West Norfolk these underlying strata themselves crop out, so that it was possible to get some insight into the weed flora of the Chalk, Gault, and Lower Greensand in addition to that of the heterogeneous glacial soils.

In the course of the season's work the following places were taken as centres, and the weed flora was investigated for some miles round: North Walsham, Aylsham, Hargham, Bressingham, Harleston, Field Dalling, Swaffham, Marham, Snettisham, and Sandringham. The plan of campaign was the same as in the two previous years, and the relative prevalence of the weeds was again notified as—

- (1) Dominant.
- (2) Sub-dominant.
- (3) Distributed.
- (4) Occasional.
- (5) Scarce.

During the season's survey about 480 fields were visited, yielding a harvest of 162 species of weeds, belonging to 104 genera. Of these 36 species, representative of 32 genera, were each seen once or twice only. The total number of species and genera occurring was far in advance of those from Bedfordshire and the West Country, though the number seen once or twice only was practically the same in each of the three districts.

The strictness with which the various plants keep to their several habitats of field and hedgerow is most remarkable. A very few species, such as *Scabiosa arvensis* and *Centaurea nigra*, are denizens of both habitats, but otherwise it is very rare to find any incursion from one to another, even at the extreme edges of the fields. As heretofore, only the plants growing in among the crops were considered as weeds.

The chief species of weeds, with their habitats and relative dominance, were as follows:

Ranunculaceae. *Ranunculus arvensis*. Confined to the heavier loams and clay. Seldom seen, never dominant.

Ranunculus repens. Distributed over all soils, but seldom seen on chalk. Once dominant on heavy loam, usually distributed.

Papaveraceae. *Papaver Argemone*. Only occasionally seen, on light loams. Never in any quantity.

Papaver Rhoeas. One of the commonest weeds. Chiefly on sand, very frequent on light loams and chalk. Often dominant.

Fumariaceae. *Fumaria officinalis*.¹ Characteristic of light and chalky soils, never seen on clay. Occasionally dominant.

Cruciferae. *Brassica alba*. Very rarely seen, and then on light and sandy loam; once dominant on sandy loam.

Brassica arvensis (*B. Sinapis*). Found on all types of soil. Specially frequent on clay and heavy loam, rare on sand. Sometimes dominant on chalk, clay, and loam.

Capsella Bursa-pastoris. Universally distributed on all soils; very common. Occasionally dominant on loam.

Raphanus Raphanistrum. Characteristic of chalk and sand. Occasionally dominant on chalk.

Sisymbrium Thalianum (*Arabis Thaliana*). Associated exclusively with light loams and sandy soils. Occasionally dominant, usually distributed.

Resedaceae *Reseda lutea*. Confined to chalk and sand. Infrequent in occurrence, never dominant.

Violaceae. *Viola tricolor*. Characteristic of light soils, sand, and chalk. Never dominant.

Caryophyllaceae. *Arenaria serpyllifolia*. Confined to light sandy and calcareous soils. Occasionally dominant on light sandy loam. Far more frequently seen than in the previous years' work.

Cerastium vulgatum. Occurs on all types of soil, though rarely on clay. Generally distributed, never dominant.

Lychnis alba. Chiefly associated with the lighter soils and sandy loam, though it is found on all types of land. The plant is very widely spread, but only occurs in small quantities.

Lychnis Githago. Usually occurs on loam. Generally scarce in distribution.

Silene anglica. Confined to sandy soils. Never very prevalent.

Silene inflata (*S. Cucubalus*). Chiefly on chalky and light soils. Twice dominant on sand, but usually distributed or occasional.

Silene noctiflora. Practically confined to the light soils and chalk. Usually distributed, never dominant.

Spergula arvensis. Confined to sand and light soils of a non-calcareous character. Frequently dominant on sand.

Stellaria media. Distributed over all types of soil; occasionally dominant on the lighter lands.

Geraniaceae. *Erodium cicutarium*. Distributed on sand and very light soils.

¹ The nomenclature throughout is now taken from Hayward's Botanist's Pocket Book, 13th edition, 1909. In the earlier papers that of Bentham and Hooker's British Flora was used, and the old collective name '*Fumaria officinalis*' is retained, as this genus is exceedingly difficult to subdivide in the field under the conditions of the investigation. Where any change has been necessary the name previously used is added in brackets.

Geranium dissectum. Associated with heavy soils. Never dominant.

Geranium molle (including var. *aequale*). Confined to light and chalky soils. Once dominant on sand, but usually distributed.

Geranium pusillum. Only seen on light and chalky soils. Never dominant.

Rosaceae. *Alchemilla arvensis*. Characteristic of light and of sandy soils, very rare on chalk. Occasionally dominant, usually distributed.

Potentilla Anserina. Chiefly associated with medium soils, less frequent on sand and rare on clay. Occasionally dominant.

Potentilla reptans. Occurred on the heavier soils, especially clay, but never seen in any quantity.

Umbelliferae. *Daucus Carota*. Associated with all types of soil and occasionally dominant.

Scandix Pecten-veneris. Found on all soils except chalk, though seen occasionally on chalky loam. Once dominant on light loam.

Rubiaceae. *Galium Aparine*. Chiefly on heavy loam and clay. Never dominant, and only seen frequently at Bressingham and Harleston.

Galium sp. Distributed on all types of soils. (This was a species which defied identification. The plant grew flat against the ground, in a kind of mimic rosette, the leaves usually being in whorls of four. In many ways it resembled a squat form of *G. Aparine*, but it was never seen in flower or fruit. This form was only seen in West Norfolk, in the districts round Swaffham and Snettisham; *G. Aparine* occurred alongside it in some cases.)

Sherardia arvensis. Found on all types of soil, but more usually on the lighter loams and chalk. Usually occasional or scarce, but generally distributed on chalk.

Dipsaceae. *Scabiosa arvensis*. Chiefly on light and sandy soils, absent from clay. Distributed or scarce.

Compositae. *Anthemis arvensis*. Chiefly on sandy soils and chalk. Very rare on clay. Occasionally dominant.

Anthemis Cotula. Usually occurred on loam, but not often seen.

Artemisia vulgaris. Distributed on light calcareous soils.

Carduus nutans. Occurred on light and calcareous soils. Once dominant on sand.

Centaurea Scabiosa. Associated with light and chalky soils. Never seen on clay. Once dominant on sand.

Chrysanthemum segetum. Confined to non-calcareous sand. Not very frequent, but usually dominant when present.

Cichorium Intybus. Associated with chalky soils, though twice seen on sand. Usually scarce.

Cirsium arvense (*Carduus arvensis*). By far the most common of all weeds. Ubiquitous among all crops and on all soils. Frequently dominant.

Filago germanica. Distributed on sandy and chalky soils.

Gnaphalium uliginosum. Characteristic of sandy soils. (The records for this plant obtained in 1910 and 1912 agree as to its habitat, and so do not fall into line with the usually accepted idea that it is a denizen of moist places.)

Matricaria Chamomilla. Occurred either on sand or heavy loam. Usually infrequent, but once dominant on sand.

Matricaria inodora. Distributed over all types of soil and occasionally dominant on light and sandy loams.

Senecio vulgaris. Found on all soils. Once dominant on sand.

Sonchus arvensis. Associated with all soils, but more especially with heavy loam and clay. Occasionally dominant.

Tussilago Farfara. Practically confined to clay and the heavier loams. Never dominant.

Campanulaceae. *Legousia hybrida* (*Campanula hybrida*). Occurred on the lighter soils, though infrequent on sand. Absent from clay. Never dominant, often scarce.

Primulaceae. *Anagallis arvensis*. Associated with all types of soil, but when it occurred on chalk it was scarce in distribution. Never dominant.

Boraginaceae. *Echium vulgare*. Characteristic of sand. Once dominant.

Lycopsis arvensis. Confined to light sandy land—apparently soils may be calcareous or not. Usually occasional or scarce.

Myosotis scorpioides (*M. arvensis*). Chiefly on sand and loam; rare on chalk. Never dominant.

Convolvulaceae. *Convolvulus arvensis*. Universally distributed as to soil, and frequently dominant. One of the commonest weeds, and often seen on root land before the seeds come up, in company with *Cirsium arvense*.

Scrophulariaceae. *Bartsia Odontites*. Chiefly associated with loam; never seen on chalk. Twice dominant on heavy loam.

Linaria Elatine. Characteristic of heavy soils. Scarce.

Linaria minor. Associated with sandy soils. Infrequent.

Linaria vulgaris. Characteristic of chalky soils. Usually distributed.

Veronica agrestis.¹ Practically confined to light and sandy soils; from chalk. Rarely dominant.

Veronica arvensis. Chiefly on the lighter soils; scarce on chalk. Never dominant.

Veronica hederæfolia. Associated with sand and light sandy loams. Absent from clay and chalk. Once dominant on loam.

¹ The exact distinction between *V. agrestis* and *V. Tournefortii* was not recognized at the beginning of the season's work, so possibly a few records of *V. Tournefortii* have been classed as *V. agrestis*, but not vice versa. However, it is evident that the error has not in any way affected the final results except as to the exact number of records of each of the two species.

*Veronica Tournefortii*¹ (*V. Buxbaumii*). Found on all types of soil, including chalk. Occasionally dominant.

Lamiaceae. *Galeopsis Tetrahit*. Characteristic of the lighter soils. Rare on chalk.

Mentha arvensis. Occurred on all types of soils, but especially on heavy loam. Twice dominant on loam.

Satureia Acinos. Chiefly associated with chalky soils. Never dominant.

Plantaginaceae. *Plantago lanceolata*. Distributed over all types of soil and occasionally dominant.

Plantago major (probably including var. *intermedia*). Universally distributed as to soil. Never dominant.

Illecebraceae. *Scleranthus annuus*. Confined to sandy soils; never on chalk. Frequently dominant on sand.

Chenopodiaceae. *Chenopodium album*. Distributed over all soils and occasionally dominant.

Polygonaceae. *Polygonum aviculare*. Very common on all soils and often dominant.

Polygonum Convolvulus. As common as *P. aviculare*, but generally associated with loam and sand. Seen on chalky loam, but never on chalk. Frequently dominant.

Polygonum Persicaria. Practically confined to light sandy soils, though one instance of dominance was on clay. (This species often came in if any part of the field happened to be rather damp.)

Rumex Acetosella. Only found on sand and light loam; never associated with chalky soils. Sometimes dominant on sand.

Rumex crispus. Distributed over all soils and occasionally dominant. (Most Norfolk farmers say that this is the worst weed they have to deal with, but such constant war is waged against it that it is by no means conspicuous in the fields.)

Rumex obtusifolius. Only seen on sandy soils. Once dominant.

Euphorbiaceae. *Euphorbia exigua*. Chiefly found on clay and the heavier loams. Never dominant, often scarce.

Euphorbia Helioscopia. Usually on chalk and calcareous soils. Occasional or scarce in distribution.

Graminaceae. *Agropyron repens* (*Triticum repens*). Chiefly on heavy land, but also found on all soils except chalk. Frequently dominant.

Agrostis alba (including var. *stolonifera*). Associated with all soils. Frequently dominant.

Alopecurus myosuroides (*A. agrestis*). Characteristic of heavy loams and clay; never seen elsewhere. Once dominant on clay.

Poa annua. Chiefly on loam and sandy loam; rare on chalk. Once

¹ See note on p. 145.

dominant. (This species is said to be particularly common among fruit trees in plantations.)

Poa trivialis. Found on loam and clay. Never dominant.

Equisetaceae. *Equisetum arvense.* Associated with most types of soil, but less common on sand and absent from chalk. Occasionally dominant.

The classification of the weeds with regard to the soils they colonize is more difficult when dealing with the drift soils than when the directly derived soils are concerned. Well-marked soils as clay, chalk, and sand are relatively scarce, while loams of all categories are in the ascendant. Generally speaking, the soils are more intermediate in type than in any of the districts investigated previously. Still, an analysis of the lists shows that the weeds do fall into well-defined classes, loam taking its place for the first time as a special subdivision.

A. Clay and Heavy Loam.

Fields in this section were comparatively seldom seen, only about 11 per cent. of the total number being really heavy in nature. The heavy soils were chiefly located round Harleston and Bressingham, where they are derived from the Boulder Clay (so being of drift origin), and again in the neighbourhood of Snettisham and Marham. At Snettisham the heavy clay land is down near the sea and is apparently also derived from Boulder Clay, but at Marham an outcrop of the Gault occurs, exceedingly heavy clay being met with cheek by jowl with the sharply defined Chalk outcrop. The dividing line between the two formations is remarkably distinct in this district.

As is so usually the case, while plenty of varieties of weeds occur on clay soils as well as in other habitats, only a few species have a decided preference for the heavy lands, and practically none can be designated as absolutely symptomatic of clay, though a few are certainly characteristic.

The following were found in association with these soils:

Alopecurus myosuroides	} characteristic.
Geranium dissectum	
Heracleum Sphondylium	
Linaria Elatine	
Potentilla reptans	
Ranunculus arvensis	
Stachys palustris	
Equisetum arvense	} relatively frequent on these soils, but found on other types as well.
Euphorbia exigua	
Galium Aparine	
Tussilago Farfara	

Matricaria Chamomilla—only seen on heavy loam and sand.
Never on clay.

B. Loams.

By far the greater part of the soils investigated in Norfolk are loams, locally known as 'mixed soils', varying in texture from light sandy land to that of a very heavy nature. A local distinction is drawn between a 'sand' and a 'light mixed soil' and between a 'heavy mixed soil' and a 'clay', but this distinction does not hold good when the weed flora is considered. Between the lightest and the heaviest loams there is an intermediate range of loams with which certain weeds are more particularly associated. It seems as though some species of plants do not care for extremes of any kind, but flourish best in the less distinctive habitats. Among such species are :

Anthemis Cotula Bellis perennis Brassica alba Chrysanthemum leucanthemum Euphorbia Peplus Lolium perenne Lychnis dioica Papaver Argemone	}	generally associated with loams.
---	---	----------------------------------

Achillea Millefolium Galeopsis Tetrahit Legousia hybrida Scabiosa arvensis Sisymbrium officinale Veronica agrestis	}	also on sand and sandy loam.
---	---	------------------------------

Centaurea nigra—also on chalk.

Poa trivialis—perhaps characteristic of the heavier soils.

Equisetum arvense Lychnis Githago Potentilla Anserina Prunella vulgaris	}	more usual on loams, but also associated with other types of soil.
--	---	--

C. Sand and Sandy Loams.

These soils are met with all over the county, and in most cases represent the sand and gravel deposits, in others the lightest types of Boulder Clay. In some places the sands are deficient in calcium carbonate ; in others, where the chalk rock comes near the surface, they are decidedly calcareous, containing chalk stones, as is well seen at Hargham and East Snettisham. In the north-west of the county the Lower Greensand crops out in the form of 'carstone', which yields a peculiar type of sandy soil deficient in chalk,

giving no effervescence when treated with dilute hydrochloric acid. These carstone soils are well seen at Dersingham, West Snettisham, and Heacham, and are usually of a decided red or yellow colour. The relative quantities of calcium carbonate in the sands are reflected in the flora, such so-called 'acid' or 'sour' plants as *Rumex Acetosella* and *Spergula arvensis* never being found on the calcareous sands. It is hardly correct to say that such plants as *Rumex Acetosella* are definitely symptomatic of 'acid' soils. An acid soil is what is known to the agriculturist as a sour soil, the use of the technical word acid in this connexion being rather unfortunate. A sour soil implies one containing no chalk at all, so that an acid reaction is obtained with litmus paper. *Rumex Acetosella* will grow on soils which do contain a very small percentage of calcium carbonate, as can be seen at Blakeney Point, so that it is better to say that the so-called acid plants are really indicators of soils deficient in chalk, though total absence of calcium carbonate is not necessarily entailed. Warming¹ suggests that nearly all lime soils are rich in soluble mineral substances and that this wealth excludes plants belonging to poorer soils, owing to the competition of plants which flourish best on the richer soils. Cultures made by C. A. Weber and Grübner have clearly demonstrated that none of the calciphobous plants, of which *Rumex Acetosella* is an example, suffer from lime when this is unaccompanied by a large amount of soluble salts, and that they are expelled from calcareous soils by competition. Nevertheless, from a practical agricultural point of view, the presence of calciphobous plants on any land is undoubtedly a sure indication of a deficiency of the chalk which is so essential to the well-being of most plants.

In the present investigation sour soils other than sands have not often come into notice, so that it is not yet possible to say whether there is a flora that is characteristic of sour land of heavier texture.

The lighter soils are characterized by the great diversity of plants composing their flora, a good proportion of the species being definitely characteristic of sand and sandy loams. The classification is as follows :

Chrysanthemum segetum	}	symptomatic of light sandy soils which are very deficient in chalk.
Rumex Acetosella		
Scleranthus annuus		
Spergula arvensis		
Bromus mollis	}	characteristic of sand.
Echium vulgare		
Erophila verna		
Lycopsis arvensis		
Myosotis collina		

¹ Warming, Eug.: Ecology of Plants, 1909, p. 67.

<i>Erodium cicutarium</i>	}	characteristic of sand and sandy loam.
<i>Gnaphalium uliginosum</i>		
<i>Holcus lanatus</i>		
<i>Linaria minor</i>		
<i>Rumex obtusifolius</i>		
<i>Sagina nodosa</i>		
<i>Silene gallica</i>		
<i>Urtica dioica</i>		

<i>Alchemilla arvensis</i>	}	also on loam.
<i>Juncus bufonius</i>		
<i>Lamium amplexicaule</i>		
<i>Polygonum Persicaria</i>		
<i>Scabiosa arvensis</i>		
<i>Sisymbrium Thalianum</i>		
<i>Veronica agrestis</i>		
<i>Veronica hederæfolia</i>		

Matricaria Chamomilla—also on heavy loam.

<i>Arenaria serpyllifolia</i>	}	also on chalk.
<i>Anthemis arvensis</i>		
<i>Carduus nutans</i>		
<i>Centaurea Scabiosa</i>		
<i>Filago germanica</i>		
<i>Geranium molle</i>		
„ <i>pusillum</i>		
<i>Raphanus Raphanistrum</i>		
<i>Reseda lutea</i>		
<i>Satureia Acinos</i>		
<i>Silene noctiflora</i>		

Papaver Rhoeas—also on chalk and light loam.

D. Chalk and Calcareous Soils.

Chalk is found underlying the drift soils over the greater part of Norfolk, but in the eastern and central parts of the county it is usually so deeply situated that it does not affect the surface soils. In West Norfolk, however, an outcrop occurs, so that in some places real chalky land is found, derived directly from the chalk rock, while in others the drift overlying the chalk is decidedly calcareous in nature, due to admixture with the chalky subsoil. Comparatively little of this chalk soil was met with in the season's work, so that it was not possible to definitely associate many species with such land.

Artemisia vulgaris	}	probably characteristic.
Cichorium Intybus		
Crepis virens		
Euphorbia Helioscopia		
Linaria vulgaris		

Aethusa Cynapium	}	also on loam.
Centaurea nigra		

Anthemis arvensis	}	also on sandy soils.
Arenaria serpyllifolia		
Atriplex patula		
Carduus nutans		
Centaurea Scabiosa		
Filago germanica		
Geranium molle		
„ pusillum		
Raphanus Raphanistrum		
Reseda lutea		
Satureia Acinos		
Silene noctiflora		

Papaver Rhoeas—also on sand and loam.

Weeds of General Occurrence.

Besides the species which are definitely associated with particular soils, there are a good many plants which occur indiscriminately on any and every kind of land, while others, though absent from one type of soil, are otherwise universally distributed. Into this category come the following:

Agrostis stolonifera	}	universally distributed.
Brassica Sinapsis		
Capsella Bursa-pastoris		
Caucalis nodosa		
Cerastium vulgatum		
Chenopodium album		
Cirsium arvense		
Convolvulus arvensis		
Daucus Carota		
Galium sp.		
Lamium purpureum		
Lychnis alba		
Matricaria inodora		
Mentha arvensis		
Plantago lanceolata		
„ major		

Polygonum aviculare	}	universally distributed.
Ranunculus repens		
Rumex crispus		
Senebiera Coronopus		
Senecio vulgaris		
Sherardia arvensis		
Stellaria media		
Veronica Tournefortii		
Sonchus arvensis—especially on clay.		
Chaerophyllum Anthriscus	}	rare or absent from clay.
Fumaria officinalis		
Glechoma hederacea		
Silene inflata		
Veronica arvensis		
Viola tricolor		
Anagallis arvensis	}	scarce on chalk.
Myosotis arvensis		
Poa annua		
Bartsia Odontites	}	absent from chalk.
Erysimum cheiranthoides		
Polygonum Convolvulus		
Scandix Pecten-veneris		
Taraxacum vulgare		
Triticum repens		

Some of the above species are both universally distributed and abundant in occurrence. Some plants (e. g. *Polygonum aviculare*, *Chenopodium album*, *Viola tricolor*, *Cerastium vulgatum*, *Capsella Bursa-pastoris*, &c.) show considerable morphological differences in different places, exhibiting variations in habit, in the size and shape of the leaves, in the size and colour of the flowers. It is quite possible that 'splits' or varieties of these cosmopolitan species may ultimately prove to be as significant as species themselves, and that a certain split may be as definitely associated with a particular type of soil as homogeneous species of other genera. Massart¹ suggests that when a species is found colonizing very diverse habitats, some essential difference really exists between the plants, and that under the combined influences of variability and natural selection a species undergoes a transformation or 'adaptation' which is hereditary, in contradistinction to the 'accommodation' of an individual to place itself in accord with its habitat.

¹ Massart, I.: Le rôle de l'expérimentation en géographie botanique. Rec. Inst. bot. Léo Errera, ix, 1912, pp. 68-80. Abst. in Bot. Centralbl., Band cxx, No. 14, pp. 353-4.

Besides the weeds mentioned in the foregoing lists the following were seen very occasionally, some only appearing once in the season's work :

Ranunculaceae	<i>Myosurus minimus</i>	sand
"	<i>Ranunculus acris</i>	loam
"	" <i>bulbosus</i>	sand and heavy loam
Papaveraceae	<i>Papaver dubium</i>	heavy loam
"	" <i>hybridum</i>	chalk
Cruciferae	<i>Lepidium campestre</i>	loam
"	<i>Sisymbrium Sophia</i>	sand
"	<i>Thlaspi arvense</i>	"
Resedaceae	<i>Reseda luteola</i>	light loam
Caryophyllaceae	<i>Sagina procumbens</i>	sandy loam
Malvaceae	<i>Malva sylvestris</i>	chalky soils
Geraniaceae	<i>Geranium pyrenaicum</i>	light loam
Leguminosae	<i>Anthyllis Vulneraria</i>	sand and chalk
"	<i>Melilotus alba</i>	sandy loam
"	" <i>arvensis</i>	sand
"	<i>Ornithopus perpusillus</i>	"
Rosaceae	<i>Potentilla sterilis</i>	sandy loam
Saxifragaceae	<i>Saxifraga tridactylites</i>	sand
Umbelliferae	<i>Anthriscus sylvestris</i>	loam
"	<i>Pimpinella Saxifraga</i>	chalk
Valerianaceae	<i>Valerianella olitoria</i>	sandy loam
"	" <i>rimosa</i>	" "
Compositae	<i>Cirsium lanceolatum</i>	distributed
"	<i>Erigeron canadensis</i>	sandy soils
"	<i>Filago minima</i>	sand
"	<i>Hypochaeris radicata</i>	heavy loam
"	<i>Lapsana communis</i>	distributed
"	<i>Picris Hieracioides</i>	loam
"	<i>Onopordon Acanthium</i>	chalky sand
"	<i>Senecio Jacobaea</i>	sand and gravel
Boraginaceae	<i>Lithospermum arvense</i>	distributed
Scrophulariaceae	<i>Linaria spuria</i>	loam
"	<i>Verbascum Thapsus</i>	"
"	<i>Veronica serpyllifolia</i>	sandy soil
Orobanchaceae	<i>Orobanche minor</i>	loam and sand
Lamiaceae	<i>Stachys arvensis</i>	chalky loam
Chenopodiaceae	<i>Chenopodium urbicum</i>	light soil
Polygonaceae	<i>Polygonum lapathifolium</i>	sand
"	<i>Rumex Acetosa</i>	"
Euphorbiaceae	<i>Euphorbia platyphyllos</i>	loam

Urticaceae	<i>Urtica urens</i>	sand
Graminaceae	<i>Aira caryophyllaea</i>	„
„	<i>Alopecurus pratensis</i>	light loam
„	<i>Bromus sterilis</i>	heavy loam
„	<i>Poa pratensis</i>	loam
Polypodiaceae	<i>Pteris aquilina</i>	sand

COMPARISON OF THE WEED FLORA OF NORFOLK WITH THAT OF BEDFORDSHIRE AND THE WEST COUNTRY.

The general aspects of the weed floras are more or less comparable as regards the distribution of the plants, but the number of the species occurring is considerably greater in Norfolk, partly because of the greater diversity in the soil and partly on account of the larger area covered by the investigation. Some few of the weeds are proving to have a real association with definite types of soil, while yet others show decided local differences in their distribution, being absent in one place from the very soil on which they are frequent or even characteristic in another locality. The question as to calcifuges can hardly be reopened at present, as so little chalk land was examined in Norfolk that the data is too meagre. Just one plant, *Poa annua*, stands out conspicuously in that it is the only plant that has proved to be consistently absent or very rare on chalk in each of the three districts.

On the whole there is a closer correspondence between the weed floras of Norfolk and Bedfordshire than between that of the West Country and the Eastern Counties, both as regards distribution and the actual species found, a fact which may be due to the geographical proximity and to a closer approximation in the nature of the soils in the east.

The most outstanding features of distinction and similarity are :

1. Certain species are definitely associated with sand, always choosing that as a habitat in every locality :

<i>Chrysanthemum segetum</i>	<i>Sisymbrium Thalianum</i>
<i>Rumex Acetosella</i>	<i>Spergula arvensis</i>
<i>Scleranthus annuus</i>	

Brassica arvensis, on the other hand, shows a consistent dislike of sandy soils. This is borne out by the work of Verhulst,¹ who states that his researches show that no affinity exists between *Sinapsis arvensis* (*Brassica arvensis*) and light soils. He finds *Brassica arvensis* to be characteristic of chalky soils and calcareous clays, while *Raphanus Raphanistrum* is confined to sand, clays, and non-calcareous muds, though where the nature of the soil

¹ Verhulst, A. : Quel est le vrai caractère biologique du *Raphanus Raphanistrum*, L., et du *Sinapsis arvensis*, L. ? Bull. Soc. Roy. Bot. Belgique, 48. 4. 1911, pp. 248-56. Abst. in Bot. Centralb. Band cxx, No. 12, p. 317.

is variable the two species occur pell-mell in various proportions. He also concludes that *Raphanus* is calcifuge and *Brassica arvensis* calcicolous, but this statement is not borne out in its entirety by the present investigations, though broadly it meets the case.

2. While *Poa annua* and *Anagallis arvensis* have a dislike for chalk, other plants are always to be found on calcareous land, though they are frequently seen on light soils as well. The chief of these are :

Centaurea Scabiosa
Papaver Rhoeas
Reseda lutea

Silene inflata
Viola tricolor

3. *Euphorbia exigua* and *Ranunculus arvensis* have always proved to be characteristic of heavy land, i. e. heavy loam and clay.

4. The following species show very striking distinctions in their distribution in different districts :

Bartsia Odontites. Never recorded from chalk in Norfolk or Bedfordshire and usually seen on the heavier soils. Characteristic of chalk in the West Country and seldom seen on the heavy land.

Chenopodium album. Bedfordshire. Never recorded from chalk, most frequent on sand and light loam.

West Country. Frequently seen on chalk and clay, but absent from sand.

Norfolk. Usually distributed over all types of soil.

Myosotis arvensis. Bedfordshire. Found on all soils.

West Country. Characteristic of chalk land.

Norfolk. Rare on chalk.

Ranunculus repens. Rare on chalk in the east, but frequent on calcareous land in the West Country.

Scandix Pecten-veneris. Bedfordshire. Practically distributed.

West Country. Characteristic of and practically confined to chalk.

Norfolk. Absent from chalk, and characteristic of clay and loam.

RELATIONS EXISTING BETWEEN THE WEEDS AND THE CROPS.

After three seasons' work in the fields it is gradually becoming possible to interpret the earlier results in the light of the current year's work. The first impression obtained was that the crop played very little part in determining the weed flora, while the nature of the soil practically settled everything. Leguminous plants proved to be an exception to this rule, presumably because they tend to smother out certain weeds owing to their peculiarly leafy habit of growth, and also because certain other weeds seem to be habitually introduced with the seeds.

In a recent study on the purity of agricultural seeds Borlase ¹ gives the following weed seeds as commonly occurring as impurities in samples of clover and other leguminous seeds :

Bromus mollis	Plantago lanceolata
Caucalis Anthriscus	Poa annua
Festuca bromoides	Prunella vulgaris
Geranium dissectum	Rumex Acetosella
„ molle	„ crispus
Lychnis alba	Sherardia arvensis

Chrysanthemum leucanthemum, *Rumex Acetosa*, and *Lychnis diurna* are also occasionally found. It appears that *Geranium dissectum* is the species of *Geranium* commonly associated with Red Clover seeds, while *Geranium molle* is found among Alsike and White Clover seeds. With regard to cereals and roots Borlase states that 'in the former there are *very* few weed seeds, as their presence would be easily detected owing to differences in size and colour, and with the latter difference of shape and colour would reveal most to the naked eye'. He also quotes two samples of weeds introduced with imported seeds which have established themselves as serious pests in parts of Cornwall. *Bromus secalinus* is a bad pest in the Winter Oat crop, but in no other, and may have been introduced from Canada, where it is common and is known as 'Cheat'. *Matricaria suaveolens* was introduced into Cornwall about fifteen years ago from North Asia or Western North America, and is now so prevalent in some places that it absolutely destroys the corn crops.

It is now evident that while the soil is the primary determining factor, still the nature of the crop plays a larger part than was originally supposed. While this influence is partly due to the different habits of the crops, it is probably more the result of the varying methods of cultivation applied to the crops. Broadly speaking, a four-course rotation is usually followed in the district studied :

- (1) Wheat.
- (2) Roots.
- (3) Barley or oats.
- (4) Seeds and leguminous crops.

With the seed crops nothing can be done to keep the land clean, so the weed flora among the ensuing wheat tends to be specially fruitful in the varieties occurring in the young corn, though if the crop is very heavy it tends to strangle many of the weeds later on, a fact that is usually attributed to the exclusion of light and air. With the root crops comes the

¹ Borlase, W. : The Study of Agricultural Seeds. Journ. Board. Agric., xix, No. 7, pp. 529-41. I am also indebted to Mr. Borlase for a private communication in which he gave me much of the information in this paragraph.

opportunity for a thorough cleaning of the land with cultivator and hoe, so many species which cannot withstand such drastic treatment tend to be conspicuous by their absence among roots. The barley and oats make a fair start on clean ground, and if the seed crop of clover, &c., is put down with the grain and makes fair growth, the weeds are very few in number and variety, as they have no chance to get a fair start in life before they are smothered out of existence. The seed crops offer quite different conditions. No cultivation is possible among such crops as clover and lucerne, so any weed seeds in the soil or introduced with the 'seeds' have the opportunity to germinate and flourish undisturbed if only they can compete successfully with the overshadowing of the crop; but many species fail utterly in doing this, and so are generally absent from seed crops, while others seem to make a speciality of growing under such conditions.

For working purposes it has proved necessary to divide up the seed crops into two classes, as the weed floras are frequently distinctive:

'Seeds'—clover, temporary pasture, grasses.

'Legumes'—peas, beans, lucerne, sainfoin, lupins.

In the 1912 season some plants were found to be absent from seed and from root crops, while a few others were nearly always associated with cereals alone or with cereals and roots.

Weeds absent or very rare in seed crops.

Agropyron repens	Polygonum Convolvulus
Agrostis stolonifera	„ Persicaria
Alopecurus myosuroides	Rumex obtusifolius
Chenopodium album	Scandix Pecten-veneris
Erysimum cheiranthoides	Silene inflata
Galium Aparine	Spergula arvensis
Gnaphalium uliginosum	Stellaria media
Legousia hybrida	Taraxacum vulgare
Poa annua	Veronica hederaefolia
Polygonum aviculare	

Weeds absent or very rare in root crops.

Aethusa Cynapium	Daucus Carota
Alchemilla arvensis	Echium vulgare
Alopecurus myosuroides	Erophila verna
Anthemis arvensis	Euphorbia exigua
Bartsia Odontites	Holcus lanatus
Bellis perennis	Lychnis Githago
Cerastium vulgatum	Lycopsis arvensis
Cichorium Intybus	Matricaria Chamomilla
Crepis virens	„ inodora

Nepeta hederacea
 Reseda lutea
 Rumex obtusifolius

Taraxacum vulgare
 Veronica arvensis

Weeds only associated with cereal crops.

Anthemis Cotula
 Galeopsis Tetrahit
 Heracleum Sphondylium
 Juncus bufonius
 Lapsana communis

Lolium perenne
 Poa trivialis
 Ranunculus arvensis
 Sagina nodosa
 Sisymbrium officinale

Weeds only associated with cereals and roots.

Brassica arvensis
 Centaurea nigra
 Chrysanthemum segetum
 Fumaria officinalis
 Lamium amplexicaule

Lamium purpureum
 Linaria minor
 Raphanus Raphanistrum
 Senebiera Coronopus
 Silene noctiflora

Weeds only associated with seeds and legumes.

Cirsium lanceolatus
 Filago germanica

Geranium dissectum

Comparison with the Bedfordshire results (1910) show that many species are consistently absent from or very rare in seed crops in both districts.

Nearly all the weeds are to be found to some extent among the cereal crops, and generally the kind of cereal makes no difference. A few plants, however, seem to exercise some selection as to which cereal crop in the rotation they associate with. Most of these species are generally or exclusively found with wheat, while yet a few more are never seen with the corn, but only with barley or oats.

Anthemis Cotula

Erophila verna

Juncus bufonius

Poa trivialis

Sagina nodosa

} always found with wheat.

Alchemilla arvensis

Alopecurus myosuroides

Cerastium vulgatum

Chrysanthemum segetum

Heracleum Sphondylium

Ranunculus arvensis

Rumex obtusifolius

Triticum repens

} usually found with wheat.

Artemisia vulgaris	}	never with wheat ; always with barley or oats.
Carduus nutans		
Linaria minor		
Raphanus Raphanistrum		
Silene gallica		

In all probability this selectivity is the result of some peculiar adaptation to the particular cultural conditions of the associated crop. This association with particular cereal crops is, however, not yet proved universally. So far as the species correspond, there is a fairly close agreement between the Bedfordshire and Norfolk results, but in the West Country some species, as *Alopecurus myosuroides*, *Heracleum Sphondylium*, *Chrysanthemum segetum*, are associated with wheat, barley, and oats instead of being chiefly found with wheat as they are in the Eastern Counties. This may prove to be due to differing local customs with regard to the growing of Spring or Winter Oats, but information on this point is not immediately available.

When the tabulated results for the three years are placed side by side and compared, it is seen that certain of the weeds are always to be found in association with all types of crop in the different districts. Other species are apparently more variable—perhaps they are rather more sensitive to differences of local conditions—and so while they may be associated with every type of crop in one place, they may be absent from one or other of the crops in another district. A few plants are much more rigid in their adherence or aversion to some particular crop. For instance, the following plants have been frequently observed in each of the three seasons, and consistently they have been found to be either absent or very rare among root crops :

Anthemis Cotula	Ranunculus acris
Bartsia Odontites	„ arvensis
Cerastium vulgatum	Taraxacum vulgare
Plantago lanceolata	

This probably indicates that these plants are particularly impatient of interference, and so they find a position among the root crops untenable on account of the repeated cultivation carried on.

Again, some other species seem to be quite unable to cope with the keen competition for light, and possibly for air, that occurs among the seed crops, as is indicated by the rarity with which the following are found in such surroundings :

Agropyron repens	Poa annua
Gnaphalium uliginosum	Veronica hederaefolia
Legousia hybrida	

This hypothesis is upheld by the behaviour of two species of *Polygonum*, *P. aviculare* and *P. Convolvulus*. These plants were exceedingly rare among seeds in Norfolk and Bedfordshire during two seasons in which plenty of rain had fallen, so that the crop had made good growth, rendering competition keen. In the West Country both these *Polygonums* were found with seeds, but this was in a very dry season in which a long period of drought immediately succeeded the sowing of the crop. As a result little growth was made, thus enabling these sensitive weeds to get their footing in an unusual habitat.

A very few plants seem to be even more exclusive in their association, the following species being found only with cereals:

Lapsana communis
Lolium perenne

Plantago media
Poa trivialis

The indications are that many of the weeds will ultimately prove to have a very decided preference for or abhorrence of some particular class of crop, but that these individual peculiarities are liable to be modified by local conditions, although some plants may prove strong enough to master the local variations, so remaining consistent in their crop association.

The question arises as to the effect of impurities in the seeds sown upon the weed flora. Broadly speaking, the effect is not well marked. Of all the impurities indicated by Borlase¹ as occurring in Leguminous seeds, *Geranium dissectum* is the only one which is confined to such crops during growth. *Poa annua*, which is introduced with the crop seed, is conspicuous by its absence in the grown crop. At present it does not seem possible to draw any conclusion with regard to this point. In the cereals so few weed seeds are sown that their effect is practically negligible.

Points of Special Interest.

1. The different orders of flowering plants vary very much in the contribution they make to the weed flora of the arable lands. Many of them provide just one or two species, but when the large orders are considered the differences in representation are very striking. Leguminosae, Rosaceae, Umbelliferae, and Chenopodiaceae are very poorly represented, both *relatively* in proportion to the size of the orders, and *actually* in the number of species occurring as weeds, Lamiaceae being very little better. Ranunculaceae, Papaveraceae, Geraniaceae, and Euphorbiaceae each provide one main genus, but in each case several members of that genus are commonly found.

¹ See p. 156.

Scrophulariaceae is very much to the fore with the genera *Veronica* and *Linaria*, both of which yield several species, the Veronicas being among the most common of weeds. Cruciferae and Caryophyllaceae are each represented by several genera with about one species from each as a rule, though the genera *Brassica* (Cruciferae) and *Lychnis* and *Silene* (Caryophyllaceae) are very rich in their contribution of species. Polygonaceae, again, is particularly well marked with several species of *Polygonum* and *Rumex*, which have the doubtful distinction of being among the commonest and worst weeds from the farmer's point of view. Graminaceae yields a fair number of species from different genera, but *the* weed order is undoubtedly Compositae so far as the number of representatives is concerned, for at least half the British genera of this large order contribute one or more of their species to the weed flora. The distribution of the Compositae, too, is very wide, both as regards the soils and crops with which they are associated.

The analyses indicate that the cultivated fields provide a definite ecological habitat, which is differently adapted to the support of the various great families of plants.

2. Different species of the same genus are often distinctive in the type of soil they characteristically inhabit, as the following well-marked instances show :

<i>Anthemis arvensis</i>	sandy soils and chalk
„ <i>Cotula</i>	loam
<i>Carduus nutans</i>	calcareous soils
„ <i>arvensis</i>	distributed
<i>Chrysanthemum Leucanthemum</i>	loam
„ <i>segetum</i>	sand
<i>Euphorbia exigua</i>	heavy loam and clay
„ <i>Helioscopia</i>	calcareous soils
„ <i>Peplus</i>	loam
<i>Geranium dissectum</i>	heavy loam and clay
„ <i>molle</i>	light and chalky soil
„ <i>pusillum</i>	„ „ „ „
<i>Linaria Elatine</i>	heavy soils
„ <i>minor</i>	sandy soils
„ <i>vulgaris</i>	calcareous soils
<i>Polygonum aviculare</i>	distributed
„ <i>Convolvulus</i>	loam and sand
„ <i>Lapathifolium</i>	sand
„ <i>Persicaria</i>	light sandy soils
<i>Ranunculus acris</i>	loam
„ <i>arvensis</i>	heavy loam and clay
„ <i>repens</i>	distributed

Rumex Acetosella	'acid' sandy soil
„ crispus	distributed
„ obtusifolius	sandy soil

These records agree in most respects with those obtained in the West Country in 1911, except in that certain plants seem rather more varied in their distribution in Norfolk.

In contradistinction to the above, the genus *Veronica* with all its different species is typically characteristic of the sandy and light soils, *V. Tournefortii* being the only one that is found to any extent on heavy land.

3. In one district, round Swaffham and Narborough, certain fields were observed to carry a flora composed of the most curious mixture of plants. Species usually associated with chalky land were found growing side by side with others characteristic of sandy soils, and even of 'acid' soils. In one case a field that used to be cultivated had been left for several years untouched, and in it were found, among other plants, *Poterium Sanguisorba*, *Anthyllis Vulneraria*, and *Reseda lutea*, all calcicolous plants, together with *Rumex Acetosella*, a decided calcifuge.

In another instance, *Reseda lutea*, *Linaria vulgaris*, *Centaurea Scabiosa*, with other less distinctive chalk plants, were found plentifully in a very sandy field in which *Scleranthus annuus* occurred and in which *Spergula arvensis* was dominant.

These sandy soils were evidently very shallow, overlying a chalk sub-soil, and the possible explanation presents itself that the differences in the root systems of the plants may account for the apparent anomaly. From a cursory examination it appears as if most of the acid species found are relatively shallow rooted, and so are able to flourish in the sandy surface layers of soil, while the chalk plants are provided with larger roots and so find it possible to strike right through the unfavourable strata and to draw on the underlying stores of chalk for their nutriment. This supposition with regard to the relative lengths of the roots needs far more confirmation before it can be accepted as proved.

4. At least four varieties of the Mayweeds occurred in the Norfolk fields. Of these, *Matricaria inodora* was the only species that was found distributed on all kinds of soils, heavy as well as light, the others being practically confined to the lighter lands. *Anthemis Cotula* was generally a denizen of loams, *Anthemis arvensis* of sandy soils and chalk, while *Matricaria Chamomilla* reserved itself for either sand or heavy loam. Once again the Mayweeds proved to be very impatient of competition, as not only were they rarely to be found in among the crops, but only at the edges and in open spaces, but also they were universally absent from root crops, where the additional factor of cultivation has to be competed with.

5. A very striking feature of the sandy soils in Norfolk is the presence

of *Lycopsis arvensis* and *Echium vulgare*, both showy plants with conspicuous blue flowers. It is impossible to give a definite opinion on the one season's records, but it seems probable that both are usually characteristic of calcareous sands as opposed to acid soils.

Common and Local Names.

For the purposes of reference an alphabetical list of the more important weeds is appended, giving the common and, where possible, the local names :

<i>Achillea Millefolium</i>	Yarrow
<i>Aethusa Cynapium</i>	Fool's Parsley
<i>Agropyron repens</i>	Couch, Twitch
<i>Agrostis stolonifera</i>	Twitch, Couch, Bent-grass
<i>Alchemilla arvensis</i>	Lady's Mantle
<i>Alopecurus myosuroides</i>	Field Foxtail, Black Bent
<i>Anagallis arvensis</i>	Scarlet Pimpernel, Poor Man's Weather Glass
<i>Anthemis arvensis</i>	Corn Chamomile, Mayweed
„ <i>Cotula</i>	Stinking Chamomile, Mayweed
<i>Anthriscus Scandix</i>	Beaked Parsley
<i>Arenaria serpyllifolia</i>	Thyme-leaved Sandwort
<i>Artemisia vulgaris</i>	Mugwort, French Tobacco
<i>Atriplex patula</i>	Common Orache
<i>Bartsia Odontites</i>	Red Bartsia
<i>Bellis perennis</i>	Daisy
<i>Brassica alba</i>	Charlock, White Mustard
„ <i>arvensis</i>	Charlock
<i>Capsella Bursa-pastoris</i>	Shepherd's Purse
<i>Carduus nutans</i>	Musk Thistle, Dog Thistle
<i>Caucalis nodosa</i>	Knotted Hedge-parsley
<i>Centaurea nigra</i>	Hardhead, Bunk, Knapweed
„ <i>Scabiosa</i>	Greater Knapweed, Bunk.
<i>Cerastium vulgatum</i>	Mouse-ear Chickweed
<i>Chenopodium album</i>	Fat Hen, Mutton Tops, Lamb's Quarters
<i>Chrysanthemum segetum</i>	Corn Marigold, Yellow Daisy.
<i>Cichorium Intybus</i>	Chicory
<i>Cirsium arvensis</i>	Creeping Thistle
<i>Convolvulus arvensis</i>	Bindweed, Wild Convolvulus
<i>Daucus Carota</i>	Carrot
<i>Echium vulgare</i>	Viper's Bugloss
<i>Equisetum arvense</i>	Horsetail, Mare's-tail, Cat's-tail
<i>Erodium cicutarium</i>	Common Stork's-bill
<i>Erysimum cheiranthoides</i>	Treacle Mustard
<i>Euphorbia exigua</i>	Dwarf Spurge

<i>Euphorbia Helioscopia</i>	Sun Spurge
„ <i>Peplus</i>	Petty Spurge, Wee Gweedie
<i>Filago germanica</i>	Upright Cudweed
<i>Fumaria officinalis</i>	Fumitory
<i>Galeopsis Tetrahit</i>	Hemp-nettle
<i>Galium Aparine</i>	Cleavers, Goosegrass, Robin-run-the-hedge, Clider
<i>Geranium dissectum</i>	Cut-leaved Crane's-bill
„ <i>molle</i>	Dove's-foot „ „
„ <i>pusillum</i>	Small „ „
<i>Gnaphalium uliginosum</i>	Marsh Cudweed
<i>Heracleum Sphondylium</i>	Hogweed, Haletrot, Rabbit-food
<i>Holcus lanatus</i>	Yorkshire Fog
<i>Juncus bufonius</i>	Toadrush
<i>Lamium amplexicaule</i>	Hen-bit
„ <i>purpureum</i>	Red Dead-nettle
<i>Lapsana communis</i>	Nipplewort
<i>Legousia hybrida</i>	Corn Campanula, Venus's Looking-glass
<i>Linaria Elatine</i>	Pointed Fluellen
„ <i>minor</i>	Small Toadflax
„ <i>vulgaris</i>	Yellow Toadflax
<i>Lolium perenne</i>	Rye-grass
<i>Lychnis alba</i>	White Campion, Cockle
„ <i>Githago</i>	Corn Cockle
<i>Lycopsis arvensis</i>	Field Alkanet
<i>Malva sylvestris</i>	Mallow, Pig-cheese
<i>Matricaria Chamomilla</i>	Wild Chamomile, Mayweed
„ <i>inodora</i>	Scentless Mayweed
<i>Mentha arvensis</i>	Field Mint
<i>Myosotis scorpioides</i>	Field Scorpion-grass, Forget-me-not
<i>Nepeta hederacea</i>	Ground Ivy
<i>Papaver Argemone</i>	Rough-headed Poppy, Pale Poppy
„ <i>Rhoeas</i>	Red Poppy, Redweed
<i>Plantago lanceolata</i>	Ribwort Plantain, Rib-grass
„ <i>major</i>	Great „
<i>Poa annua</i>	Annual Meadow-grass
„ <i>trivialis</i>	Rough „ „
<i>Polygonum aviculare</i>	Crab-grass, Stoneweed, Pigweed, Iron-grass, Iron- weed, Wire-grass, Wireweed, Knotgrass
„ <i>Convolvulus</i>	Black Bindweed
„ <i>Persicaria</i>	Spotted Persicaria
<i>Potentilla Anserina</i>	Silverweed
<i>Ranunculus acris</i>	Buttercup, Ram's-glass

Ranunculus arvensis	Corn Crowfoot, Bur Buttercup
„ repens	Creeping Buttercup
Raphanus Raphanistrum	Radish, Charlock, Charlick
Reseda lutea	Wild Mignonette
Rumex Acetosella	Sheep Sorrel
„ crispus	Common or Curled Dock
„ obtusifolius	Broad-leaved Dock
Satureia Acinos	Calamint
Scabiosa arvensis	Field Scabious, Corn Flower
Scandix Pecten-veneris	Shepherd's Needle, Venus's Comb
Scleranthus annuus	Knawel
Senebiera Coronopus	Swine-cress
Senecio Jacobaea	Ragwort, Cankerweed
„ vulgaris	Groundsel
Sherardia arvensis	Field Madder
Silene anglica	English Catchfly
„ inflata	Bladder Campion
„ noctiflora	Night-flowering Catchfly
Sisymbrium Thalianum	Thale-cress
Sonchus arvensis	Sow Thistle, Milk Thistle
Spargula arvensis	Spurrey, Sand-grass, Makebeg
Stellaria media	Chickweed
Taraxacum vulgare	Dandelion
Tussilago Farfara	Coltsfoot, Floatweed
Urtica dioica	Stinging Nettle
Veronica agrestis	Field Speedwell
„ arvensis	Wall „
„ hederifolia	Ivy-leaved Speedwell
„ Tournefortii	Buxbaum's Speedwell, Cuckoo's Leader
Viola tricolor	Wild Pansy, Kiss-me-over-the-garden-gate, Love-in-idleness.

SUMMARY.

1. The close association existing between the weeds of arable land and the soils on which they grow holds good for 'drift' soils as well as for those derived from the underlying rocks. As before, the texture of the soil was more important than its derivation in determining the weed flora.

2. It was again found that this association may be either—

(a) *General*. When a weed is always associated with one type of soil in every district.

(b) *Local*. When a weed associated with a soil in one district is absent from or rare on similar land in other places.

3. On the whole the Norfolk and Bedfordshire weed floras compare more closely with one another than with that of the West Country, a fact attributed partly to geographical proximity and partly to closer approximation in the nature of the soil in the Eastern Counties.

4. A closer relationship evidently exists between the weeds and the crop than has hitherto been recognized. This is probably largely due to the particular conditions of cultivation of the various crops and to their place in the rotations practised.

5. It is possible that a very few species will prove to have a preference for growing with wheat, while yet a few others are very rare with that crop. This suggestion, however, is very tentative as yet.

6. The different orders of flowering plants contribute to the weed flora in varying proportions, some of the larger orders being represented by very few species, while others are most generous in the contribution they make.

7. When several members of a genus occur as weeds, it frequently happens that each is a denizen of one particular type of soil characteristic to itself.

8. In one district a curious mingling of 'acid' and 'chalk' plants was found, possibly owing to the superposition of a thin layer of a non-calcareous sand on a chalk subsoil, the difference in the root systems of the plants enabling each to tap the particular soil most suited to its needs.

In conclusion, I wish to express my indebtedness to Professor T. B. Wood and to Sir Eustace Gurney for the many introductions which alone made the work possible in Norfolk, and also to Mr. W. A. Nicholson, who identified many of the doubtful specimens which came to hand. It is not possible to acknowledge by name all those who have aided me by hospitality and advice during the progress of the research, but to all such I desire to tender my grateful thanks.

October 25, 1912.

Brenchley, Winifred E. 1913. "The weeds of arable land. III." *Annals of botany* 27, 141–166. <https://doi.org/10.1093/oxfordjournals.aob.a089447>.

View This Item Online: <https://www.biodiversitylibrary.org/item/237410>

DOI: <https://doi.org/10.1093/oxfordjournals.aob.a089447>

Permalink: <https://www.biodiversitylibrary.org/partpdf/319963>

Holding Institution

Smithsonian Libraries

Sponsored by

Biodiversity Heritage Library

Copyright & Reuse

Copyright Status: Not in copyright. The BHL knows of no copyright restrictions on this item.

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>.