

COMMON WEEDS OF
THE FARM & GARDEN

HAROLD C. LONG

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COMMON WEEDS OF THE
FARM AND GARDEN

COMMON WEEDS OF THE FARM & GARDEN

BY

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OF THE BOARD OF AGRICULTURE AND FISHERIES

IN COLLABORATION WITH

JOHN PERCIVAL, M.A., F.L.S.

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AS A SMALL TOKEN
OF AFFECTION AND ESTEEM
I DEDICATE
THIS VOLUME TO
MY MOTHER AND FATHER

206456

*That which ye sow ye reap. See yonder fields !
The sesamum was sesamum, the corn
Was corn. The Silence and the Darkness knew !
So is a man's fate born.*

*He cometh, reaper of the things he sowed,
Sesamum, corn, so much cast in past birth ;
And so much weed and poison-stuff, which mar
Him and the aching earth.*

*If he shall labour rightly, rooting these,
And planting wholesome seedlings where they grew,
Fruitful and fair and clean the ground shall be,
And rich the harvest due.*

Sir EDWIN ARNOLD, *The Light of Asia.*

INTRODUCTION

AGRICULTURE has been defined by the Bishop of Newcastle as "A controversy with weeds." The growth of weeds certainly constitutes one of the chief troubles of the tiller of the soil, for weeds are too often luxuriant where a good cultivated crop is awaited. The average farmer is quite familiar with the ordinary tillage operations which conduce to clean farming, and the gardener is able by intense cultivation to keep down weeds, but there are many methods which may be successfully employed in combating a given species which are not generally known. The agricultural Press testifies almost daily to the fact that information on the best means of eradicating weeds is badly needed by all concerned in the growth of crops, and I have long been convinced that the subject was deserving of special treatment. Careful thought quickly crystallised into the idea that a volume dealing with weeds and their destruction, and summarising under one cover the information scattered in many volumes published in this and other countries, would be of practical value. I hope, therefore, that the following pages will supply a real need, and prove useful to all engaged in the various branches of agriculture.

It would be a great pleasure to me should the critic complain that the use of the word "Common" in the title of this volume is misplaced, as one of the

artists, who experienced some difficulty in obtaining certain species for illustration, humorously suggested! The term, however, appears to fit the text. In the third week of August of the past year, when examining a field of standing wheat, I spent about ten minutes collecting such weeds as were most easily found within an area of perhaps little more than 100 square yards. In this small plot were quickly gathered the following twenty-nine species, eighteen of which were already illustrated for the pages of this book:—

* <i>Convolvulus arvensis</i>	<i>Senecio vulgaris</i>
* <i>Polygonum Convolvulus</i>	* <i>Galium Aparine</i>
* <i>Polygonum Aviculare</i>	<i>Vicia sativa</i>
* <i>Rumex</i> sp.	* <i>Matricaria inodora</i>
* <i>Tussilago Farfara</i>	<i>Plantago major</i>
* <i>Mentha arvensis</i>	<i>Lychnis alba</i>
* <i>Sinapis arvensis</i>	* <i>Euphorbia exigua</i>
* <i>Sonchus arvensis</i>	* <i>Alopecurus agrestis</i>
* <i>Stellaria media</i>	* <i>Agrostis</i> sp.
<i>Papaver</i> sp.	<i>Triticum repens</i>
* <i>Ranunculus arvensis</i>	<i>Poa annua</i>
* <i>Viola</i> sp.	* <i>Veronica</i> sp.
<i>Potentilla Anserina</i>	<i>Myosotis</i> sp.
<i>Æthusa Cynapium</i>	<i>Alchemilla arvensis</i>
<i>Scandix Pecten-Veneris</i>	

Most of these species are troublesome weeds, and it may be added that those marked with an asterisk were abundant.

In a wheat field in which the crop was already cut were found thirteen species of weeds, several being serious pests; and in a field of peas was an almost overwhelming quantity of Field Bindweed (*Convolvulus arvensis*), Black Bindweed (*Polygonum Convolvulus*), and Perennial Sow Thistle (*Sonchus arvensis*), besides many other weeds.

These notes will serve to show that, unless these

cases were purely the result of bad farming, weeds are still far more plentiful than they ought to be.

An important point should be emphasised. Although, for example, the Creeping Thistle may be almost or quite eradicated on a given farm by the methods mentioned at pp. 86 and 180, yet its growth in the future is unfortunately not prevented, for fresh seed may blow in from beyond the boundary hedge. For farms to be kept free from many—I had almost written *all*—weeds, *farmers must work together*. There is every reason why farmers should combine to exterminate weeds by tillage and other operations, including the cutting of weeds on waste land and roadsides, and also to ensure purity in the supply of farm seeds. This matter might well be taken up in their own neighbourhood by the members of chambers of agriculture, farmers' clubs, and agricultural societies.

In the preparation of this volume the fullest advantage has been taken of the information contained in a large number of other works, and an endeavour has been made to give due acknowledgment in every case. In describing the various plants, Hooker's *Student's Flora of the British Islands* and Johns' *Flowers of the Field* have been especially utilised. The Bibliography at p. 372 will indicate the extent of the literature consulted.

I desire to make the fullest acknowledgment of the assistance of Professor Percival, who not only read the major portion of the manuscript, but the whole book in proof, making many useful suggestions for its improvement. In addition, Professor Percival has written the notes at pp. 43–48 on the destruction of weeds by chemical means; those at pp. 368–371 on the weed seeds found in commercial samples of clover and grass seeds, and on purity and germinating capacity; those

at pp. 271-275 on the semi-parasites *Euphrasia*, *Melampyrum*, *Pedicularis*, *Bartsia*, *Lathræa*, and *Viscum*; and Chapter IX. on Weeds in Ponds and Water Courses. To all those who so kindly responded to the inquiry, the results of which are summarised in Chapter VI., and who made many helpful suggestions, I tender my warmest thanks, as also to many others, both at home and abroad, who may not be mentioned personally. In connection with the preparation of Appendix IV., dealing with legislation enforcing the destruction of weeds in various countries, I must express much gratitude for the kind help received from the Agents-General for the Colonies, and from foreign departments of agriculture, as well as for information received through the Colonial Office and Foreign Office by the Board of Agriculture and Fisheries and kindly placed at my disposal. I am much indebted to the artists who have contributed such excellent work for the improvement of this volume, especially to my wife (sketches initialled A. S. L.), to Miss B. Reid, Miss M. Smith, and Mr. J. C. Varty-Smith, all of whom have taken considerable pains to ensure good illustrations. The blocks illustrating "Java" beans have been kindly lent by the editor of *The Field*. For help in reading the proofs, and in preparing the notes on legislation and the index, I am indebted to my colleague Mr. J. L. Bryan.

I shall be most happy to receive criticisms and suggestions for the improvement of any part of this volume; and as there are sure to be omissions, I shall look out with a lively interest for the aid which readers will be in a position to give.

If this volume helps in but a small degree to eliminate some of our weeds, the labour of preparing it will not have been in vain. I hope the critics will

be kind, for they should be aware that it is easier to review or revise a book than to write it; and I trust that, in the words of my father, those who read the book "will find something interesting if not instructive, or instructive if it be not interesting." If any would suggest that the ground must bring forth thorns and thistles, he may be reminded of the promise under a later dispensation, "Instead of the thorn shall come up the fir tree, and instead of the brier shall come up the myrtle tree."

HAROLD C. LONG.

January 1910.

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COMMON WEEDS OF THE FARM AND GARDEN

CHAPTER I

WHAT WEEDS ARE, AND HOW THEY AFFECT OUR CROPS AND STOCK

"Everything that grows without being sown or planted, among a Crop that has been sown or planted, is in that Place a Weed. The whole Benefit of the Tillage was intended for the Crop, and this robs it of a Part."

—THOMAS HALE, *The Compleat Body of Husbandry*, 1756.

IT is frequently stated that "a weed is a plant out of place," meaning that it is a plant growing in such a position and under such conditions that it is interfering in some way with a cultivated crop, rendering a lawn or a gravel drive unsightly, or in some other way making itself objectionable. For our present purpose we may consider that a weed is any plant, of whatever nature, which is found growing where the agriculturist or horticulturist has not placed it and does not desire it to grow. Thus, from this point of view, just as the common poppy is a weed in the wheat field, so would wheat equally be a weed if growing amongst the gardener's Shirley poppies; and just as thistles are weeds among the potato crop, so are potatoes "out of place" and properly classed as weeds when self-sown and found flourishing in a bed of carrots. Potatoes, oats, or turnips may alike be weeds if they interfere in any way with man's cultivated crops. At the time of

writing, indeed, some self-sown oats are flourishing in full ear in the writer's garden, but on account of their beauty are left among the flowers in a small group.

1. *Uses of Weeds*

Weeds are in general regarded as harmful, and in future chapters will be so considered. It will be well, however, to point out certain ways in which weeds may be said to be useful.

(a) Weeds may sometimes be the means of retaining nitrates in the soil, especially in cases where the soil is left without a crop for a time, as in bare fallowing. Without the intervention of weeds nitrates may be washed out. It is probable that other plant foods are also similarly retained by weeds, and after these are ploughed under the valuable constituents in them are utilised by the next cultivated crop. As we shall see later, weeds take up considerable amounts of the essential plant foods. The growth of a green crop, however, will have the same effect, and is doubtless more useful than weeds, for, unless great care is exercised, many of the latter will seed before being ploughed under and ultimately cause trouble; nothing is more true than the adage, "One year's seeding is seven years' weeding."

(b) Another way in which weeds are useful—annual ones, perhaps, especially—is that they act in the same way as green manure when ploughed under, and even such weeds hoed up and left to die on the surface sooner or later become mixed with the soil and improve it in various ways. During their active growth they take up carbonic acid gas from the atmosphere, utilise the carbon, and return the oxygen—both acts in themselves useful in purifying the air—and, on

decaying, increase the amount of humus in the soil. The addition of humus to the soil benefits both heavy soils and those of a light or sandy character, rendering the former more open and porous, and the latter more compact and retentive of moisture.

(c) Perhaps the most useful part played by weeds, however, lies in the fact that by their mere presence they indirectly promote good tillage, without which first-class agricultural crops cannot be raised. No sooner are the root and many other crops through the surface than the hoe of a good farmer or gardener is put to work to keep down the weeds, and this act of tillage, quite apart from the destruction of weeds, is one of the chief means which conduce to good crops, since it leads to the production of a fine tilth and minimises the evaporation of moisture by capillary action. In field cultivation hand hoeing is very materially assisted by the horse hoe; in ordinary gardening the hand hoe alone must be kept hard at it early and late. It has been well said by a recent writer that "many a casual gardener owes what success he has largely to the accidents of weeds. They demand the use of the hoe; and the more soils and plants are studied, the more manifest does it become that a friable, carious, well-worked surface is the prime secret of cultivation, even in the case of many things that grow deep."¹

(d) In connection with the uses of weeds, their manurial value should not be lost sight of in another direction. If gathered into heaps and mixed with soil and a little lime they make a valuable compost. Placed at the bottom of a good-sized trench; with garden refuse, such as cabbage leaves and pea haulm, and then covered in, weeds help to form a first-rate bed on which marrows and other crops may be

¹ *The Times*, May 25, 1907.

grown. It is generally accepted as sound advice that all such weeds as Couch, Creeping Thistle, and Bindweed should be burnt, but the following note from *The Times* (May 25, 1907) shows that the advice is not universally adopted:—"A suggestive example of the difference of attitude towards weeds is to be seen in the parts of the country where small cultivators flourish. Some years ago in a Bedfordshire parish the farmers had been busy at their normal task of clearing their fields of that most pestilential weed known as Twitch, and they had stacked the harvest by the side of the road before carrying it off to the bonfire. But they were anticipated. The small cultivators seized on the heaps in triumph, buried them deep in their plots, and are now growing the best of true gardener's stuff from the bed of this excellent fertiliser." Practical experience of the same weed has convinced the author that there need be no hesitation in following this plan, but trenching must be well done.

(e) It may be recalled here that all our cultivated crops have been derived from wild plants, and it is not unlikely that certain "weeds" of to-day may become valuable cultivated plants in the future, though they would still be weeds if found growing in the wrong place. For example, mangolds and beet have been derived from the *Beta maritima* L., a wild plant of the sea-shore; and our cauliflowers, broccoli, and Brussels sprouts are derivatives of the wild *Brassica oleracea* L., certain organs of which have been exaggerated by cultivation and selection.

Certain plants sometimes spoken of as "weeds" are useful in various ways. For example, rushes and sedges, frequently troublesome in damp, low-lying land, are often used for the manufacture of baskets and mats; Chicory (*Cichorium Intybus*), occasionally classed as a

weed, is extensively cultivated for its roots, which are dried and ground for use as a partial substitute for coffee, and its foliage is sometimes fed off with sheep; Spurrey is one of our worst weeds in certain districts, but a form of it is widely grown as a fodder crop in Belgium and elsewhere; the Dandelion, a very troublesome weed, is gathered for the purpose of making "dandelion tea" and "dandelion wine," and is frequently cultivated for use in salads; Watercress, a weed of shallow streams, is also an important salad throughout the country; even Couch, that pest of arable land, is not without its use, for its white underground stems are gathered in some places and cooked for food, chiefly, we believe, in Italy; while Groundsel, than which no commoner garden weed exists, is an excellent green food for cage birds.

Deadly Nightshade, Foxglove, Poppy, Meadow Saffron, Aconite, all poisonous plants, contain certain substances which are greatly used in medical practice.

Finally, it should never be forgotten by those who love a garden that many so-called weeds are in themselves elegant and delightful to the eye, even if undesirable among the crops with which they grow, and are sufficiently beautiful to lend grace to the most charming of gardens, while many of the cultivated flowering plants are derivatives of varieties of wild forms which in their native land are counted as "weeds." Various coloured Cornflowers are forms of the Corn Blue-bottle (*Centaurea Cyanus*); Shirley Poppies were derived from the wild red Poppy, and may themselves easily become weeds; Meadow Saffron is also grown in gardens for its beauty, while it is a very poisonous weed of grass land; many other similar examples might be mentioned.

No weed is more attractive in its simplicity and colour

than the little Scarlet Pimpernel or Poor-Man's Weather-glass (*Anagallis arvensis*); and among other weeds possessing a beauty of their own may be noted the small and great Bindweeds (*Convolvulus arvensis* and *C. sepium*), Ragwort (*Senecio Jacobæa*), and Corn Marigold (*Chrysanthemum segetum*).

2. Harm done by Weeds

Although, as we have seen, weeds have their uses, it is generally agreed that they are a nuisance, and, while they are undoubted incentives to good cultivation, without which the best crops cannot be grown, all good farmers and gardeners are equally bent on their eradication. Before considering the principles involved in their destruction, it will be well to get a clear understanding as to the way in which they are harmful to the farmer or gardener. If we give a little thought to the matter, it will soon become evident that cultivated crops are harmed and profit is reduced by weeds in a variety of ways.

(a) *Weeds take up Space which should be occupied by the Crop.*—Both the farmer and the gardener are aware that their crops require plenty of space to enable each individual plant to grow, and this is quite plain when we observe the space allowed for a turnip, a mangold, an onion, or a potato root. The principle of space is involved in the idea of "singling" root and other crops and flowers. Two plants cannot advantageously grow on the spot of ground intended for one, and if a Charlock plant and a wheat plant grow together with their roots in the same cubic foot of soil, it is certain that the Charlock will exert an adverse influence on the wheat, and prevent it from yielding its full crop. A Plantain growing on a lawn covers quite a large area with its

broad flat leaves, under which grass does not grow, the removal of the weed leaving a bare patch. Under ideal conditions the whole of the cultivated area should be *occupied*, even if not *covered*, by the planted crop.

(b) *Weeds rob cultivated Crops of (1) Food; (2) Light, Air, and Heat; (3) Moisture.* When we see a cornfield crowded with weeds we may be quite sure that these not only take up much space, but that they also rob the cultivated crop of food, light, and moisture.

(1) A large crop of weeds not only takes up much carbonic acid gas from the atmosphere, but needs a considerable quantity of mineral food, which can only be obtained from the soil and from the manures applied for the sown crop. That weeds absorb soluble ingredients from the soil in considerable quantity is clearly shown by analysis. Some analyses made at Königsberg, and lately reported by Professor Stutzer and L. Seidler,¹ show that the amounts of nitrogen, phosphoric acid, potash, and lime which are removed are deserving of serious consideration. A number of weeds without their roots were collected from oat fields, the soil of which was fairly heavy and poor in humus. In the case of the Wild Radish or White Charlock the plants had already formed many seed-pods, but the other weeds were in full bloom. The table on page 8 shows the percentage of ingredients in the dry matter. These figures indicate in a general way the amount of the chief plant foods required by weeds. The nitrogen in the *Persicaria* nearly equalled 20 per cent, and that in the Sow Thistle nearly 15 per cent of albuminoids in the dry matter. Phosphoric acid was chiefly taken up by Spurrey and *Persicaria*; potash by the Sow Thistle and Spurrey; and lime by *Persicaria*, Yarrow, and Cornflower.

¹ Fühling's *Landwirtschaftliche Zeitung*, June 15, 1908, p. 429.

PERCENTAGE CONTENTS OF DRY MATTER

	Nitro- gen.	Phos- phoric Acid.	Potash.	Lime.	So- dium.	Crude Ash.
Sow Thistle (<i>Sonchus oleraceus</i>)	2.39	0.88	4.77	1.94	2.16	14.95
Cornflower (<i>Centaurea Cyanus</i>)	2.30	0.78	1.94	3.13	1.07	8.12
Spurrey (<i>Spergula arvensis</i>)	2.36	1.08	4.21	1.52	1.91	10.12
Wild Radish (<i>Raphanus Raphanistrum</i>)	1.85	0.78	1.30	1.81	0.71	5.22
Persicaria or Redshank (<i>Polygonum Persicaria</i>)	3.12	1.16	3.12	4.93	2.53	10.58
Yarrow (<i>Achillea Millefolium</i>)	2.30	0.93	3.15	3.84	1.17	9.61
Average of six weeds	2.38	0.93	3.08	2.86	1.59	9.76

Weeds, therefore, take food material which would have been equally available for the cultivated crop, but which is thus lost to the farmer, at least for the time being. Although the weeds may in some way be utilised, or the food they have taken be in part returned to the soil, it would be of greater benefit to the farmer if the food removed by the weeds were immediately utilised in building up larger and better grain, root, or fodder crops.

(2) For the most successful growth of any ordinary crop an unrestricted amount of light is requisite, green crops being unable to develop the green colouring matter, or chlorophyll, necessary for their nutrition, except in the presence of sunlight. This may be clearly seen when a patch of grass is covered with a board or a sack, the grass which grows beneath being of a sickly yellowish-white colour. Further, even if the green colour is developed, light is necessary in order that the process

of food-making from the simple substances which the plant takes in may go on. Some crops can tolerate the absence of a free supply of light better than others, but as a general rule the more light the better. A large crop of weeds tends to restrict the light supply, and has therefore a bad effect on the cultivated crop. The supply of heat to the soil and crop is also restricted, and the free circulation of air is prevented. Ripening corn crops especially suffer in this way from a profusion of weeds, both as standing crops and when stooked to dry. Wollny found that an unweeded soil was colder to a depth of 4 inches than a soil kept free from weeds.

(3) Weeds also absorb from the soil and "transpire," or pass off into the atmosphere, large quantities of moisture which would be of great service to the growing crop. For example, a maize plant has been observed to transpire in the 16 weeks between May 22nd and September 4th as much as 36 times its own weight.¹ A large oak tree is also stated to transpire 10 to 20 gallons of water in a day; while barley, beans, and clover were found to transpire, during five months of their growth, over 200 times their dry weight of water. Experiments conducted at the Agricultural Experiment Station of Cornell University showed that during the growth of a 60-bushel crop of maize the plants pumped from the soil, and transpired into the air through the leaves, upwards of 900 tons of water. A 25-bushel crop of wheat similarly disposed of 500 tons of water. Weeds also transpire, and if the ground be covered with weeds it is certain that much of the moisture which would be of value to the crop will be lost in the manner indicated. Weeds are especially harmful in this way in a hot summer, and the loss is most felt by the cultivated crop on light sandy soils.

¹ Fream, *Elements of Agriculture*, p. 108.

(c) *Weeds hinder proper and thorough Cultivation.*—When a cultivated crop is infested with a multitude of weeds, proper and thorough cultivation is largely hindered. “Singling” of root crops, earthing up of potatoes, even ploughing, cultivating, and harrowing, are all rendered more difficult and costly by their presence.

(d) *Weeds harbour injurious Insects and Fungi.*—The harm frequently done by weeds in sheltering insect and fungoid pests is considerable. Besides merely acting as hiding-places for insects, they may be intermediate host plants for both insects and fungi. As examples of these harmful weeds may be mentioned Charlock (*Sinapis arvensis*), Shepherd’s Purse (*Capsella Bursa-Pastoris*), and Garlic Mustard or Jack-by-the-Hedge (*Sisymbrium Alliaria*), and other Cruciferæ, which shelter Flea Beetles (*Haltica* spp.), these, in due time, attacking turnips and causing the infestation known as “fly.” Cruciferous plants also support the larvæ of the Diamond-back Moth (*Plutella maculipennis*). The Bean Aphis (*Aphis rumicis*) is similarly found on Docks and Goosefoot, and the Stem Eelworm (*Tylenchus devastatrix*) is largely supported and spread by many weeds, as also are other species of Eelworms. The well-known fungus Ergot of rye (*Claviceps purpurea*) occurs on hedgerow and other grasses, and may thence pass to rye and other cereals; the Rust of wheat (*Puccinia graminis*) passes one stage of its life on the Barberry; Finger-and-toe of turnips (*Plasmodiophora brassicæ*) finds a host in Charlock and other Cruciferous weeds; while White Root-rot (*Rosellinia necatrix*) attacks a number of weeds. Many other insects and fungi are similarly sheltered by weeds, not only in the open, but in corners of fields and gardens, in hedgerows and ditches, and round buildings.

It may be useful to give a list of a few of the more

common insect and fungoid pests which are spread by means of weeds acting as host plants:—

WEED "HOST."	INSECT.
Charlock (<i>Sinapis arvensis</i>) and similar Crucifers	{ Turnip Flea Beetle or "Fly" (<i>Phyllotreta (Haltica) nemorum</i>). Cabbage and Turnip Gall Weevil (<i>Ceutorhynchus sulcicollis</i>).
Goosefoot (<i>Chenopodium album</i>) Thistles (<i>Cnicus</i> spp.) Sow Thistle (<i>Sonchus</i>) Dandelion (<i>Taraxacum</i>) and apparently Docks (<i>Rumex</i>)	{ Mangold Fly (<i>Pegomyia betæ</i>).
Charlock and other Crucifers Prickly Saltwort (<i>Salsola Kali</i>)	{ Diamond-back Moth (<i>Plutella maculipennis</i>).
Thistles, and the Cotton Thistle (<i>Onopordon Acanthium</i>)	{ Celery Fly (<i>Acidia heraclei</i>).
Hops, Yorkshire Fog, <i>Poa annua</i> , Daisy, Shepherd's Purse, Spurrey, Buttercup, Cornflower, Sow Thistle, Black Bindweed (<i>Polygonum Convolvulus</i>), and Plantain	{ Stem Eelworm (<i>Tylenchus devastatrix</i>) (not an insect).
Nightshades, Henbane, Hedge Mustard, Thistles, Goosefoot, and many other plants	{ Colorado Beetle (<i>Doryphora decemlineata</i>).
Shepherd's Purse, Winter Cress, Hedge Mustard	{ Cabbage Root Fly (<i>Phorbia brassicæ</i>).
Various Grasses	Frit Fly (<i>Oscinis frit</i>).
Docks, Goosefoot, and some other weeds	{ Bean Aphis (<i>Aphis rumicis</i>).
Docks, Thistles, Burdock	{ Ghost or Otter Moth (<i>Hepialus lupuli</i>).

WEED "HOST."

FUNGUS.

Charlock and other Crucifers	{ Finger-and-toe of turnips (<i>Plasmodiophora brassicæ</i> Wor.).
” ” ” . . . . .	. <i>Peronospora parasitica</i> De Bary.

COMMON WEEDS

WEED "HOST."	FUNGUS.
Many Species	{ White Root-rot (<i>Rosellinia necatrix</i> Prill.).
" "	{ Sclerotium Disease (<i>Sclerotinia sclerotiorum</i> Mass.).
Wild Barley (<i>Hordeum murinum</i>)	{ Blindness in Barley and Oats (<i>Helminthosporium gramineum</i> Erikss.).
Shepherd's Purse and other Crucifers	{ White Rust of Cabbages (<i>Cystopus candidus</i> Lév.).
Many Species	{ Violet Root-rot (<i>Rhizoctonia violacea</i> Tul.).
<i>Agrostis canina</i> L., and other grasses	{ Reed-mace Fungus (<i>Epichloe typhina</i> Tul.).
Barberry	{ Rust of wheat (<i>Puccinia graminis</i> Pers.).
Sedges (<i>Carex</i>)	{ Gooseberry-leaf Cluster-cups (<i>Puccinia pringsheimiana</i> Kleb.).
Goosefoot	{ <i>Peronospora effusa</i> Rab., on spinach.
Docks, Sorrel, and many others	{ <i>Rosellinia radiciperda</i> Mass. A White Root-rot in New Zealand.
Hawkweed (<i>Hieracium</i>)	{ Chrysanthemum Rust (<i>Puccinia hieracii</i> Mart.).
Groundsel, Ragwort, and other species of <i>Senecio</i>	{ Pine Cluster-cups (<i>Peridermium pini</i> Wallr.).
Many wild Grasses	{ Ergot of rye (<i>Claviceps purpurea</i> Tul.).

These few data will make it quite clear that weeds may frequently be of great importance in connection with insect and fungus infestations.

(e) *Weeds may be Parasitic on certain Crops.*—Some weeds are actually parasites living on the crop under cultivation, feeding on the juices elaborated by the crop

for its own uses. (Such weeds as these may do great damage, even killing extensive areas of the crop on which the farmer may be largely depending. The two most serious agricultural parasitic weeds are Dodder and Broom-rape, both of which attack red clover (*Trifolium pratense*). Other weeds, as Yellow Rattle (*Rhinanthus Crista-galli*), Lousewort (*Pedicularis*), Eye-bright (*Euphrasia officinalis*), and a few others, are semi-parasitic on the roots of grasses. (See Chap. VII.)

(f) *Some Weeds are Poisonous*, either to man or to farm live stock, and, as such, are to be destroyed. Numerous plants have from time to time been recorded as poisonous, and have frequently proved fatal. (See Chap. VIII.)

In other cases, although not directly harmful to stock, weeds may taint the milk, and consequently the butter made from it, of cows which have fed upon them, thus lowering the market value of the produce or rendering it distasteful for home consumption. Such weeds as Garlic (*Allium* sp.), Garlic Mustard (*Alliaria officinalis*), Ivy (*Hedera*), *Ranunculus acris*, Chamomile (*Anthemis*), and others, are harmful in this way to the dairy farmer.

(g) *Climbing and Binding Weeds drag down the Cultivated Crop and prevent proper Growth*.—This may be well seen in the case of the Bindweeds (*Convolvulus arvensis*, *C. sepium*, and *Polygonum Convolvulus*), which twine themselves round bush fruit-trees, cereals, and many garden crops. When they once gain a footing they are difficult to eradicate, and may do much damage. Wild Vetches, Cleavers, &c., may by sheer weight break down corn crops. Traveller's Joy (*Clematis Vitalba*), Bryony (*Bryonia dioica*), and Honeysuckle (*Lonicera Periclymenum*) are climbing hedge weeds.

(h) *The Commercial Value of Agricultural Seeds is much*

Reduced by the Presence of Weed Seeds.—The importance of sowing clean seeds is fairly generally recognised, and farmers, as a rule, prefer a high-class to a low-class sample. At the same time it is to be feared that sufficient care is not always exercised in the selection of agricultural seeds. The reliable seed merchant is certain only to offer a low price for samples of grain, clover, grass, and other seeds badly infested with weed seeds, for considerable trouble and expense is involved in cleaning them. The seeds of *Melampyrum arvense* darken wheat flour, and are stated to render the latter dangerous to health. For milling purposes wheat is much reduced in price if it contains much seed of Corn Cockle, Black Bindweed, or wild or cultivated Tares; and clover samples containing Dodder and other weed seeds are seriously depreciated in value. The Fourteenth Annual Report of the Agricultural Experiment Station of the University of Minnesota (1905-6) quotes two cases in which wheat samples were respectively docked 16 lb. and 23 lb. per bushel on account of weed seeds, chiefly Wild Oats. This is perhaps an extreme example, but it illustrates the serious nature of weed infestation in certain cases. Agricultural seeds suffer if weed seeds are present, not only because the seed merchant must expend time and money in cleaning them, but if this be not done thoroughly the farmer is faced with the introduction of new and harmful weeds on his farm. (See also Chap. XI.)

(i) *Stoppage of Drains.*—It must be remembered, too, that the growth of roots and underground stems is sometimes responsible for the stoppage of drains, and may, therefore, cause considerable expenditure in correcting this trouble.

(j) *General.*—From what we have seen, it will be gathered that weeds are a source of great loss owing to

the harm done to cultivated crops. A point to which attention has not yet been directed is that of harvesting weeds with corn, hay, and other crops. In such a case, where weeds are very abundant, reaping or mowing the crop is much more difficult and prolonged, while drying or curing is also rendered troublesome. Much opportunity is thus offered for the spoiling of both grain and straw by long exposure to the weather, to say nothing of loss due to birds and animals. Where many thistles abound hand tying of sheaves is extremely difficult, while pitching, loading, stacking, and thrashing are all rendered more troublesome and costly.

Money Losses due to Weeds.—That great losses are due to the infestation of crops by weeds requires no proof, yet the exact amount of financial loss due to their presence among crops has rarely been ascertained. In those few instances where careful observations have been made, the extent of the pecuniary loss has been proved to be greater than the farmer would anticipate. Percival, in writing of some field observations, says:¹ "In many cases the moderately-weeded areas carried from 40 to 50 per cent more crop than those on which the weeds were unchecked." Again, according to Maier-Bode,² Wollny has placed the annual loss of crops due to weeds in Bavaria at an average of 30 per cent. Investigations conducted in Norway by E. Korsmo³ show that the effect of weeds on the yield and money value of crops is very serious. Hay, barley, and potatoes were each grown on duplicate plots of the same size, one being clean and the other weed-infested. The crops were carefully weighed and the yields calculated per hectare. The results may be given thus in English

¹ *Jour. Bd. Agric.*, March, 1904.

² Fr. Maier-Bode, *Die Bekämpfung der Acker-Unkräuter.*

³ *Tidsskr. Norske Landbr.* 10 (1903), Nos. 6, pp. 247-280; 7, pp. 295-330. (Review by F. W. Woll in *U.S. Expt. Sta. Record*, 1903-4, p. 683.)

figures (taking 2.2 lb. = 1 kilogram, and 2.48 acres = 1 hectare) :—

Crop.	Yield per Acre.		Percentage Loss in Money Value on Weedy Plot compared with Clean Plot.
	Clean Plot.	Weedy Plot.	
Hay	Cwt. 49	Cwt. <i>a</i> 13.8 + 23	Per Cent. 47
Barley— Grain	18	6.6 } <i>a</i> 13.8 + 19	46
Straw	30		
Potatoes	175	90	49

a Weight of weeds included with hay and straw.

In an instructive experiment carried out in 1907 and 1908 at University College Farm, Reading, it was found that when mangolds were not weeded after the plants were singled the yield in the two years averaged $16\frac{1}{4}$ tons per acre, while on a similar plot on which the weeds were kept down by hand weeding only, without hoeing, the yield averaged 39 tons. When kept clean by hoeing the yield was practically the same as with hand weeding, but with two hoeings only the yield averaged $37\frac{1}{4}$ tons per acre; with one hoeing only the yield was 31 tons. Two points in this experiment stand out clearly: one hoeing only appears to have almost doubled the yield; while hand weeding, and keeping quite clean by hoeing, had about the same effect and much more than doubled the yield, the “no weeding” and “hand weeding” comparing in yield as 100 to 240. (See also Charlock, p. 59.)

Finally, as will be observed at p. 367, the loss in purchasing agricultural seeds will be 24s. in every £5

spent if the real value on account of impurity and poor germinating capacity be only 76 per cent. Were such a sample sown, however, the loss would probably be far greater than 24s., owing to the large number of weed seeds which would be sown and obtain a footing in the crop, causing subsequent trouble in the ways already discussed.

The practical thinking farmer or gardener who knows his business and is thoroughly alive to his own interests will allow no weeds to grow if he can possibly help it. Fortunately, when once a farm is clean it is, with due care, not difficult to maintain it in this condition, and the first object of a farmer, gardener, or fruit-grower who has land foul with weeds is to exterminate these as quickly as possible. Eradicating Charlock in the wheat field, Thistle cutting on both arable and pasture land, cleaning arable land of Couch or Twitch, cleaning saved seeds from weed seeds—all these absorb much time on the part of the farmer, and consequently mean the loss of much money.

However, the persistent destroyer of weeds will find that as time goes on his expenditure on this score becomes less and less, until the weeds are kept down effectually in the ordinary processes of good cultivation; but both preventive and remedial measures must be closely and faithfully followed, and no slackness or negligence allowed to creep in: "One year's seeding means seven years' weeding" is a motto which should be well graven in the minds of all cultivators of the soil.

"It is needless to go about to compute the value of the damage weeds do, since all experienced husbandmen know it to be very great, and would unanimously agree to extirpate their whole race as entirely as in England they have done the wolves, though much more innocent and less rapacious than weeds."—JETHRO TULL, *The Horse Hoeing Husbandry*, 1731.

CHAPTER II

THE CLASSES OF WEEDS, AND HOW THEY ARE SPREAD

“Slack neuer thy weeding, for dearth nor for cheap,
the corne shall reward it, yer euer ye reape.”

—THOMAS TUSSEK, *Five Hundreth Pointes of Husbandrie*, 1557.

IT will now be our purpose to consider the classes of weeds and the manner in which they are distributed. We may usefully regard weeds as divisible into three classes, *Annuals*, *Biennials*, and *Perennials*, and an understanding as to what these terms mean and the principles they involve will be of use in enabling us the more successfully to combat weeds.

Annuals are plants which grow from seed which is, in general, produced the year before, and they attain maturity, produce flowers and seeds, and die the same season. Among annual weeds may be mentioned Poppies, Charlock, Corn Cockle, Spurrey, Groundsel, Clover Dodder, Cleavers. Some plants, such as Chickweed and Groundsel, which are capable of producing several generations in one season, are frequently termed *ephemerals*.

Biennials include all plants which grow from seed and complete their life cycle in two seasons. The first year they spend in establishing themselves in the soil, and in the second year produce flowers and seeds and then die. In any season therefore will be found plants of one year's and of two years' growth, the former being immature, while the latter at the right

period will flower and seed. Examples of biennial weeds are: Marsh Thistle, Burdock, Hemlock, and Foxglove.

Perennials are those plants which live and continue to produce flowers and seeds for a number of years in succession; they grow from seed, and may be propagated and spread by means of their rootstock and other organs. Examples are: Couch Grass, Coltsfoot, Ox-eye Daisy, Creeping Crowfoot, Creeping Thistle, Knapweed, Yarrow, Bindweed, and Stinging Nettles.

These three classes of weeds may be spread or distributed in a great variety of ways, the chief of which are given below.

(a) *Weeds are Spread by Natural Seeding and by the Wind.*—In the ordinary course of events weeds produce seeds at their normal seasons, such seeds being naturally distributed over a narrow or wide area according to certain botanical characters of the plant. Many seed-vessels are so constructed that on ripening they split and throw out their seed with considerable force, projecting it to a distance from the parent plant.

Other seeds bear flight organs or are “winged,” and are carried through the air for long distances by the wind (*e.g.* seeds of Thistles, Groundsel, Dandelion, Yellow Rattle, and Dock). Some seeds, such as those of Broom-rape and Poppy, are very small and light, and are readily scattered by the agency of the wind. (See Plates I., II., and III., Weed Seeds.)

(b) *Weed Seeds are Distributed by Natural Agencies.*—In addition to the transport of seeds by the wind may be mentioned the conveyance by rivers, streams, heavy rains, and floods which often wash seeds away from the parent plants and carry them long distances.

Some seeds, or fruits, bear numerous little hooks by means of which they become attached to passing

animals, and are rubbed off at a distance from their source (*e.g.* Burdock, Cleavers). Others again are devoured by animals and birds, and, being undigested, are passed through the alimentary system unharmed, and deposited in the fæces perhaps miles away from their original home. Birds frequently carry succulent fruits and seeds to favourite positions in order to eat them at leisure, and in various ways leave or lose them. Squirrels, mice, and other seed- or fruit-eating animals also aid in the distribution of plants in a similar manner.

(c) *Weeds are Spread by means of Seeds mixed in Samples of Agricultural Seeds.*—Either through carelessness or inadvertency weed seeds are introduced into fields at the time these are seeded for a crop. Most or all of our agricultural seeds are frequently impure, containing—as we shall see later—large numbers of weed seeds; these are thus sown with the good seed, after which, in many cases, “the tares and the wheat” must grow together until the harvest. Although such distribution of weeds is doubtless generally due to carelessness, it is also perhaps frequently to be attributed—despite the extension of present-day knowledge—to ignorance on the part of those chiefly concerned. Perhaps most seedsmen worthy of the name supply good clean seed, but there come into the market many samples which have been only very imperfectly cleaned if at all, and these find their way through irresponsible dealers to many of the farms of this country. Any individual or firm found to supply samples of seed containing more than the minimum of impurity should be studiously ignored.

Many weeds are introduced from other countries in the large quantities of clover, grass, and other seeds which are imported. Dodder especially is introduced

from abroad in seeds used for agricultural purposes (see p. 258). In the Colonies some plants have been introduced from Great Britain, and, having got out of hand, have become serious pests.

(d) *Weeds are Spread in many other Ways.*—A few examples will suffice. (1) Couch or Twitch is spread

by the creeping rootstock (Fig. 1, a), or by small pieces of this adhering

to farm implements, the wheels of carts, and the boots of workmen, these pieces perhaps falling in

a clean field and starting to grow. The Creeping

Thistle (*Cnicus arvensis*) and Bindweed (*Convolvulus sepium*) may also be distributed in this way (Fig.

1, c and b). (2) All sorts of weeds are occasionally placed on the dung-heap, to be taken at a later date

to the fields, where they may form centres of infestation on account of the seeds they contain.

(3) Hay-loft and other sweepings are frequently a source of trouble, as they contain seeds of many undesirable plants. If they

are thrown on the dung-heap, or, as often happens, are used for seeding bare patches, the weed seeds which are present will rapidly manifest their presence. (4) A

good example of the manner in which seeds may be spread is that of the 5-acre site at the end of the

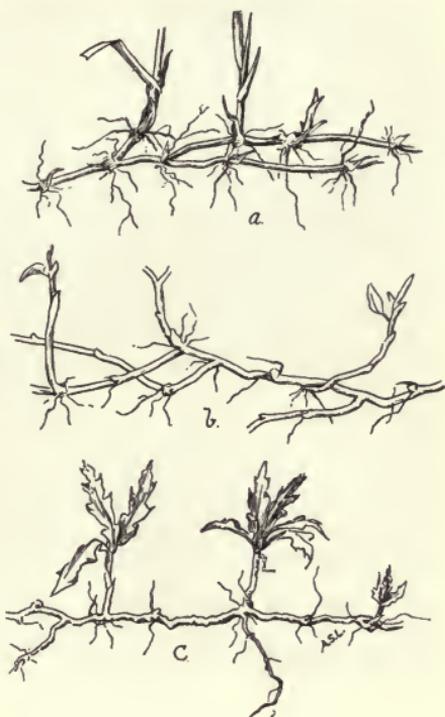


FIG. 1.—a. Rootstock of Couch (*Triticum repens* L.); b. Rootstock of Great Bindweed (*Convolvulus sepium* L.); c. Roots of Creeping Thistle (*Cnicus arvensis* Hoffm.). All $\times \frac{1}{2}$.

Strand in London, which has for several years been unoccupied by buildings. It was found during the summer of 1907, by a botanical representative of the *Graphic*,¹ that no less than fifty-five species of plants had become established since the old buildings had



Photo, 1908.

H. C. Long.

FIG. 2.—A weed-distributing area: showing an abundance of Thistles and other weeds in flower, and a big crop of leaves of Coltsfoot. Photographed about June on a suburban building plot.

been removed some years previously. These may have been brought by the wind, or by birds, or introduced with rubbish, the contents of window-boxes and horses' nose-bags. (5) A very common source of infestation consists in the seeding of weeds in waste corners on the farm, round farm buildings, and in the neighbour-

¹ *Journal of Horticulture*, August 8, 1907.

hood of towns upon empty building plots. Such a weed-distributing area is well shown in the photograph (Fig. 2). All weeds on such spaces should be cut as regularly as elsewhere.

SEEDS PRODUCED BY VARIOUS WEEDS

In view of what has been said about the manner in which weeds are spread, it is interesting to give a few notes on the number of seeds produced by a single flower or plant of various weeds. Below (p. 24) is a table, from which it may be seen at a glance that many weeds produce a prodigious number of seeds, affording a striking example of the harm a single plant may do. With such prolific plants one need no longer wonder at the rapid increase and distribution of weeds when no care is taken to keep them within bounds. The number of seeds largely depends on the size of the plants examined. The different figures given for the same plant are the result of separate investigation by different authors.

THE VITALITY OF SEEDS

Prevention of seeding of weeds is especially important in view of the fact that many seeds possess great *Vitality*, and are able to live on in the soil under what might be considered adverse conditions. One of the best known cases is that of Charlock (see p. 58), the seeds of which may lie dormant in the soil for many years. De Candolle¹ believed that if seeds are buried sufficiently deeply in the soil, where they would be well and continuously protected from the great influence of moisture and oxygen, their vitality would be

¹ *Physiologie Végétale*, tome xi. p. 618. Paris, 1832.

	Number of Flowers to each Plant.	Number of Seeds to each Flower.	Total Seeds for a Single Plant.
Common Groundsel (<i>Senecio vulgaris</i>)	30	10	300 ^a
Do. . . . .	...	...	20,000 ^c
Do.	130	...	6,500 ^d
Corn Cockle (<i>Agrostemma Githago</i>)	10	40	400 ^a
Do.	7	...	2,590 ^d
Sow Thistle (<i>Sonchus arvensis</i>) . . . . .	...	...	3,000 ^b
Do.	190	...	19,000 ^d
Do. . . . .	...	...	8,169 ^e
Fool's Parsley (<i>Æthusa Cynapium</i>)	300	2	600 ^a
Do. . . . .	...	...	6,000 ^c
Wild Carrot (<i>Daucus Carota</i>)	600	2	1,200 ^a
Do. . . . .	...	...	4,000-110,000 ^b
Poppy (<i>Papaver Rhæas</i>)	100	...	50,000 ^d
Do. (<i>P. dubium</i>) . . . . .	...	...	60,000 ^c
Charlock (<i>Sinapis arvensis</i>)	400	...	4,000 ^d
Do. . . . .	...	...	1,192 ^e
Dandelion (<i>Taraxacum officinale</i>)	27	2.0	5,400
Do. . . . .	...	...	3,153 ^e
Ox-eye Daisy (<i>Chrysanthemum Leucanthemum</i>) . . . . .	...	...	1,300-26,000 ^b
Do. . . . .	...	...	1,300-4,000 ^e
Scentless Mayweed (<i>Matricaria inodora</i>) . . . . .	...	...	310,000 ^b
Do. . . . .	...	...	34,478 ^e
Broom-rape . . . . .	...	Several hundreds.	Many thousands. ^f
Dodder . . . . .	...	4	Very large numbers.
Narrow-leaved Plantain (<i>Plantago lanceolata</i>) . . . . .	...	...	2,500-15,000 ^b
Bindweed (<i>Convolvulus arvensis</i>) . . . . .	...	...	600 ^c
Cleavers (<i>Galium Aparine</i>) . . . . .	...	...	1,100 ^c
Chickweed (<i>Stellaria media</i>)	50	...	500 ^d
Coltsfoot (<i>Tussilago Farfara</i>) . . . . .	...	...	5,000 ^c
Corn Marigold (<i>Chrysanthemum segetum</i>) . . . . .	...	...	13,500 ^c
Burdock (<i>Arctium Lappa</i>) . . . . .	...	...	24,520 ^c
Shepherd's Purse (<i>Capsella Bursa-Pastoris</i>) . . . . .	...	...	4,500 ^c
Goosefoot, Fat Hen (<i>Chenopodium album</i>) . . . . .	...	...	3,123 ^e

^a Morton's *Cyclopædia of Agriculture*, 1856, vol. ii. p. 1116.

^b H. Dorph-Petersen, Director, Danish Seed Control Station. See *Landsmandsblade*, No. 47, 1906; also *Mitt. der Deut. Land. Gesell.*, December 12, 1906, p. 474.

^c Maier-Bode, *Die Bekämpfung der Acker-Unkräuter*, 1908.

^d Dr. Fr. Nobbe, *Handbuch der Samenkunde*, 1876.

^e E. Korsmo, *Kampen mod Ugræsset*, 1906.

^f P. Sorauer, *Pflanzenkrankheiten*.

retained for a much longer period than usual. Another investigator, Giglioli, writing at a much later period,¹ says: "There is no reason for denying the possibility of the retention of vitality in seeds preserved during many centuries, such as the mummy wheat and seeds from Pompeii and Herculaneum, provided that these seeds have been preserved from the beginning in conditions unfavourable to chemical change. . . . The original dryness of the seeds and their preservation from moisture or moist air must be the very first conditions for a latent secular vitality." All attempts to germinate seeds from Egyptian mummy cases, however, appear to have failed. Contrary statements have been made, but these have probably been based on error or on imperfectly authenticated experiment.

It has been concluded² that "The average life of seeds, as of plants, varies greatly with different families, genera, or species, but there is no relation between the longevity of plants and the viable period of the seeds they bear. The seeds of some plants lose their vitality in a few weeks or months, while others remain viable for a number of years."

A large number of experiments show that the longevity of seeds chiefly depends on moisture and temperature, well-dried seeds maintained in a dry atmosphere at a temperature not higher than 37° C. (= 98.6° F.) in general retaining their vitality for considerable periods. Specially dried vegetable seeds put up in sealed receptacles were taken by Captain Scott in the steamship *Discovery* in 1901, and on the return of the exploring party were found in 1904, after passing twice through the tropics and being exposed to the low

¹ *Nature*, 1895, pp. 544-5.

² *The Vitality and Germination of Seeds*, Bull. No. 58, Bur. Plant Indust., U.S. Dept. Agric., 1904.

temperature of 72° F. below freezing-point, still to possess high germinating powers—radish 92 per cent, lettuce 85 per cent, turnip 96 per cent, &c.¹ All this suggests that the length of life of many weed seeds may be considerable.

An interesting case showing the length of time seeds will lie dormant in the soil and germinate when brought to the surface occurred in connection with the Yeomanry manœuvres in 1901. A large rabbit warren on the Oxfordshire hills was dug and levelled, no other soil being used nor seeds of any kind sown. Yet in 1902 the whole surface produced a dense plant of yellow Charlock. In the following year the Charlock died down and was succeeded by a mass of White Campion (*Lychnis vespertina*). The seeds of both plants must have been buried in the earth for an unknown period of years, and the disturbance of the soil enabled them to germinate.²

The number of weed seeds which may be found in the soil of a field is also extraordinary. Korsmo found that in 1 square metre (1.19 square yard) of a fallow field the seeds having power of germination, to a depth of 25 centimetres (9.8 inches), were 10,332. This was determined by three different weedings. In a field intended for spring grain, the same crop having been sown for four successive years, no less than 33,574 such weed seeds were found per square metre. In a third field, which was fallowed, the seeds found numbered 1,755.

In a good garden soil which has been well cultivated for at least three years, few weeds having been allowed to shed their seed during that time, the author measured off 1 square yard and removed all the seedling weeds

¹ *The Times*, 6th December 1904.

² *Lawns*, Sutton & Sons, p. 9.

by hand on 17th May, 1909. An attempt was made to count the seedlings and separate them roughly into species, with the following result:—

	Number.
Buttercup (? chiefly <i>Ranunculus repens</i>)	654
Annual Meadow Grass (<i>Poa annua</i>)	107
Dock (<i>Rumex</i> sp.)	60
Goosefoot (<i>Chenopodium album</i> ?)	26
Groundsel (<i>Senecio vulgaris</i>)	25
Shepherd's Purse (<i>Capsella Bursa-Pastoris</i>)	15
Annual Sow Thistle (<i>Sonchus oleraceus</i>)	14
Chickweed (<i>Stellaria media</i>)	10
Persicaria (<i>Polygonum Persicaria</i>)	8
Charlock (<i>Sinapis arvensis</i>)	5
Creeping Thistle (<i>Cnicuse arvensis</i>)	4
Plantain (<i>Plantago</i> sp.)	1
Clover (<i>Trifolium</i> sp.)	1
Various	120
Total	<u>1,050</u>

In addition to these were found two plants of Shepherd's Purse near the seeding stage, two growing portions of Couch rhizomes, and one small potato plant.

WEEDS AS INDICATORS OF GOOD AND POOR LAND

Weeds often afford a very good indication of the character of the soil on which they grow, and to some extent the state of fertility or otherwise of the land. For example, it is well known that Mosses, Horse-tail (*Equisetum*), Rushes, Sedges, Silver-weed, and other plants chiefly grow upon wet, undrained land. Quaking Grass, Ox-eye Daisy, Yorkshire Fog, *Bromus sterilis*, and other plants indicate poor soils. Stinging Nettles, certain Thistles, Buttercups, Coltsfoot, and others usually occur on good land. It may perhaps be said as a general

rule that the weeds referred to below indicate damp, poor, and good soils respectively.

<i>Damp Soils.</i>	<i>Poor Soils.</i>	<i>Good Soils.</i>
Rushes	Quaking Grass	Buttercups
Sedges	Yorkshire Fog	Certain Thistles
Horse-tail	Sterile Brome Grass	Coltsfoot
Silver-weed	Ox-eye Daisy	Stinging Nettles
Tussock Grass	(Absence of Clover)	Groundsel
Certain Mosses	Dyer's Green-weed	Goosefoot or Fat Hen
Cowslips	Sheep's Sorrel	Cleavers
Butter-bur	Rest Harrow	Dandelion
Knot-grass	Spurrey	Chickweed
Lady's Smock	Ragwort	Sow Thistle
Meadow sweet		
Ragged Robin		

It is, however, not to be taken for granted that a soil is poor merely because certain of the weeds included in the above list are plentiful: the list given is not arbitrary and absolute, but general and suggestive. The character of the land is not only indicated in some sense by the weeds which are present, but largely also by their manner of growth. Large, strong Thistles, for example, and large elegant Buttercups and Cowslips, only grow on good land—on poor land such plants will generally be much smaller or stunted in growth.

Spurrey, Corn Marigold, Sheep's Sorrel, Cornflower, and small Bindweed are common on sandy soils; Burnet, Bladder Campion, Chicory, Viper's Bugloss, and others are characteristic of calcareous soils; while most of the weeds enumerated above under "good soils" are common on loamy soils. The soils on which the various weeds grow will be dealt with in subsequent chapters.

CHAPTER III

GENERAL PREVENTIVE AND REMEDIAL MEASURES

“ I will go root away
The noisome weeds, that without profit suck
The soil's fertility from wholesome flowers.”

—SHAKESPEARE, *Richard II.*, Act iii. sc. 4.

IN considering how to eradicate a particular weed it is well first of all to discover what is its life history and how it is distributed, as these conditions will influence the method adopted in order to suppress it. The difference between Couch and Charlock, or between Charlock and Sheep's Sorrel, for example, is very marked, and upon these differences must be based the means to check the plants. All weeds should be attacked at their weakest or most vulnerable period, which can only be determined when their complete life history is known.

It will be useful to examine the general methods of combating weeds as a body, and these may be conveniently divided into Prevention and Remedy.

PREVENTION

Under this heading may be included such operations as cultivation, rotations, sowing of clean seed, and prevention of seeding of weeds.

(a) *Good Cultivation.*—It should at the outset be strongly emphasised that good cultivation of the highest order is not only largely conducive to the suppression of weeds, annual and perennial alike, but

is perhaps of greater importance in the growth of good crops than any other factor in practical agriculture. In dealing with insect infestation Professor Somerville writes: "Using the term in its widest sense, *good cultivation* will be found to be the best protection that the farmer or gardener can offer his crops against the ravages of insects." This remark applies with equal force to weeds; in fact, one of the chief reasons that good cultivation is valuable in keeping down noxious insects is that weeds are destroyed, besides which the soil is rendered friable, open and mellow, and is better able to grow a healthy crop which will tend to resist the growth of weeds. Autumn cultivation is especially valuable, many roots of weeds being then exposed to frost, and so destroyed, while seedlings are buried.

(b). *Growth of Dense Crops.*—The growth of dense heavy crops, such as vetches, lucerne, sainfoin, and maize, largely tends to suppress weeds, for once such crops are well established they choke out weeds. A good "take" of lucerne is especially useful, since, owing to its rapid growth, it not only tends to smother weeds, but as it is cut several times during the summer months weeds are also cut and seeding is prevented. Maize is useful on account of the fact that it is well hoed and cleaned, and provides an abundance of shade.

(c) *Prevention of Seeding.*—This is one of the chief means of combating weeds, and is usually most easily managed by cutting them down just before or at the time of flowering, or whenever they are of sufficient size to be readily cut or mown. On grass land the mowing machine may be run over infested fields without much trouble two or three times during summer.

A box attachment for reaping machines and binders, by which seeds shaken out in the process of cutting cereal crops are caught, is a useful means of reducing

the number of weed seeds which are shed broadcast in the harvest field.

The number of seeds produced by various weeds is dealt with at pp. 23-4. As an example, we may note here that "a single red Poppy, left undisturbed, may ripen more than 40,000 seeds, each capable of producing a successor. In something less than seven years that one Poppy could produce plants enough to occupy every inch of the thirty and odd million acres of the United Kingdom with red Poppies. The cardinal point in weeding, then, is to prevent seeding."¹

Percival writes that "A single Poppy plant frequently bears more than twenty flowers, and each of these may produce two or three hundred seeds. Similar enormous increase is met with in Groundsel, Sow Thistle, Campion, Charlock, and practically all annuals."

These figures, and the table at p. 24, clearly demonstrate that the prevention of seeding is most important, and deserves the closest attention of all connected with agriculture.

(d) *Sowing Clean Seed.*—The manner in which weeds are introduced through the medium of agricultural seeds has already been dealt with. It is abundantly clear that if impure seeds be sown all the preventive and remedial measures combined will not avail to keep a farm, garden, or lawn clean and free from weeds. Too much stress cannot be laid upon this matter, which is not sufficiently recognised, although more pains are now taken by seed merchants to supply clean seed than was formerly the case. But, as Mr. Primrose M'Connell has said,² it would be interesting to know what becomes of all the second and third year old seed. Agricultural seeds which contain more than a very

¹ Vinton's *Handbooks of the Farm*, "The Crops," p. 136.

² *Diary of a Working Farmer*.

small percentage of dead or weak seeds will, if sown, cover the ground far from completely, and this is offering a premium on the spread of weeds, which tend to grow more strongly in the absence of a heavy cultivated crop. The presence of but 1 per cent of Dock seed in a mixture of grass and clover seed means no less than *ten or more Dock plants per square yard* all over the field whenever such a sample is sown at the ordinary rate for leys.¹

(e) *Rotation of Crops.*—In the management of a farm rotations are of very great value for several reasons, only one of which need be mentioned here. The change of crops due to rotations affords an opportunity of cleaning the land. When an area is sown with wheat in autumn and the crop is not harvested until the following August it is obvious that little can be done in the way of suppressing weeds, except in the case of Thistles, Docks, and one or two other large weeds which may be removed by hand, or Charlock, which can be destroyed by spraying. In certain cases, however, corn crops are hoed when young, while harrowing in spring to destroy annuals is extremely useful. After the end of May little can be done, and the crop and land must be left untouched until the harvest, by which time many weeds will have shed their seeds. When, however, wheat land is ploughed up, left to mellow during winter, well cultivated in spring, and then used for taking a root crop, an opportunity occurs for suppressing weeds. During spring and summer especially, when the previous year's seeds germinate, hand and horse hoeing are employed to keep the weeds well in hand, and seeding is almost entirely prevented. The rotation of crops commonly followed, by which a root crop is taken once in four

¹ *Leaflet* No. 112, Board of Agriculture and Fisheries.

years, largely conduces, when thoroughly carried out, to the destruction of weeds, and results in a clean farm.

(f) *Thorough Brushing of Hedges and Ditches* is a valuable preventive measure, many weeds being destroyed which would otherwise distribute their seeds and harbour insect and fungous pests.

(g) *Screenings from Thrashing Machines, Winnowing Machines, and Mills* should be thoroughly ground before they are fed to live stock. It is well known that weed seeds may pass through the digestive system unharmed, and hence they should not be given to stock whole. In Korsmo's experiments, two lots of mill screenings, which contained from 25 to 47 per cent of weed seeds, were ground, and the samples then examined for weed seeds. In 100 grams ($= 3\frac{1}{2}$ ozs.) of the ground screenings only one weed seed was found capable of germinating.

Before coming on to a farm a thrashing machine should always be thoroughly cleaned, and the wise farmer will insist on this being done, otherwise it is quite likely that many weed seeds will be brought on to his land.

REMEDY

From what has already been said under "Prevention" it will be gathered that at many points "Prevention" and "Remedy" are almost identical, since cultivation, prevention of seeding, brushing of hedges and ditches, all tend to eradicate weeds as well as prevent future infestation. No hard and fast line can be drawn between the two, and a certain amount of overlapping will of necessity occur in the suggestions already made and those which follow.

(a) *Thorough Cultivation: Ploughing, Harrowing, Hoeing, &c.*—Not only does cultivation in the broadest sense

tend to prevent the growth of many seeds, but such cultivation must frequently be employed without fail if weeds are to be eradicated. Perhaps the large majority of weeds are destroyed when ploughed under. Scarifying and harrowing may drag out Couch, Bindweed, and Creeping Thistle, which may then be drawn together for burning by means of a stout horse-rake; harrowing leaves many weeds on the surface to be scorched by the sun or destroyed by frost; hoeing by hand or by horse labour, especially when the weeds are in the seedling stage, is one of the most efficient and common means of destroying weeds; and all the tillage operations are calculated to ameliorate the soil and render it more fit to grow the cultivated crop.

Another efficient remedy consists in *surface cultivation* in spring in order to destroy seedlings. The production of a fine tilth encourages dormant seeds to germinate, and as soon as these are fairly started the application of light harrows, the American Weeder, Poppy Destroyer, or in gardens the hoe (Fig. 5), effectually destroys them. By this means very large numbers of annuals are killed, and many perennials also which are exposed to late frosts. The process should, if possible, be repeated two or three times at intervals of two or three weeks, and may be practised on young corn crops with great advantage until quite late in spring. *The Poppy Destroyer* (Fig. 3) is an example of an implement specially designed to eradicate a surface-growing annual.

(b) *Fallowing and Fallow Crops*.—As a means of destroying weeds bare fallowing is of much value, for owing to the repeated ploughing, harrowing, and rolling which the land receives weed seeds successively germinate, but are prevented from establishing themselves and are

killed. Perennial weeds, such as Couch and Docks, are dragged to the surface, sun-dried and burned. In connection with bare fallowing, however, it must be noted that a covering of annual weeds may be of value in retaining nitrates in a highly pervious soil, instead of allowing them to be carried into the subsoil drains and lost. Care must be taken, in any case, that the weeds are ploughed under before they have time to seed, and

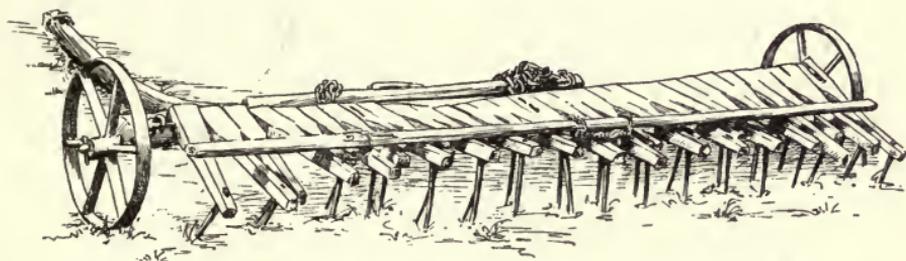


FIG. 3.—Poppy Killer—used for light surface cultivation. (After a photograph published by the Board of Agriculture.)

this is accomplished by two or more successive ploughings. Bare fallowing, however, is not practised to the extent it used to be—and rightly so—the introduction of a fallow or catch crop serving the double purpose of retaining nitrates in the soil and destroying weeds. Good farming will, in general, keep land sufficiently free from weeds as to obviate the necessity of a bare fallow for the purpose of eradicating them. On very heavy land, however, bare fallowing is practised on account of its great value in the general improvement of the soil, and in wet seasons, on certain land, its practice may be essential; and where heavy land is very weedy, bare fallowing is a certain means of “cleaning up.”

Where lighter land has become very foul with weeds a catch crop may well replace bare fallow. Spring ploughing, followed by successive harrowings to destroy the successive crops of annual weeds, may end

in a final ploughing between mid-May and mid-June, when the drill may deposit rape and mustard. These crops grow rapidly, and largely tend to smother weeds, which can be ploughed under with them later in the season, thus giving a good green manuring. Or sheep may be fed on the crop with cake, the plough following, when many deep-rooted plants may be destroyed. A heavy crop of winter vetches may then be grown and be cut, with the contained weeds, in the succeeding spring, the following crop being late turnips. Some such procedure will both enrich and improve the soil, and eradicate or immensely reduce the weeds. Useful catch crops are lupins, vetches, rape, mustard, serradella, green rye, and trifolium.

(c) *Mowing, Spudding, &c.*—It is a useful practice to run the mowing machine over grass land where Thistles,

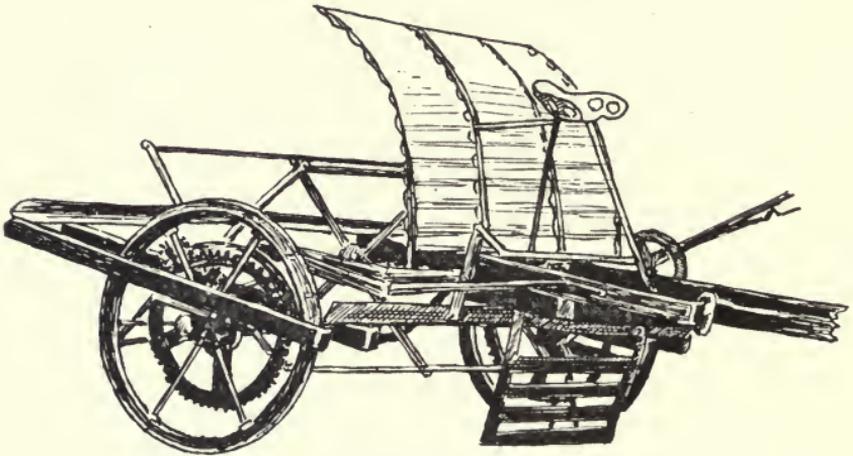


FIG. 4.—Thistle and Bracken Cutter (Allan & Sons).

Knapweed, and other weeds prevail, and this may be done two or three times during the summer months. Special machines, *e.g.* the Thistle Cutter (Fig. 4), are sold for a similar purpose. Many of these are very useful, and can be easily managed by a lad.

The *spud* is extremely useful in many cases, for by

its aid Thistles, Plantains, Dandelions, and other strong-rooted plants may be cut off clean just below the

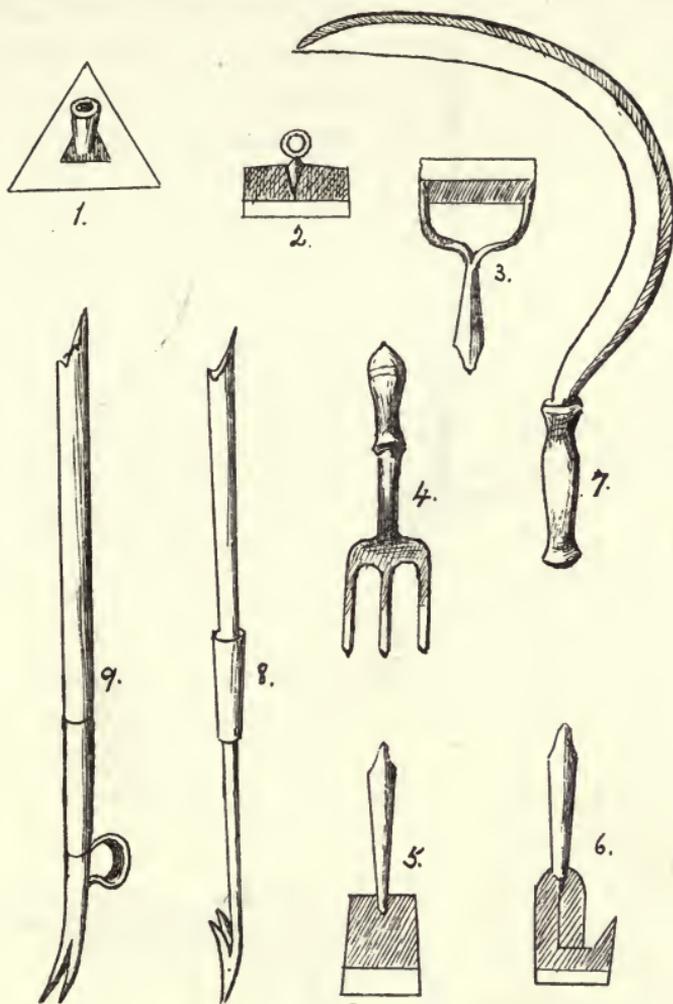


FIG. 5.—A group of implements useful in eradicating weeds and preventing them from seeding. 1. Triangular Hoe, useful in seed beds. 2. Ordinary Hoe for general work. 3. Dutch Hoe for "push" work, cutting weeds off well below the surface, and stirring the soil deeply. 4. Hand-weeding Fork for garden work—also used with a long handle, or with the broad prongs turned the other way, not "flat." 5. Ordinary Spud, and 6. Spud with a "hook"—both useful for cutting off weeds in all sorts of positions. 7. Sickle or Hook useful for brushing along hedgerows and ditches, cutting down tall weeds round farm buildings, thistles and other weeds in fields, &c. 8 and 9. Two forms of Weed Grubs, useful for removing daisies, &c., from lawns.

surface of the ground. A spud attached to the end of a stick (see Fig. 5) is a handy tool for cutting down

weeds met with in the course of daily walks on the farm. Certain forms of *mattock* are useful for destroying weeds, and for earthing up potatoes (Fig. 6) ; while the *bagging-* or *fagging-hook* is very handy for cutting Thistles and other weeds on small areas of grass land, trimming round farm buildings and along hedgerows and ditches (Fig. 5).

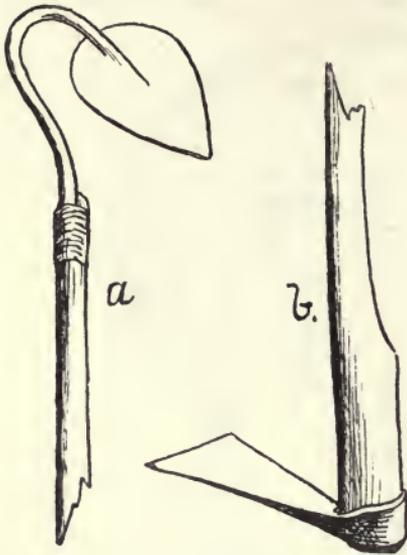


FIG. 6.—Two types of implements useful for eradicating weeds: *a.* a type of Mattock used in Germany; *b.* a more common form of Mattock, useful in garden cultivation for earthing up potatoes, cutting off weeds deeply, and well stirring the soil.

Hand pulling must frequently be adopted as the only feasible means of removing weeds, especially in the case of tall species in corn and other crops. Before the introduction of copper sulphate as a spray against Charlock the later

crops of this weed were commonly removed by hand, and we have spent many a day at such work. Other tall weeds, however, must still be dealt with by hand when infesting cereals, young lucerne, and similar crops.

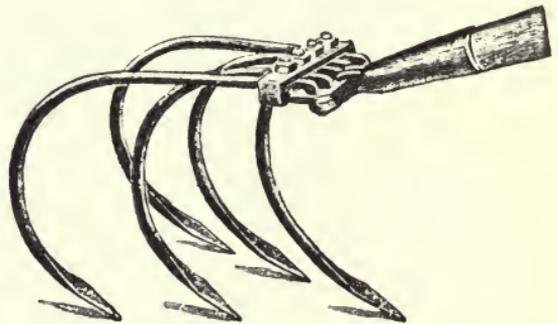


FIG. 7.—The "Buco" Hand Cultivator, employed in the West Indies as hoe, fork or rake. Sold by the Barbados Co-operative Cotton Factory.

On lawns and tennis-courts various *daisy grubbers* and weed extractors may be very helpful (Fig. 5); and in

garden beds the small hand fork is useful (Fig. 5). An implement found useful in the West Indies for general hand cultivation is illustrated in Fig. 7.

(d) *Special Methods*.—In eradicating many weeds special means are necessary. *Draining* is often of much value in the case of Mosses, Horse-tails, Sedges, Rushes, and other weeds which grow in damp, low-lying situations.

Irrigation.—It has been observed that irrigation may frequently bring about an improvement in the herbage of grass land, and where it is possible the question of its practice should be considered. In a meadow on the banks of the Churn, near Cirencester, only one-half of which could be covered with water, observations were made¹ by Professor Buckman on the effects of irrigation after two years and four years respectively. The results are given in the following table:—

Botanical Name.	Common Name.	Proportions.		
		Before Irrigation.	After Two Years' Irrigation.	After Four Years' Irrigation.
<i>Alopecurus pratensis</i>	Meadow Foxtail	1	2	4
<i>Poa pratensis</i>	Field Meadow-grass	2	3	4
„ <i>trivialis</i>	Rough Meadow-grass	1	2	1
<i>Cynosurus cristatus</i>	Dogtail	2	1	∴
<i>Dactylis glomerata</i>	Cocksfoot	1	2	3
<i>Avena flavescens</i>	Yellow Oat-grass	2	3	3
<i>Lolium perenne</i>	Perennial Ryegrass	2	4	6
<i>Trifolium pratense</i>	Broad Clover	1	2	2
„ <i>repens</i>	Dutch Clover	2	∴	∴
* <i>Briza media</i>	Quaking Grass	2	∴	∴
* <i>Aira cæspitosa</i>	Hassock-grass	1	∴	∴
* <i>Agrostis stolonifera</i>	Marsh Bent-grass	1	2	3
* <i>Avena pubescens</i>	Downy Oat-grass	1	1	1
* <i>Hordeum pratense</i>	Meadow Barley-grass	1	2	2
* <i>Ranunculus acris</i>	Acrid Buttercup	1	3	1
* „ <i>bulbosus</i>	Bulbous Buttercup	3	1	∴
* <i>Plantago lanceolata</i>	Ribwort Plantain	3	1	1
* „ <i>media</i>	Broad-leaved Plantain	3	∴	∴
* <i>Anthriscus vulgaris</i>	Common Beaked Parsley	1	2	1

¹ “The Natural History of British Grasses,” Prof. James Buckman: *Jour. Roy. Agric. Soc.*, 1855.

It will be observed from these figures that a number of the better grasses were much increased, several being three or four times as plentiful as before irrigation. Dutch clover disappeared, but after two years broad clover was doubled. As regards weeds (marked with an asterisk), several of the worst had disappeared after four years, while others were much reduced. In short, Buckman remarked that the field on which the experiment was made was "trebled in value in four years."

Feeding-off with sheep may occasionally be employed to suppress weeds, such as Ragwort and Spurrey, but the operation should always take place before the time the seeds ripen. It is known that sheep eat certain plants which cattle reject, such as Ragwort (*Senecio Jacobæa*), Knapweed (*Centaurea nigra*), and Ox-eye Daisy (*Chrysanthemum Leucanthemum*). It may therefore be useful to run a few sheep with the larger stock on pastures where these weeds abound.

Spraying with plant poisons is a valuable method of suppressing weeds; for example, Charlock in young corn crops can be destroyed by means of sulphate of copper, Wild Onion has been largely reduced by the use of carbolic acid, and Dodder by the use of several chemical preparations.

The sulphates of copper and iron, salt, carbolic acid, arsenite of soda, and other materials have all been used for the destruction of weeds. In an experiment on a very weedy plot of wheat at the North Dakota Experiment Station¹ a 10 per cent solution of copper sulphate was used on June 1st when the wheat was 3 to 5 inches high, "the principal weeds being Charlock, Wild Barley, Wild Rose, Penny Cress, Shepherd's Purse, Wild Buckwheat, Lamb's Quarter, and Great Ragweed." On August 8th "all the weeds except the Wild Rose and the

¹ U.S. Dept. Agric., *Farmers' Bull.* 124.

older plants of Penny Cress were dead." Although some of the leaf tips of the wheat were slightly burned, "the yield of grain was considerably larger than from an equal unsprayed area." The question of destroying weeds by spraying is more fully discussed at p. 43.

Ploughing weeds under is usually satisfactory where weeds are getting the upper hand, especially where annuals are concerned, but this should be before seeding takes place. In garden cultivation weeds may be deeply buried when trenching is done; even Couch, Bindweed, and Creeping Thistle may be dealt with in this way, as we have proved, but the work must be well done. It has been suggested that Couch might well be piled in large heaps and rotted for manure (see p. 3).

Use of Tarred Paper.—A plan much recommended in the United States for eradicating patches of perennial weeds, like Creeping Thistle and Stinging Nettle, is to cover the whole surface with large sheets of strong tarred paper in order to exclude light. The paper may be pegged down and have a few stones placed on the top. This method is stated to be of great value and very effective.

"*Lawn sands*," the basis of which appears generally to be sand and sulphate of ammonia, are largely used for the improvement of lawns, the finer grasses being encouraged, and the weeds suppressed or choked out. Such treatment occasionally has an almost marvellous effect.

Manuring is a valuable aid in the war against weeds, land in high condition enabling the crop to hold its own. Grass land is rapidly improved by the use of manures (see Chap. V.), and liming is frequently of great value, especially in combating Sheep's Sorrel, Corn Marigold, Spurrey, and some other weeds.

It was shown many years ago by Heinrich's experi-

ments that *mineral manures* tend to reduce weeds to a minimum ; *nitrogenous manures* favoured the growth of weeds, which attained their most vigorous growth on undunged land. His results may be given thus :¹—

	Percentage of Weeds contained in the Crop.
Undunged	53.0
Sulphate of Ammonia	30.0
Nitrate of Soda	26.0
Sulphate of Magnesia	10.0
Common Salt	7.0
Sulphate of Potash	5.5
Carbonate of Lime	4.9
Quicklime	4.5
Superphosphate	4.4
Gypsum	1.9

Collection of Weeds by School Children.—Dr. Ewart, Government Botanist, Victoria, called attention last year² to a plan for suppressing weeds which is worthy of consideration. It consists in offering prizes to school children for collecting certain weeds, and Dr. Ewart mentions an instance in which, after prizes were offered by the police magistrate at some (then recent) prosecutions under the Thistle Act, 12,000 plants of Ragwort were brought in during the first four days, and this number quickly rose to nearly 20,000 plants.

In both preventive and remedial treatment, however, each case must be taken on its merits, and after consideration of the individual conditions concerned ; at the same time it must be emphasised that if good results are to be obtained, perseverance and faithful attention to the principles involved (not forgetting the life history of the plant) are essential.

¹ Dr. Fr. Nobbe, *Handbuch der Samenkunde*, 1876, p. 578.

² *Jour. Dept. Agric.*, Victoria, August 10, 1908.

THE DESTRUCTION OF WEEDS BY MEANS OF
CHEMICAL SUBSTANCES

Up to comparatively recent times the methods adopted by the farmer and gardener for the eradication of weeds were largely those which aim at removing or disturbing the latter by mechanical means. The weeds were ploughed under, harrowed out when young and allowed to dry in the sun, pulled up by hand, or cut off with hoes, spuds, scythes, and other similar implements, in the manner already described.

During the last few years, however, attention has been drawn to the possible destruction of weeds on a large scale by the application of various chemical substances, either in solution in the form of a fine spray, or in a powdered state.

The materials chiefly employed are ammonium sulphate, common salt, carbolic acid, sodium arsenite, and the sulphates of iron and copper. The two latter compounds have proved the most effective for practical farm purposes, the rest being only applicable in exceptional cases.

1. *Ammonium Sulphate* is a well-known fertiliser containing nitrogen, and extensively used in small amounts up to 1 or $1\frac{1}{2}$ cwt. per acre for the manuring of cereals, root crops, and grass land. In larger doses it checks the growth of vegetation for a time, or kills it altogether. When spread in considerable quantities it prevents the germination of seeds, and when mixed with sand or brick dust it is much used to destroy Plantains, Daisies, and other weeds on lawns and small plots of grass. The weeds are checked or killed, and the grass, although at first more or less damaged, is stimulated to such an extent that it soon chokes out the weeds.

When placed upon the cut ends of Dandelions,

Docks, and other strong-rooted plants left in the ground ammonium sulphate tends to destroy them. (See also p. 346.)

2. *Common Salt* is a deliquescent substance which extracts water from damp air and surrounding objects with which it may be brought into contact. When applied to succulent plant tissues it draws water from them and produces an effect similar to drying or scorching; leaves to which it is applied are killed, and look as if they had been burnt. Salt may be used on a small scale for the destruction of Nettles and other weeds, and its application has been found beneficial in checking weeds and indirectly improving the useful herbage of grass land. The semi-parasites Yellow Rattle (*Rhinanthus*) and Lousewort (*Pedicularis*) are reduced by it.

3. *Carbolic Acid*, 1 pint thoroughly mixed with 4 pints of water, has been found a very efficient weed killer. It is most frequently used on small areas, at the rate of 8 gallons per square rod. It was found at the Woburn Experiment Station of the Royal Agricultural Society that Wild Onion (*Allium vineale*) may be destroyed by carbolic acid (see pp. 126, 209).

4. *Sodium Arsenite*.—This substance, or allied compounds of arsenic, is the basis of many of the proprietary weed-killers sold by chemists and nurserymen. It is one of the most effective of all plant poisons, but cannot be used for weeds on cultivated ground or on grain land, because it not only destroys weeds but kills all other vegetation as well, and prevents crops from being grown on that soil for a considerable time afterwards. It may be properly used on paths, gravel courts, and similar places where vegetation of all kinds is out of place. Its highly poisonous and dangerous character, however, precludes it from general use.

5. *The Sulphates of Iron and Copper* have been very extensively employed on arable land for the destruction of weeds among corn and other crops, and these substances may be regarded as the only materials at present of practical importance for such purposes.

To be effective they must be applied in solution and absorbed by the tissues of the plants, and as such solutions have only a local action and are not distributed through the body of the plant as materials absorbed by roots would be, the whole or a great part of the leaf-surface of the plant must be wetted if the weeds are to be killed. Moreover, since the only parts which can be got at are the leaves and stems above ground, spraying is most effective upon weeds of annual duration which have no reproductive machinery upon their roots. Perennials which maintain a store of food in tubers, and thickened rhizomes and similar structures in the soil, cannot be readily destroyed by applications of poisons to their leaves, for after the latter have been destroyed fresh stems and leaves may be sent up from buds on the underground parts.

Even when solutions are applied to the sub-aerial leaves and stems, the result depends not only upon the nature of the chemical substances and the strength of the solution used, but also upon the kind of plant, its habit of growth, the stage of development which it has reached, and other factors. As a rule, the young growing points of the stems of plants are enclosed in the interior of buds, or are protected, as in the grasses, by the surrounding leaf-sheaths. While the older exposed leaves may be killed, the weed may still be able to grow from its protected buds and to perfect its seeds.

Plants with small, narrow, upright leaves are not so easily destroyed as those with broad, spreading leaves, for the solution runs off the former more readily than

the latter. In some cases the leaf surfaces of plants are covered with a greyish waxy excretion or "bloom," which prevents the solution from adhering to or wetting the plants; the solution collects in drops, which roll off easily, or are shaken off by the wind.

Copper sulphate is more poisonous to plants, and can therefore be used in weaker solutions, than iron sulphate. A 2 or 3 per cent solution of copper sulphate is about as effective as a 15 per cent solution of the iron salt. Which of them is the more economical depends of course upon the relative price at which the two substances can be purchased. The iron salt is always much cheaper pound for pound than the copper compound; but the market price fluctuates considerably, and which to use must be determined after obtaining quotations for both.

The amounts generally used are 40 to 50 gallons per acre of a 2, 3, or 4 per cent solution of *copper sulphate* (say on an average 12 lb. in 40 gallons of water per acre), or 40 to 50 gallons of a 15 per cent solution of *iron sulphate* (say 60 lb. in 40 gallons of water per acre). Stronger solutions than these are liable to do permanent damage to crops among which the weeds are growing.

Hundreds of trials have been made in various parts of the world, to determine the influence of these solutions upon many kinds of weeds. They have been found to be most active upon Charlock (*Sinapis arvensis*) and Wild Radish (*Raphanus Raphanistrum*), and it may be said that it is for these two weeds alone that spraying is generally practised.

On the other hand, it is true that many other weeds are much damaged by the solutions of copper and iron sulphates. It was found, for example, in 1899, at the Holmes Chapel Agricultural and Horticultural College,

that *Persicaria* or Redshank (*Polygonum Persicaria*) was completely killed by a 4 per cent solution of copper sulphate, 100 gallons per acre sprayed on clover and grass seeds sown in May, the clover and grass being uninjured.

The solutions are partially effective on Docks, Black Bindweed (*Polygonum Convolvulus*), Dandelion, Perennial Sow Thistle (*Sonchus arvensis*), Poppy (see p. 55), Spurrey (see p. 74), Groundsel, and Corn Cockle, and while these are not completely destroyed, seeding is generally prevented. Spraying with solutions of the strengths mentioned above has also no permanent effect on Cornflower (*Centaurea Cyanus*), Bindweeds (*Convolvulus* sp.), Creeping Thistle (*Cnicus arvensis*), species of *Anthemis* and *Matricaria*, Couch and Horse-tails. Although the leaves of these weeds are turned brown and killed in patches the plants are able to continue growth, and ultimately produce flowers and ripe seeds.

Species of *Chenopodium*, Spurges (*Euphorbia* sp.), Fumitory, and *Sisymbrium Thaliana* are protected by the glaucous bloom on the leaves, and spraying, even with very much stronger solutions than those mentioned, has little or no effect upon them. Knot-grass (*Polygonum Aviculare*) and Small Toadflax (*Linaria minor*) also resist these solutions.

As spraying is chiefly used against weeds growing among ordinary farm crops, it is important to determine to what extent the latter are injured by copper and iron sulphate solutions. In the strengths given above it has been found that cereals are not permanently injured by them. The tips of the leaves are generally killed and sometimes portions of the flat leaves also, but the growing points are effectively protected and continue to grow, new leaves are unfolded, and the crop does not suffer.

The first leaves of red clover, which is generally sown among the spring cereals barley and oats, turn black and die after being sprayed, but the growing central buds of the plants are uninjured and develop satisfactorily later.

Peas, vetches, and potatoes are, however, seriously and permanently damaged, so that weeds among these crops must be dealt with in other ways.

The best time for spraying is in the morning of a clear day when there is no wind and no likelihood of rain. A heavy shower or two immediately after spraying or long-continued rain within twenty-four hours after the solutions have been applied, reduces the value of the operation or stops its action altogether.

The plants should be young and in a vigorous state of growth; seedlings possessing three or four well-developed leaves are most easily destroyed. Especially is it essential to deal with the young plants of Wild Radish (*Raphanus*), as in the older stages they are more resistant to the poisonous materials than Charlock. The latter may be sprayed with success even when the plants are in flower; if not too far developed the leaves are destroyed, and although pods may form, they usually contain only shrivelled seeds incapable of germination.

The effects of copper and iron sulphates and other plant poisons when used in weak solutions are not seen until three to six days or more have elapsed, so that the value of spraying for weed destruction cannot be determined immediately after the operation is carried out.

“ In May get a weedhook, a crotch and a gloue,
and weed out such weeds, as the corne doth not loue :
For weeding of winter corne, now it is best,
but June is the better, for weeding the rest.”

—THOMAS TUSSER, *Five Hundreth Pointes of
Husbandrie*, 1557.

CHAPTER IV

WEEDS OF ARABLE LAND

“ In the later ende of May is tyme to weede thy corne.”

—JOHN FITZHERBERT, *Boke of Husbandry*, 1523.

A VERY large number of wild plants occur as weeds in arable land, and it is in such positions that weeds are generally held to be most troublesome. As has already been stated (p. 27), the author found no less than 1050 individual young plants on a square yard of good garden soil after leaving it unhoed for a short time. Yet, as we shall see in a subsequent chapter, very many weeds are extremely harmful in grass land, where they may occur in plenty and sometimes occupy the land almost to the complete exclusion of good grasses and clovers.

The small extent to which a cultivated crop can compete with weeds has been shown at Rothamsted,¹ where a plot of wheat which was allowed to shed its grain and reproduce itself in subsequent years without any kind of cultivation or help against weeds was found in the second year to produce only about half a crop, less the next year, and only two or three stunted wheat plants in the fourth season, after which the wheat disappeared entirely—a literal case of a crop being “smothered by weeds.” Instances are known to every farmer in which a vigorous fight against weeds has had to be waged in order to raise a successful crop of corn or roots (see examples, p. 15). We may now

¹ A. D. Hall, *The Book of Rothamsted Experiments*.

deal with the various weeds of arable land, and the best means of eradicating them.

RANUNCULACEÆ

Mousetail (*Myosurus minimus* L.) is a small annual of cornfields, especially on damp land. It is 3 to 6 inches high, with erect, fleshy, linear leaves, and flowering stems, at the end of which are single, minute yellow-green flowers. Flowering takes place between April and June. In the fruiting stage the receptacle of the flower elongates enormously, when the stem and its achenes superficially resemble a miniature Plantain. It is not usually so plentiful as to be a serious pest, and, being an annual, thorough cultivation will keep it under.

Creeping Buttercup (*Ranunculus repens* L.) must be classed as one of the worst weeds of arable land. This Buttercup (Fig. 8) is a hairy perennial, with leaves divided into three segments, the segments also being lobed and toothed; stems 1 to 2 feet high, bearing yellow flowers of nearly 1 inch in diameter, and extensive runners which root at the nodes, and quickly cover the ground with a network of the weed. The flowers appear between May and August. If not attacked in good time seeds are plentifully produced and grow freely, soon completely overrunning the land. As stated at p. 27, the author found in cultivated garden soil over 650 seedlings of this weed in a square yard. It is sometimes introduced to farms in samples of clovers and ryegrass.

This pest must be attacked by means of vigorous and frequent cultivation, and the loosened plants must be collected and burnt. Fallow crops will be most useful, and if the weed be very plentiful, two root

crops may be taken in succession with the object of reducing it. The weed occurs most freely in damp



FIG. 8.—Creeping Buttercup (*Ranunculus repens* L.), $\times \frac{1}{2}$.

land, and draining is found to reduce it. In garden cultivation deep trenching will destroy the growing plants, but unless this work be done thoroughly it will

be better to fork out the weeds and burn them. Frequent hoeing in spring and summer will destroy thousands of the young plants (Fig. 9).

Corn or Field Buttercup (*Ranunculus arvensis* L.) is an annual which is frequently extremely troublesome in cornfields on all soils. It appears, however, to favour



Photo, 1903.

H. C. Long.

FIG. 9.—Seedlings of Creeping Buttercup (*Ranunculus repens* L.).

the chalk formation, and is plentiful on the strong and clayey wolds of North Lincolnshire, few being found on the light soils; and it is found in summer fallow wheat and winter sown barley more than in spring corn.

The Corn Buttercup or Crowfoot has very variable segmented and toothed leaves, and solitary stems 1 to 2 feet high. The flowers, opening between May and July, are pale yellow, and about $\frac{1}{2}$ inch across. In other

Buttercups the fruits are small, hard and dry (achenes), but in this species they are large, few in number, and covered with hooked spines. When ripe the fruits are flat and spiny, and in some districts they are known by the name of "Watch Wheels."

As this weed is an annual and grows rapidly in the spring months, it is obvious that spring cultivation and hoeing will destroy the seedlings. Later, should any flowering plants be observed they must be hoed out to prevent seeding. Cereals and unmilled sainfoin should be examined for the fruits before sowing.

PAPAVERACEÆ

Four species of the genus *Papaver* are met with in Great Britain—*P. Rhœas* L., *P. dubium* L., *P. Argemone* L., and *P. hybridum* L., while a fifth, *P. somniferum* L., the Opium Poppy, occurs occasionally as an escape from cultivation. The two first are the most important agriculturally, occurring commonly in cornfields in many parts of the country. What is a more magnificent sight than the waving scarlet cloth flung wide over the fields between June and August in the district around Cromer aptly named "Poppyland," in parts of Lincolnshire, Sussex, Hants, and elsewhere? The mixed Poppies and grain crop form indeed a striking and picturesque spot of colour in the landscape, especially when seen in undulating country and backed by woods. Yet all who are acquainted with the harm which an excess of weeds may cause will appreciate the picture also from another point of view, for the corn crop is sometimes ruined by the presence of the crowding scarlet-capped plants.

The Common Red Poppy (*P. Rhœas*) and the Long Smooth-headed Poppy (*P. dubium*) are erect annual

weeds of two or more feet in height, with deep tap-roots, and branched hairy stems and flower stalks ; the hairs in the former spread outwards from the flower stalk, but in the latter are pressed close to it. The stems exude a milky juice when bruised or cut ; the leaves are pinnatifid or "feathered," bearing segments arranged on each side of a common midrib ; and the scarlet flowers are about 3 inches across. In the case of *P. Rhæas* the seed capsule is not much longer than broad, but in *P. dubium* it is more than twice as long as it is broad. Both seed capsules are smooth, and contain seeds in large numbers, frequently as many as 10,000 to 50,000 on one plant. The seeds are very small, and on escaping from the capsule are carried about by the wind ; in addition, they are of an oily character, and when buried in the soil may retain their vitality for some years, germinating and producing new plants when brought to the surface under favourable conditions. This fact was recognised over a century ago : "The seeds remain underground, retaining their vegetative powers for a long time, and furnishing a fresh crop of Poppies whenever the earth is turned over."¹ It is therefore clear that if the Poppy is permitted to shed its seeds, these are so easily spread that it is difficult to keep one farm in a district clean if other farms are neglected.

These Poppies have received a large number of common names, of which the following may be mentioned :² — Corn Poppy, Cornflower, Corn Rose, Canker Rose, Cock Rose, Cop Rose, Copper Rose, Blind-eyes, Headache, Red-weed.

P. Rhæas occurs throughout the southern and mid-land counties of England, and in Ireland and the

¹ Smith and Sowerby, *English Botany*, 1799, vol. viii. p. 645.

² A. B. Smith, *Poisonous Plants of all Countries*, 1905.

Channel Islands, but, according to Hooker, is rare north of the Tay. *P. dubium*, however, is, according to the same authority, found in Britain north to the Shetland Islands. Both species are most commonly found on light, dry, sandy, and gravelly soils, but flourish even on heavy wheat land, though not to the same extent as on the lighter soils, such as barley land. It is during damp, warm weather in spring, on a soil in good tilth, that the Poppy seed germinates most freely, the established plants growing most strongly and rapidly in hot summer weather, when they may quickly mature and scatter their seed broadcast.

Poppies may be combated in several ways: (1) By employing pure seeds for sowing. (2) When the seeds are present in the soil deep ploughing should not be practised, as the seeds will only be brought to the surface later. Surface cultivation should be the rule, and after producing a fine tilth in the spring, and encouraging the seeds to germinate, thousands of the young plants may be destroyed later by the use of the hoe, light harrows, the Poppy Killer (Fig. 3), and various types of American Weeder. Such a method should be repeated until the corn crop is too high to permit of it, when hand weeding may be necessary. (3) Where Poppies are very plentiful it is useful to take an extra root crop in the rotation. (4) Spraying with the sulphates of copper and iron has been found to injure the Poppy. At the Woburn Experimental Farm in 1900 and 1901, *P. Rhæas* was sprayed with a 2 per cent solution of copper sulphate, and when the solution was applied to the underside of the leaves as well as to the upper surface, "the leaves turned brown, became shrivelled, and to a great extent the plant was killed, for the seeding was almost entirely prevented,



Photo, 1909.

J. C. Varty-Smith.

FIG. 10.—Fumitory (*Fumaria officinalis* L.).

the flower heads withering up.”¹ The height of the corn crop, however, would forbid spraying by means of horsed vehicles when the Poppies were nearly at the flowering stage, but a 3 per cent solution of copper sulphate (which in the case of Charlock spraying has been found to do little, if any, injury to the cereal crop) might be tried when the Poppies are no more than half grown. If necessary, two applications with an interval of a few days could be tried. It has been stated² that the common Scarlet Poppy is very sensitive to a 13 to 20 per cent solution of sulphate of iron, and since a cereal crop can withstand a 15 per cent solution (*vide* Charlock spraying), a solution of such a strength should be tried. With a solution of either of the sulphates 40 gallons will suffice for an acre.

(As to the poisonous properties of Poppies, see p. 281.)

FUMARIACEÆ

Common Fumitory (*Fumaria officinalis* L.) is a common annual of a rather prostrate habit of growth, often plentiful in cornfields on light, sandy, and loamy soils. This plant (Fig. 10) is 1 to 1½ feet high, with much divided leaves, and long racemes of many irregular dark or pale rose-purple flowers, which appear between May and September. It is occasionally very troublesome, but, being an annual, can be got rid of by persistent hoeing and surface cultivation in spring and early summer.

CRUCIFERÆ

Many plants of this order are troublesome weeds, almost all being pests of arable land; a number must

¹ *Jour. R.A.S.E.*, 1902, p. 360.

² F. Maier-Bode, *Die Bekämpfung der Acker-Unkräuter* 1908.

be considered here. Crucifers should be cut down and eradicated, both because they are harmful to crops, and because they harbour insects and fungi injurious to farm and garden crops.

Hedge Mustard (*Sisymbrium officinale* L.) is a common weed of hedgerows, waste places, and roadsides, in which latter position "it seems to have a peculiar aptitude for collecting and retaining dust" (Johns). It is an annual 1 to 2 feet high, with deeply lobed, hairy leaves, and small yellow flowers; the downy pods when ripe are closely pressed to the leafless stem. It can be kept in check by hoeing and cutting down to prevent seeding.

Garlic Mustard (*Sisymbrium Alliaria* L.), also known as Sauce-alone, Jack-by-the-Hedge, is a leafy annual of 2 to 3 feet high, with rather large stalked leaves, more or less heart- or kidney-shaped, and coarsely toothed. The flowers are white, $\frac{1}{4}$ inch across, and appear from April to June, while the stiff, rather curved pods are over 2 inches long. This weed is very common along hedge banks and similar positions, especially on the heavier soils. It should be regularly cut down.

Charlock (*Sinapis arvensis* L.), so well known as Kedlock, Skellock, Yellow Weed, and Wild Mustard, is a ubiquitous weed of arable land, especially cornfields, and is probably more troublesome on almost all soils (especially light calcareous loams) than any other annual. It is a tall, rough, branched weed, with large ovate or lyrate toothed leaves, yellow flowers of $\frac{1}{2}$ inch or over in diameter, and spreading, angled, rough pods 1 to 2 inches long (Fig. 11). When pulled by hand Charlock quickly discolours the skin a dirty green.

Not only is this pest a strong, rapid grower, but

it produces an abundance of seed, which ripens quickly, and has a wonderful vitality which enables it to lie for many years in the soil uninjured, and later such buried seed may germinate when brought to the surface. Further, the seeds ripen before cereal crops are cut, and this affords an opportunity for the perpetuation of

the weed, which is only overcome with the greatest difficulty. If land be laid down to pasture, Charlock will disappear, being exclusively a weed of cultivated land; but should an old pasture be ploughed, Charlock is almost certain to spring up. Experiments conducted by Professor Peter at Göttingen have shown¹ that the seeds of Charlock can retain their

vitality or germinative capacity for forty years, especially when they lie at considerable depths in the soil.

Losses due to profuse growth of Charlock and allied species (described below) have been found in Germany to be very great. The following examples may be



FIG. 11.—Charlock (*Sinapis arvensis* L.), $\times \frac{1}{3}$.

¹ *Deutsche Landw. Presse*, July 24, 1909.

given, taking 2.5 acres to the hectare, 2.2 lb. to the kilogram, and oats at 42 lb. per bushel :¹—

	With Charlock, Bushels per Acre.	Without Char- lock, Bushels per Acre.	Approximate Loss due to Charlock, per Cent.
1. Oats.	45	67	33
2. Oats	24.8	76.5	67.5

There are three chief methods of combating Charlock : (1) By preventing the introduction of the seeds in seeds for sowing, (2) by destroying the seedlings and older plants by mechanical means, and (3) by spraying.

The first plan is obvious, and may be said to be applicable to all weeds, and has been dealt with elsewhere.

As regards the second method, this may be carried out in several ways : by hand hoeing corn crops ; by bringing about a fine tilth in warm spring weather to encourage the Charlock seeds to germinate, and then passing light harrows or the American Weeder over the young plants ; by hand and horse hoeing root and pulse crops ; by chopping off the flowering heads by means of reaping-hooks, scythes, hooks with jagged teeth, and various specially constructed machines ; and by hand pulling. The growth of early potatoes, with the constant tillage they receive, is a valuable means of destroying Charlock. Root crops generally are more useful than any other where Charlock abounds, as the frequent hoeing both aids the roots to grow more

¹ *Arb. der Deut. Land. Gesell.* : Ackersenf und Hederich, Gustav Schultz, 1909.

strongly, and destroys immense numbers of seedlings. Sometimes also the seeds of Charlock may be encouraged to germinate in a mild autumn, when the young plants are destroyed by the first sharp frost. An important plan, which should be more often practised, is to use a trough on the harvester or binder when cereal crops are cut, in order to catch the Charlock and other seeds which are shed, and prevent them from reaching the ground (see p. 30).

The third method, spraying, is of great importance, and may be carried out when the cereal crop and the Charlock are both young. The narrow, smooth, erect leaves of the cereal do not retain much of the solution used, and consequently escape any permanent injury, while the somewhat broad, rough, horizontal leaves of Charlock catch and retain the solution, and are thus permanently damaged. In May and June, when the Charlock plants are in the "rough leaf," and not over 3 inches high, and while the cereal is still comparatively short, the whole may be sprayed with a 2, 3, or 4 per cent solution of copper sulphate (8, 12, or 16 lb. in 40 gallons of water), applying 40 gallons per acre by means of a machine which generates a fine spray under air pressure. Soft water should be used when possible, the copper sulphate should be of 98 per cent purity, and wooden buckets or tubs should be employed for mixing.

Sulphate of iron at the rate of 40 gallons per acre of a 15 per cent solution (60 lb. in 40 gallons of water) may be employed in place of copper sulphate.

Such spraying, if well done, results in a large proportion of the young Charlock then growing being killed (see also p. 45). The seeds of Charlock contain a considerable amount of oil, and it is stated by Percival that they are sold by many farmers to oil-

cake manufacturers, finally appearing as impurities in rape and other "cakes."

Wild Radish, Runch (*Raphanus Raphanistrum* L.), also known as White Charlock, or Jointed Charlock, resembles *S. arvensis* in habit. It is a stout erect or spreading annual, somewhat hairy, with large lyrate, coarsely toothed leaves, white- or straw-coloured flowers $\frac{3}{4}$ inch in diameter, and pods 1 to 3 inches long. This weed flowers between May and September. It should be dealt with as described above in the case of Charlock, but it is essential to spray the young plants.

"During September (1907) the Board received from Wolverhampton specimens of two cruciferous weeds resembling White Charlock (*Raphanus Raphanistrum* L.). They were identified as *Raphanus microcarpus* Willk. and *R. sativus* L., var. *oleifer* DC. The former is not very common in this country, while the latter is a rare casual. As they were growing freely amongst corn, the weeds were sprayed early with strong, pure, copper sulphate solution, which, however, had no effect on them whatever. They are not likely to prove very troublesome, but where they come up thickly the hoe should be freely used in a root crop, while in corn crops they should be hoed, or "topped," with a scythe when the plants are flowering. Some plants are very bulky, consisting of as many as twenty stems, while they are from 2 feet to 3 feet high. The introduction of a potato crop into the rotation two or three years after a root crop often clears land of Charlock, and this plan might be tried with the species under consideration. Seeding should be prevented, even if hand pulling must be resorted to, while any grain sown should be entirely free from the seeds."¹

Wild forms of Brassica allied to the turnip, rape or

¹ *Jour. Bd. Agric.*, February, 1908.

swede, occur as weeds of cultivated fields on practically all soils, flowering from June to September. They should be attacked in the same way as Charlock.

Gold of Pleasure (*Camelina sativa* L.) is a slender annual of 2 to 3 feet in height, branched above, with small yellow flowers of $\frac{1}{8}$ inch in diameter, and somewhat egg-shaped inflated pods. Flowers appear in June and July. This plant is an escape from cultivation, and occurs sporadically among flax and in cornfields. It is not troublesome in general agriculture. Hooker states that the seeds are used for soap-maker's oils, oil-cake, and for feeding poultry. Where plentiful, it should be attacked vigorously with the hoe or by hand pulling.

Shepherd's Purse (*Capsella Bursa-Pastoris* DC.) is found in almost all situations and at almost any time of the year, flowering practically from early March to early December. It is a branched, upright annual (Fig. 12), which attains nearly 18 inches in height; the small white flowers are placed on slender stalks, and are about $\frac{1}{16}$ inch in diameter; the roots are long and tapering. At the base of the stem a rosette of leaves is spread flat upon the soil, the plant therefore demanding considerable space. Seeds are produced in large numbers, the seed "pods" being somewhat peculiar in shape, almost triangular, and much compressed laterally, resembling a shepherd's "sporrán." The flowers and pods easily distinguish it from other weeds of the order.

Shepherd's Purse is occasionally a troublesome pest, especially on light land, occurring abundantly both in field and garden. It grows rapidly and seeds freely in hidden positions behind larger cultivated plants; the soil is often rapidly covered by young plants, which frequently follow one another as fast as they are hoed out. In addition, the weed, like other crucifers, serves as a host for insect pests, and is specially liable to be

infested by the white rust *Cystopus candidus*, which may



FIG. 12.—Shepherd's Purse (*Capsella Bursa-Pastoris* DC.), $\times \frac{1}{3}$.

become distributed to cultivated crucifers, such as wall-flowers, cabbage, and related plants.

As Shepherd's Purse is a quick-growing annual, which seeds freely in many months of the year, the obvious remedy is the prevention of seeding. To this end the hoe should be kept vigorously at work whenever the pest appears. In field cultivation also the seeds may be encouraged to germinate, and then be destroyed by the use of the harrow, or in root crops with the hand or horse hoe.

Field Pepperwort (*Lepidium campestre* Br.) is an annual or biennial weed, 6 to 18 inches high (Fig. 13); it is slightly branched; the leaves on the stems are almost lanceolate, and arrow-head shaped at the base; the white flowers are very small, and the ovate rough flattened pods about $\frac{1}{4}$ inch in diameter. Flowering takes place between May and August; last season (1909) in Lincolnshire it was practically over by mid-July. The weed is



FIG. 13.—Field Pepperwort (*Lepidium campestre* Br.), nat. size, with flower enlarged.

occasionally very troublesome in arable land. Only last summer (1909) a friend wrote to the author from Lincolnshire: "I never saw Pepperwort here until a few years ago; it appeared in a field on the site of an old stackyard, now all arable. I hoe it, pull it, and this year I have mown 50 square yards, corn and weeds together. It seems to spread awfully, and is appearing at other points. I am sowing the field down to four years' ley, and trust it will not come after."¹ The taking of a root crop, or if necessary two root crops in succession, should reduce it considerably. As the plant is only produced from seed, seeding must be prevented by tillage operations or by hand pulling.

Another **Pepperwort** (*Lepidium Draba* L.) is occasionally troublesome on land near the sea, as on warp land, chiefly in the south of England. Although an "alien" in Britain, it is a common weed of roadsides and fields on the Continent. It is a perennial, branched, downy plant, 1 to 3 feet high. The leaves are oblong, the lower being stalked, while the upper have an arrow-headed base which clasps the stem. The flowers are white, $\frac{3}{4}$ inch in diameter, in short corymbose clusters. The pods are nearly heart-shaped, and constricted in the centre. Flowering occurs from May to June. If allowed to seed, this weed may spread rapidly and become a pest. It is therefore necessary to prevent seeding entirely for a year or two by thorough tillage operations and the use of hoed crops.

Penny Cress or Mithridate Mustard (*Thlaspi arvense* L.) is an erect annual with simple stem, 1 to 2 feet high. The leaves on the stem are somewhat oblong, arrow-shaped, and toothed; the white flowers are only $\frac{1}{4}$ inch across, while the round flat pods are two or three times this diameter, broadly winged, with a deep notch at the

¹ W. C. Brown. See p. 241.

top, and borne on slender stalks. The seed-vessels have been compared in appearance with silver pennies ; they are easily scattered by the wind. Each pod contains about a dozen brownish oval seeds, and an average plant is stated to produce about 20,000 seeds.¹ The flowers appear from May to July or later. The plant has an unpleasant smell when bruised.

This weed should be persistently hoed out to prevent seeding, and the growth of root or other hoed crops will render this possible and easy. Where the weed is very abundant it should be mown and burnt. Penny Cress is a noxious weed in the Dominion of Canada, and is described as a terrible pest of the farmer in Manitoba and the North-West. It is there known as Stinkweed, on account of its abominable smell. "S-t-i-n-k is a small word with a big meaning, easily understood by any one who has ever handled Stinkweed, or tasted milk or butter from a cow which has eaten it."²

In order to eradicate Penny Cress, great care should be taken not to plough under plants with ripe seed-vessels. Where land is infested, an endeavour should be made to encourage germination by means of surface cultivation, proceeding generally to harrow the young plants as described in the case of Charlock (p. 60). Taking three or four years' ley will largely choke out the weed, and any plants which may appear the first year may be cut and destroyed. Should any plants appear in the next cultivated crop, they must be attacked with the hoe, by hand pulling, and by general cultivation.

Bitter Candytuft (*Iberis amara* L.) is an annual weed of cornfields, especially on dry chalky soils in the

¹ Bull. 128, Ontario Agricultural College.

² *Farm Weeds*, Dept. of Agric., Ottawa.

south and east of England. It is under a foot high, with sessile oblong-lanceolate leaves, white, reddish, or purplish flowers $\frac{1}{4}$ inch in diameter, and very small, broad, flat pods. The flowers appear about July. Where this weed occurs plentifully, it should be met by surface cultivation and the vigorous use of the hoe.

Wart Cress, Swine's Cress (*Senebiera Coronopus* Poiret.) is an annual or biennial weed of cultivated ground, roadsides, and waste land. It is a small, smooth, leafy plant, with many slender prostrate branches. The minute white flowers are in very short clusters opposite the leaves, and, with the small compressed pods, give the plant the appearance of being "warty." Flowering takes place between June and September. This weed must where necessary be hoed out. It is unlikely to be very troublesome, but occurs sometimes in cornfields.

VIOLACEÆ

Heart's-ease, Corn Pansy (*Viola tricolor* L. and sub. sp.) is chiefly a weed of arable and waste land. It is a very variable annual, with angular branched stem 6 to 18 inches high, and well-known, pretty flowers $\frac{1}{4}$ to $1\frac{1}{4}$ inch in diameter. It has a long flowering period, from May to September, and is perhaps most common in cornfields. The seeds occur in samples of timothy, alsike, and other farm seeds. Persistent hoeing of root crops after corn, with surface cultivation if the pest is plentiful, will reduce it; and, as it seeds freely, it must not be permitted to ripen its seed capsules.

CARYOPHYLLACEÆ

Bladder Campion (*Silene inflata* Sm.) is one of the commonest weeds of cornfields, and grows on many kinds of soil. It is a smooth, shiny perennial, 1 to 2 feet high, with ovate or oblong pointed leaves and drooping white flowers $\frac{3}{4}$ inch in diameter, appearing from June to August. The calyx is inflated and bladder-like, with violet veins, and is often picked by children to "pop" by hitting the open end against the hand. The capsule is globose.

Red Campion (*Lychnis diurna* Sibth.) is a softly hairy, viscid perennial, 1 to 3 feet high, with slender, branched rootstock. The leaves are ovate, and the flowers, which are found in June and July, have reddish-pink divided petals.

White Campion, Evening Campion (*Lychnis vespertina* Sibth.) much resembles *L. diurna*, but the flowers are white, and fragrant at night. Flowering occurs between June and September. This plant is perhaps most common on light, sandy soils.

These three species are all common enough in cornfields, leys, and clover crops. Their seeds are often found as impurities in timothy and clover samples. Wherever the plants are met with an endeavour should be made to prevent seeding by hand pulling or other means. Only pure clover samples and temporary "seeds" should be sown.

Corn Cockle (*Agrostemma Githago* L.), a common plant of cornfields, is dealt with at p. 283.

Mouse-ear Chickweed (*Cerastium triviale* Link.) occurs in arable land, and, like the following species, is sometimes very troublesome. It is also common in grass land (see p. 156). A closely-allied perennial species, *C. arvense* L., occurs in quantity on arable land,

especially on light, sandy soils. It has a hairy stem, linear-lanceolate leaves somewhat crowded at the base of the shoots, and clusters (cymes) of many small, white flowers.

These two species are frequently kept down by the earlier sown cereals, which soon over-top the low-growing weeds. They are harmful, however, owing to their habit of growing closely around the base of the stems of corn and root crops. Thorough cultivation, and deep ploughing with the use of the skim coulter, keeps them in check.

Chickweed (*Stellaria media* L.) is an annual weed which is ubiquitous on arable land on most soils, especially in gardens and on rich, well-tilled land. It is a low, prostrate weed, much branched, and easily distinguished by the fact that "a linear whisker runs up one side of the stem, and when a pair of leaves is reached the whisker is continued on the opposite side" (M'Alpine and Wright). "Water poured on the plant runs down these, and Stahl explains them as adaptations similar to drip-tips (*cf.* *Ficus*) for drying the plant after rain; Lindman thinks they convey the water to the leaf-axils, where it is absorbed by the plant."¹ The leaves are ovate, the lower ones being stalked and the upper sessile. Large numbers of small white flowers in lax clusters are produced from early spring to late autumn, and the plant exhausts itself in seed production. Chickweed is a lowly weed which hugs the soil closely, wrapping the ground in a mantle of green. It is perhaps more troublesome in gardens than on the farm; but it grows and matures so rapidly, and sheds such an abundant supply of seeds, that a close watch must be kept upon it. To keep it down a continual use of the hoe in hot dry weather is neces-

¹ Willis, *Flowering Plants and Ferns*.

sary. In damp weather, especially in garden cultivation, the hoed-out weeds may with advantage be raked off and placed on the compost heap or smother fire, or be deeply buried in the rubbish trench for the growth of marrows. On the farm, surface cultivation to encourage the germination of the seeds, followed by harrowing in hot weather, will destroy large numbers of the seedling plants. Deep ploughing, with the use of the skim coulter, will also destroy this weed. In root crops, where the weed presses closely around the base of the plants, especially on the tops of potato-drills, the hand and horse hoe must be freely used.

Sandwort (*Arenaria tenuifolia* L.) is an erect, slender annual, 3 to 9 inches high, with fine narrow leaves, rather crowded below and widely separated above. The white flowers, $\frac{1}{2}$ inch across, in many-flowered cymose clusters, appear from June to August. It is not commonly troublesome, but occurs in sandy fields in some districts, chiefly in the Eastern counties (Hooker).

Thyme-leaved Sandwort (*Arenaria serpyllifolia* L.) is another annual somewhat similar to *A. tenuifolia*. It is, however, downy, more or less decumbent, repeatedly forked, with broader leaves, which are ovate and pointed, resembling those of thyme, and much smaller flowers ($\frac{1}{8}$ inch in diameter), which open between June and August. This weed is abundant in dry places, even on walls, and in dry cornfields.

Both species of Sandwort require the vigorous use of the hoe, and encouragement of the seeds to germinate for subsequent destruction with the harrows during spring. Owing to their small size they are unlikely to do much harm in cornfields, unless present in quantity.

Spurrey (*Spergula arvensis* L.) is one of the most troublesome weeds of arable farms on light sandy soils,



Photo, 1909.

J. C. Varty-Smith.

FIG. 14.—Spurrey (*Spergula arvensis* L.).

and, if not checked, quickly ripens large quantities of seeds, which are readily shed. This weed (Fig. 14) is a more or less downy and sticky, branched annual, 6 to 18 inches high, with thickened nodes or joints. The leaves are small and fine, $\frac{1}{2}$ to $1\frac{1}{2}$ inch long, awl-shaped, with a groove beneath, and arranged in whorls at the joints of the stem. The flowers, appearing between June and August, are small ($\frac{1}{4}$ inch across), white, on slender stalks in loose terminal clusters (panicked or sub-umbellate cymes). The seed capsules are more or less round.

Spurrey invades both corn and root crops, and if plentiful may quite smother any spring or summer sown crops. The growth of young turnips may be seriously impeded by the luxurious growth of Spurrey, and the thinning of carrots may be an arduous task completed with the greatest difficulty, while corn crops may be quite overrun by the pest. "It never does any injury to corn after lea, but corn after root-crop is sometimes completely destroyed by it, and the grazing grasses and clovers sown with the corn may be entirely smothered."¹

Wherever Spurrey appears, strenuous efforts must be made to prevent it seeding. If root crops be infested they should be hoed as often as may be necessary to keep down the weed and prevent the ripening of seed, while the roots should be hurried on by means of manures. Should a corn crop be early observed to contain Spurrey, the weed should be hoed out or hand pulled; but if the land be known to contain the seeds, the surface cultivation recommended for Poppies (p. 55) should be practised. In the case of fallow crops also, late quick-growing turnips may be sown; this will afford an opportunity for one or more surface

¹ M'Alpine and Wright, *H. and Agric. Soc. Trans.*, 1894.

cultivations at intervals of a fortnight before the turnips are sown. Large quantities of Spurrey may thus be destroyed in this manner, and the practice may be followed by thorough hand and horse hoeings. If necessary, the next "seeds" may be sown without a corn crop, and this also will enable the plan of surface cultivation in spring to be followed, the "seeds" being sown in June.

It is stated that lime has a good effect in ridding land of Spurrey, and Hall even says that the presence of Spurrey on arable land is a pretty sure sign of the absence of lime. At Woburn, when part of an infested field was treated with lime, the Spurrey disappeared. On the other hand, a correspondent of the *Mark Lane Express* states¹ that "in November 1908 I ploughed into 4 acres about 13 tons of gas-lime, and this spring my oats were suffocated with Spurrey." In an experiment at Capel Curig also, two plots, which respectively received 10 cwt. and 20 cwt. of ground lime before the corn was sown, showed no difference at harvesting. Where, after the corn and Spurrey had made some growth, a plot was sprayed with 50 gallons per acre of a 5 per cent solution of copper sulphate, the Spurrey was completely destroyed. In another trial at Bodorgan, where a considerable quantity of Spurrey appeared, 3, 4, and 5 per cent solutions of copper sulphate were tried; all were more or less effective, only half the Spurrey forming seed on the plot treated with the 3 per cent solution, and not more than 20 per cent on the other two plots.²

A form of Spurrey is widely grown as a fodder crop in Belgium and elsewhere on the Continent, and

¹ August 30, 1909.

² Agric. Dept., Univ. Coll. N. Wales, Bangor, *Bull.* ix., 1906; *Bull.* vii., 1907.

a crop badly infested with the weed may be fed off with sheep before the seeds are ripe. The weed is also occasionally made into hay. Wolff quotes the following analyses of Spurrey:¹—

	GREEN.		HAY.	
	Total.	Digestible.	Total.	Digestible.
Water	80.0	...	16.7	...
Crude Albumen	2.3	...	12.0	...
Crude Fibre	5.3	3.3	22.0	13.1
Nitrogen-free Extract	9.7	6.5	36.6	23.7
Fat	0.7	0.3	3.2	1.9
Ash	2.0	...	9.5	...
Albuminoids and Amides . . . . .	...	1.5	...	7.6

ILLECEBRACEÆ

Annual Knawel (*Scleranthus annuus* L.) is a small tufted annual (or biennial) under a foot high, with slender branched prostrate stems, nearly awl-shaped leaves of about $\frac{1}{2}$ inch long, placed opposite one another in pairs, and small green flowers in clusters at the end of the stems or singly in the axils lower down. The flowers open from June to September. The fruits are one-seeded. This weed (Fig. 15) is common on arable land, especially on light, sandy soils, where it may prove troublesome. The seeds are sometimes found in samples of clover and grass seeds.

When this weed is at all plentiful it should be hoed out; in corn crops, surface cultivation in spring (see p. 34) quickly reduces it. Crops which grow vigorously

¹ *Farm Foods*, pp. 300 and 302.

—*e.g.* vetches—smother it out. If very plentiful in young clover, the latter may be cut early for hay.



FIG. 15.—Annual Knawel (*Scleranthus annuus* L.), nat. size, with flower magnified.

GERANIACEÆ

Three species of Geranium or Crane's-bill commonly occur as weeds of arable land. All are annual or biennial weeds, all flower between the months of May and September, and in all the fruit is extended into

a long "beak," resembling the bill of a crane, hence the name Crane's-bill (*Geranium* is derived from the Greek *geranos*, a crane).

Dove's-foot Crane's-bill (*Geranium molle* L.) is softly hairy, prostrate in habit, with branches up to 1 foot long, leaves somewhat round, and seven- to nine-lobed, and rose-purple or pink flowers nearly $\frac{1}{2}$ inch in diameter. This species chiefly occurs on light, sandy, loamy and calcareous soils, and the seeds are commonly found as an impurity in samples of white clover.

Cut-leaved Crane's-bill (*G. dissectum* L.) is a hairy weed, with long, slender, spreading, branched stems, roundish leaves divided nearly to the base into five to seven lobes, which are themselves segmented, and bright red flowers nearly $\frac{1}{2}$ inch across. This weed (Fig. 16) is found in positions similar to *G. molle*, and its seeds



FIG. 16.—Cut-leaved Crane's-bill (*Geranium dissectum* L.), $\times \frac{1}{2}$, with flower nat. size.

are a frequent impurity in samples of clover and ryegrass seeds.

Herb Robert (*G. Robertianum* L.) is a well-known flower of hedgerows, roadsides, and waste places, but occurs also in both grass and arable land, especially on loamy, clayey, and calcareous soils. It is the most common and generally distributed of the Crane's-bills. The straggling branched stems are reddish, brittle, and somewhat hairy; the leaves are segmented and pinnatifid, and in autumn become reddish like the stems; the flowers, $\frac{1}{2}$ inch across, are bright pink, elegantly veined and streaked with dark and light red. The whole plant has a strong, but not altogether unpleasant, smell.

Wherever the Crane's-bills occur in cultivated crops they should be eradicated, more especially when clovers or grasses are intended for seed. They may be removed by hand from clovers and rotation grasses, and this should be done early before the seed is ripened. All are propagated only by seed, and in hoed crops therefore may easily be destroyed, as they are seldom very plentiful in such positions. As regards grass land, see p. 159.

ROSACEÆ

Silver-weed or Goose Grass (*Potentilla Anserina* L.) is a perennial weed of prostrate habit, very common by roadsides, its glossy, silky, silvery-white pinnate leaves, bright yellow flowers, and long runners making it a conspicuous object in the summer months (Fig. 17). It is occasionally a serious pest on arable land, growing well on almost all soils, especially when these are damp. Silver-weed is not easily eradicated, as the runners are readily broken, and, as they root at the nodes, small pieces form new plants. Where the weed is a pest it should be given no rest during which it can

re-establish itself. Extra deep ploughing, with the use of a skim coulter, will kill much of it, and in ordinary tillage operations much may be gathered and burnt after harrowing. Two fallow crops, such as potatoes and mangolds, may also be taken in succession, so as



Photo, 1909.

H. C. Long.

FIG. 17.—Silver-weed (*Potentilla Anserina* L.).

to afford an opportunity for continual cultivating and hoeing.

It has been recorded¹ by Mr. W. E. de Winton, Pembroke, that wood-pigeons are at certain times partial to the "sweet and succulent root of the Silver-weed," while pheasants also eat it. Some pigeons, indeed, "seemed to prefer an exclusive diet of this root."

Creeping Cinquefoil (*Potentilla reptans* L.) is a perennial of similar habit to the last-named species, with runners rooting at the joints, long stalked leaves divided into five lobes, and solitary yellow flowers on slender

¹ *Jour. Bd. Agric.*, Feb. 1908, p. 686.

stalks. The flowers appear from June to August. Like *P. Anserina*, it occurs by roadsides, in pastures, and in arable land, and should be dealt with in the same way. (See also p. 164.)

Parsley Piert, Field Lady's Mantle (*Alchemilla arvensis* Lamk.) is a small annual (Fig. 18) often



Photo, 1907.

H. C. Long.

FIG. 18.—Lady's Mantle (*Alchemilla arvensis* Lamk.)

common in cornfields on dry, loamy, and calcareous soils. It is a hairy plant, 4 to 9 inches high, with

small fan-like leaves which appear to clasp the stem like an inverted mantle, while the dense clusters of minute green flowers, appearing from May to August, are crowded in the axils. Where this weed occurs in quantity it should be hoed out; the growth of a root crop reduces it.

UMBELLIFERÆ

Shepherd's Needle (*Scandix Pecten-Veneris* L.), also known as Needles, Venus' Comb, and Crow's Needles, is an annual weed of cornfields, especially on light and chalky soils, and is sometimes very troublesome. In North Lincolnshire, for example, it appears to grow, like *Ranunculus arvensis* (p. 52), exclusively on the Chalk formation, and not on the Oolite. "Needles seem to favour the thinner soils on chalk, and come in any corn crop, autumn or spring sown. Not troublesome on the *strong* land, which runs in some places in valleys or on the edge of the chalk" (W. C. B.). Hooker describes the Shepherd's Needle as "a cornfield weed from Ross southwards."



FIG. 19.—Shepherd's Needle (*Scandix Pecten-Veneris* L.), $\times \frac{1}{2}$, with enlarged flower.

The Shepherd's Needle (Fig. 19) is a small plant of

6 to 18 inches high, much branched from the base, somewhat hairy, with leaves finely cut into slender segments. The umbels of small white flowers are at the end and side of the stem, and the fruit is prolonged into a very slender rough beak, 1 to 3 inches long, hence the names of the plant. Flowering occurs between June and September.



FIG. 20.—Hedge Parsley (*Torilis nodosa* L.), $\times \frac{1}{2}$, with enlarged flower.

This weed is perhaps of sufficiently early growth in spring for much of it to be destroyed by surface cultivation, but in corn crops it may be necessary to hand pull it, although this is too tedious and expensive an operation on large areas. Where very plentiful it is worth while to take two root crops in succession; a late sown turnip crop permits of much of the weed being destroyed. Seeding must be prevented.

Hedge Parsley (*Torilis nodosa* L.) is a plant which occurs on dry banks, in hedges, and along the margins of fields "from Forfar southwards, rather rare in Scotland and Ireland" (Hooker). It

is common in calcareous corn-fields, and is an annual which flowers in May to July. Its stems are 6 to 18 inches high: "Well distinguished from all other British umbelliferous plants by its prostrate stem, its very small, almost globular, simple, lateral, and nearly sessile umbels of small pinkish-white flowers, and by the outer fruits in each umbel

being covered with hooked bristles, while the inner are warty.”¹

This plant (Fig. 20) should be cut down regularly before seeding takes place, and if this be done it will be materially reduced in two or three years.

Fool's Parsley (*Æthusa Cynapium* L.), described at p. 298, is an annual weed of gardens and arable land generally. In North Lincolnshire it appears to be very annoying on the low clayey peaty alluvium, and is difficult to eradicate, even a bare fallow in 1908 failing to reduce it effectively, the wheat crop in 1909 being full of it. As the weed is an annual, two successive root crops should materially reduce it, if hoeing be regularly and faithfully practised. Fool's Parsley is poisonous, and should be hoed out or hand pulled wherever it appears.

RUBIACEÆ

Cleavers (*Galium Aparine* L.), commonly termed Goose-grass, Cliver, Hariff, Cliders, Clithe, Grip-grass, or Catch-weed, is a weak hook-climber which occurs on all soils on arable land, in hedges and waste places. This weed (Fig. 21) is a straggling annual, often climbing several feet with sufficient support, and forming tangled masses amongst other vegetation. The stems are four-angled, and bear small, stout hooked hairs, by means of which the weed obtains support on other plants; the leaves are narrow and lanceolate, $\frac{1}{2}$ to 2 inches long, and arranged in whorls of six to eight; the small flowers appearing in June and July are white, in small clusters, and grow from the axils of the leaves; the large, roundish, two-lobed fruits are purplish, very rough, and adhere closely to the clothes of man or the fur of animals, by

¹ Johns, *Flowers of the Field*.



FIG. 21.—Left: Cleavers (*Galium Aparine* L.), with seedling $\times \frac{2}{3}$, and flower nat size. Right: Field Madder (*Sherardia arvensis* L.), $\times \frac{2}{3}$, and flower nat. size.

whom they are easily distributed. The whole plant is very rough to the touch ; it is often chopped up and fed to poultry.

Cleavers is especially troublesome among cereal crops on light, loamy soils, climbing among the corn, pulling it down, and rendering harvesting difficult. The fruits are found in samples of red clover, Italian ryegrass, and seed corn, and care should be taken that they are not in this way introduced to the farm. Percival says, "In some of the worst cases we have seen the weed was brought to the farm by dung containing the seeds," and this source of contamination should be guarded against. The seedlings (Fig. 21) are much like the mature plants, and easily recognisable. The pest is most conveniently eradicated by hoeing during the spring months, and by surface cultivation generally.

Corn Bedstraw (*Galium tricornne* With.) closely resembles Cleavers, but is smaller and has more prostrate stems ; the fruits are large, with no clinging hooks, and are borne on slender recurved stalks. It is an annual weed of cornfields, especially on chalk soils, from Cumberland southwards, but apparently absent from Scotland and Ireland (Hooker). The flowers appear from June to October. It should be dealt with in the same way as Cleavers.

Field Madder (*Sherardia arvensis* L.) is a small, much-branched prostrate annual, with stems 6 to 18 inches long. The narrow, pointed, obovate-lanceolate leaves are under an inch in length, and in whorls of four to six ; the small lilac flowers, which open from April to October, are $\frac{1}{8}$ inch in diameter, in terminal sessile clusters ; the two-lobed fruits are small and rough, crowned by the erect, spiny calyx-teeth.

Field Madder (Fig. 21) is often very plentiful in cultivated fields, and occurs particularly on light sandy,

loamy, and calcareous soils. The fruits are a fairly common impurity in red clover samples and in samples of Italian ryegrass. Like other annuals it must be attacked by means of the hoe and by surface cultivation from quite early in spring, as it flowers and seeds from April onwards. Pure farm seeds should be sown.

COMPOSITÆ

Cornflower, Corn Bluebottle (*Centaurea Cyanus* L.) is an annual or biennial 1 to 2 feet high, with blue flowers, and is a favourite garden plant, there being several cultivated varieties of different colours. Flowering takes place from June to September, and the seeds are easily scattered by the wind. Although the Cornflower appears occasionally in grass land, it is, as its name implies, chiefly a weed of cornfields, and it is said to be a good index of poor sandy soils. Hoed crops and surface cultivation during the spring months reduce it; care should be taken that samples of red clover, trifolium, and grass seeds are free from its seeds.

Creeping Thistle (*Cnicus arvensis* L.) is typically a weed of arable land, and is, as stated at p. 180, held by some to be the commonest weed pest of agriculture.

A general account of this Thistle is given with other species at p. 180, and the harm it does in corn crops is there noted. The creeping roots often run deeply into the soil, and are propagated in every direction horizontally, while the flowers produce an abundance of seed which is distributed by the wind to great distances, thus causing neighbouring crops to be infested. Flowering unfortunately takes place between July and September, during the time of harvest, and the distribution of its seeds is ensured during the process of cutting and carting corn. Where this pest is found in

corn crops great care should be taken to hoe early and late in spring, and pull up the Thistle by hand as long as it is possible to get among the standing corn.

The creeping roots are easily broken by the plough, cultivator, or harrows, and this renders the pest almost more difficult to deal with than Couch (*Triticum repens*) or Bindweed (*Convolvulus arvensis*).

The only final method of reducing the Creeping Thistle consists in destroying the rootstocks, and this can be done by the process of exhaustion—cutting off all shoots that appear until the reserve of food in the roots is used up. Faithful, systematic work will in this way almost certainly have the desired effect, and it is this principle which is involved in the statement that “the growth of a couple of root crops in succession where the weed is very prevalent in arable land is a sure plan of getting rid of this most troublesome agricultural pest.”¹ In root crops the hoe must be kept regularly at work; it is not enough merely to prevent seeding: the new shoots must be prevented from attaining any size and strength, the end in view being to encourage the roots to throw up successive batches of shoots for the hoe and the sun to destroy.

Other species of Thistles which occur in arable land may be similarly attacked, but except in the case of the Corn Sow Thistle (p. 101), creeping rootstocks do not make the process so difficult.

Coltsfoot (*Tussilago Farfara* L.), known also as Foal's-foot, is undoubtedly one of the most troublesome weeds of arable land, and questions are frequently asked as to its eradication. It produces a dense mass of creeping rootstocks, and is one of the few plants, like Butterbur, which send up their flower stalks before the leaves. Thick flowering stalks, 4 to 12 inches high, and bearing

¹ Leaflet No. 166, Bd. Agric.

many scaly bracts, appear during the months of February or March and April, and at the summit of each is a yellow head of flowers, over 1 inch in diameter (Fig. 22). In the bud stage the heads are drooping. In the seeding stage the heads are covered



Photo, 1909.

H. C. Long.

FIG. 22.—Coltsfoot (*Tussilago Farfara* L.), as seen in March, and showing the extensively creeping rootstock.

with a soft snowy pappus. The flowers are followed by large stalked leaves (Figs. 2 and 23), often nearly a foot broad, "cobwebby" above, and covered with dense white down beneath; the leaves continue during summer to manufacture food material for storage in the creeping rootstock for the production of flowers in

the next year. They are somewhat like a foal's foot in shape, hence the names of the plant.

Coltsfoot is especially a weed of moist or wet stiff soils, particularly if calcareous, an abundance of lime appearing to be favourable to it. The weed is very harmful for two reasons: (a) The extensively creeping rootstock monopolises the ground to the detriment of the cultivated crop; and (b) the large broad leaves cut off the light supply from the young growing corn



Photo, 1909.

H. C. Long.

FIG. 23.—Piece of ground infested with Coltsfoot (*Tussilago Farfara* L.), showing the leaves beginning to cover the ground after flowering is nearly over.

or other plants. Several methods of attacking Coltsfoot may be followed: (1) The flowering stems must be sought and cut early in the year in order to prevent seeding—this operation is of great importance, for as it is useless to lock the stable after the horse is stolen, so it is a poor plan to cut the leaves of Coltsfoot and dig out the rootstocks while seeding is permitted; (2) if the leaves appear in the cultivated crop they must be repeatedly cut off, this procedure tending to exhaust the reserves of food in the rootstock and pre-

vent the manufacture and storage of fresh material; (3) fairly deep draining may be necessary, for Colts-foot does not flourish on dry soils; (4) deep ploughing and cultivating, during hot weather, with the removal of the rootstocks, will materially reduce it; (5) the amelioration of the soil by the use of sand, ashes, and long farmyard manure will render the task of extirpation more easy; (6) the growth of dense crops like maize and vetches tends to reduce it, since it requires a good light supply, which is cut off by such crops.

Corn Chamomile (*Anthemis arvensis* L.) is a hairy annual of arable land, especially of cornfields. It is 1 to 2 feet high, "usually erect from a decumbent base," and much branched. The leaves are much divided into short linear segments, almost hair-like; and the flower heads are on long stalks, the outer florets being white, and having styles; the central or disk florets are yellow. The receptacle of the flower head of this and following species has small, thin, membranous bracts upon it among the flowers. Flowering takes place between June and August.

Stinking Mayweed or Stinking Chamomile (*Anthemis Cotula* L.) much resembles the last species, but is a few inches shorter, with thinner flower stalks. The leaves are more cut into hair-like segments and dotted with glands, and the plant has a strong foetid odour. The white ray florets are usually barren—without styles. It is an acrid weed, the crushed foliage often blistering the hands of those who gather it. This weed (Fig. 24) is often very troublesome in arable land, especially cornfields. It is annual, and flowers between June and September.

Wild Chamomile (*Matricaria Chamomilla* L.) is also a common annual weed of cornfields, flowering from

June to August. The plant is much branched, and in general appearance resembles *A. arvensis* and *Matricaria inodora*, but is smooth. The leaves are bipinnate, and



FIG. 24.—Left: Corn Marigold (*Chrysanthemum segetum* L.), $\times \frac{1}{3}$.
Right: Stinking Mayweed (*Anthemis Cotula* L.), $\times \frac{1}{2}$.

divided into narrow hair-like segments; the flower heads, in corymbose clusters, are only $\frac{1}{2}$ to $\frac{3}{4}$ inch in diameter, with an outer row of white florets, and a central yellow disk. The receptacle of the flower head

is hollow and conical, and there are no bracts among the flowers.

Scentless Mayweed (*Matricaria inodora* L.), also called Corn Feverfew and Horse Daisy, is a common annual or biennial weed of arable land and waste ground on all soils (Fig. 25). The stem is branched and angular, the leaves much cut and hair-like, and the heads solitary, and larger than in *M. Chamomilla*, being 2 inches in diameter. The whole plant is odourless, or nearly so. Flowering lasts from June to October.

These four weeds may all prove troublesome if allowed to seed, and, as all are annual or biennial, the chief method of reducing them consists in preventing seeding. This may be done by hoeing and surface cultivation in spring, by pulling up the growing plants so long as practicable in standing corn, and by the growth and thorough cultivation of root crops—two in succession if necessary.

Corn Marigold or Yellow Ox-eye (*Chrysanthemum segetum* L.) is a beautiful but destructive annual weed, 1 to 1½ feet high. It (Fig. 24) is smooth, light grey in appearance, and little branched. The leaves are somewhat oblong, toothed and lobed, the lower pinnate and stalked and the upper clasping the stem. The flower heads are golden-yellow, including the outer or ray-florets, and nearly 2 inches across; they open between June and September, or even October. The "seeds," which are produced in large numbers, are very light, and easily blown from field to field; they are said also to lie dormant like the seeds of Charlock; by reason of these facts the weed is very difficult to extirpate completely. Both seeds and flower heads are stated to be poisonous, and chaff containing many should be burnt and not given to stock. Thaer states¹

¹ *Landw. Unkräuter.*

that the seeds pass through the digestive system of



Photo, 1907.

H. C. Long,

FIG. 25.—Scentless Mayweed (*Matricaria inodora* L.).

the horse and other animals without losing their

vitality, and suggests that where chaff contains only a few it should be steamed before use.

The Corn Marigold is often very troublesome, especially on sandy and loamy soils, and in 1907 it was reported to the Board of Agriculture as doing much damage at Northallerton. "An attempt had been made to eradicate it by taking four successive green crops, but the weed was stated to be as flourishing as ever. The present year has been very favourable to its growth, and it has practically destroyed 2 acres of barley and nearly destroyed a third, the 2 acres being so bad that harvesting of the crop was not attempted."¹

This weed was troublesome to farmers a century ago. "This plant (*C. segetum*) may still be found in our corn-fields, although careful farming has greatly diminished its places of habitation, and shortly it may find the garden its only place of refuge. It is a very troublesome weed to the farmer, particularly in the turnip fields of Norfolk, on a sandy soil. In Denmark there is a law to oblige farmers to root it up out of their fields; and Threlkeld states, in 1727, that in Britain "Maunour courts do amerce careless tenants who do not weed it out before it comes to seed," a laudable practice worthy of being retained.²

Where the Corn Marigold occurs some trouble will be necessary to bring about its extermination, or even a great reduction in its numbers.

As the "seeds" occur in seed corn, and in samples of red clover, sainfoin, and other grasses, an obvious means of preventing infestation on clean farms is to ensure a clean seed supply.

Where the Corn Marigold is a pest, care should

¹ *Jour. Bd. Agric.*, December, 1907.

² Sowerby's *English Botany*, Ed. 3, vol. v. p. 40.

be taken to destroy all seeds in chaff and thrashing refuse before giving these to stock. Thorough steaming or cooking will suffice for this purpose. All waste from thrashing which is not given to stock should be burnt.

Should the weed be present on a farm, the seeds should be encouraged to germinate in spring, and the young plants destroyed by hoeing and surface cultivation. Later, hand pulling should be resorted to in corn crops; and since the object is to prevent seeding, *the removed plants should be burnt*, for, as Fream says of this plant,¹ "It is possessed of great vitality, and when pulled up and thrown aside, does not perish and decompose, but continues growing and ripens its seed." As to the effect of lime, see pp. 41, 151.

A good practice is to take two or more root crops in succession, these enabling free and continued hoeing, and the consequent destruction of young plants which may be encouraged to grow by surface cultivation. As the seeds appear to possess great vitality it may be needful to combat this weed for some years in succession, *the chief object being always to prevent seeding of the plants which appear*. It would be well for neighbouring farmers to co-operate in destroying this as well as other weeds.

Tansy (*Tanacetum vulgare* L.) is a strong-scented, shrubby perennial 2 to 3 feet high. The leaves are alternate on the stem and much divided, the segments being toothed; the lower leaves are stalked, but the upper clasp the stem. The heads are small, $1\frac{1}{3}$ inch in diameter, dull yellow in colour, and arranged in corymbose clusters, somewhat like umbels. The flowers, which have been described as button-like, appear in August and September. In arable land this weed may

¹ *Complete Grazier*, p. 858.

usually be kept within bounds by thorough and "clean" cultivation.

Marsh Cudweed (*Gnaphalium uliginosum* L.) is a small branched annual weed of 3 to 6 inches high. It is woolly or cottony, of a delicate silvery-white colour, and has small, narrow leaves which reach beyond, or over-top, the terminal clusters of small sessile heads of flowers, which open between July and September. This weed is common in arable land, more especially perhaps in cornfields, where, being small, it has a better chance of appearing. It favours damp, light sandy soils, "especially where water has stood during winter" (Johns). Although small it may, if very plentiful, do some damage by crowding the roots of corn and other crops. It may be reduced by hoeing and thorough cultivation. (See also p. 187.)

Groundsel (*Senecio vulgaris* L.) is a weed of almost all soils, and is especially prolific and plentiful on good land. It may sometimes occur in gardens and on rich arable fields in almost incredible quantity, completely smothering any young crop. As a green food for cage birds it is almost as well known by townspeople as by dwellers in the country. Groundsel (Fig. 26) is a succulent branched annual, 6 to 15 inches high, with ragged, coarsely toothed and cut leaves; the small heads of yellow flowers, $\frac{1}{3}$ inch in diameter, are placed several together in clusters, each head on a short stalk. In the fruiting stage the short pappus hairs give the heads the appearance of silky balls. This weed flowers almost all the year round, one plant continuing to produce flowers and seeds for some months. Growth is rapid, and, if permitted, the plants quickly produce silky ribbed fruits, which are widely scattered by the wind.

Groundsel must be combated in gardens by the repeated and vigorous use of the hoe while the plants

are still seedlings. In field cultivation both the horse and hand hoe must be kept busy in root crops.



Photo, 1908.

H. C. Long.

FIG. 26.—Groundsel (*Senecio vulgaris* L.), flowering plant and seedlings.

Nipplewort (*Lapsana communis* L.) is a common annual weed of cultivated land, hedgerows, and waste

ground, and occurs also on the borders of grass fields. It appears to grow best on loamy and clayey soils. Nipplewort (Fig. 27) is a slender, branched weed 1 to 4 feet in height, and contains a milky juice. The upper leaves are small, entire, and scattered, while those at the base contract into the stalk, and are thin and lobed,



FIG. 27.—Nipplewort (*Lapsana communis* L.), \times about $\frac{1}{2}$.
1. Floret; and 2. Achene, \times about 2.

the terminal lobe being large. The heads of few yellow florets are $\frac{1}{4}$ inch in diameter on slender stalks. The pale brownish-yellow fruits often occur as an impurity in clover and grass seeds.

This weed is easily kept within bounds by thorough cultivation and the free use of the hoe, combined with hand pulling where it occurs among corn crops or in young clover or "seeds."

Wild Chicory (*Cichorium Intybus* L.) or Succory, the cultivated form of which is so extensively used for the manufacture of chicory for admixture with coffee, is a stout perennial, rather rough, with large tapering fleshy roots. It occurs on waste ground and roadsides throughout England, but is "rare, if native, in Scotland and Ireland" (Hooker). The stem is 1 to 3 feet high, alternately branched, tough, angled and grooved; the stem leaves are small, more or less oblong-lanceolate and clasping the stem, but the lower leaves are 6 to 8 inches long, and resemble those of the Dandelion; and there are many heads, 1 to 1½ inch in diameter, of delicate, bright blue flowers, the individual florets of which are clearly five-toothed. The flowers appear between July and October, and usually close about mid-day. An average plant is stated¹ to produce about 3,000 seeds.

Chicory may sometimes be found troublesome on arable land, especially on light sandy or calcareous soils, and in districts where the plant has been cultivated in the past. The seeds occur as an impurity in samples of clover seeds and Italian ryegrass. It should be attacked by careful and persistent spudding to prevent seeding or even strong growth above ground; by removal of the roots during ploughing and cultivating operations; shortening the rotation, taking more root crops, which should be persistently hoed. It has been said that "Chicory is not often seen in good farming districts except as a wayside weed."²

Annual Sow Thistle (*Sonchus oleraceus* L.) is frequently very troublesome in arable land, and appears to grow most freely on medium sandy and calcareous soils. In gardens, too, it is often much too common.

¹ Ont. Agric. Coll., *Bull.* 128.

² *Farm Weeds*, Dept. Agric., Ottawa.

This Sow Thistle (Fig. 28) is an erect annual, 1 to 3 feet high, with a tubular grooved stem, branched, smooth



Photo, 1908.

H. C. Long.

FIG. 28.—Annual Sow Thistle (*Sonchus oleraceus* L.).

and shiny, and “bleeding” with a milky juice when broken. The lower leaves are stalked and much lobed, and the upper ones are lobed or entire, angular and toothed, and clasping the stem. The crowded heads of yellow flowers are smooth or slightly cottony, nearly 1 inch in diameter, and appear between June and September. The pale brown fruits are attached to a feathery pappus, by means of which they are borne away by the wind and distributed far and wide.

Wherever the Annual Sow Thistle occurs the chief object is to prevent seeding; this end may be attained by cutting down the young plants with the hoe as fast as they appear, and pulling out by hand any which

may escape notice and reach the flowering stage. The latter may be most easily effected after rain has softened the ground. Surface cultivation in spring, so frequently recommended in these pages against annual weeds, will destroy many seedlings. In root crops as well as in garden cultivation the regular and thorough hoeing which is usual suffices to keep down the weed.

The Perennial or Corn Sow Thistle (*Sonchus arvensis* L.) is a much more troublesome weed than the species mentioned above, since it is propagated both by seeds and by a creeping rootstock. The stem is 2 to 4 feet high, but little if at all branched, and tubular and angular; the leaves are wavy and toothed, almost spinous, but very variable; the heads of the yellow flowers are somewhat hairy, and 1 to 2 inches in diameter. This weed is spread by seed as in the case of *S. oleraceus*, but it does not bloom so early, not until August and September, when the annual species is scattering its seeds. It is a vigorous grower, and is stated to be one of the most aggressive enemies of the Canadian farmer.

The Corn Sow Thistle occurs on all soils, and often causes great loss. It must not only be prevented from seeding, but the creeping rootstock must be destroyed. Both may be accomplished as in the case of the Creeping Thistle (p. 87), but rather more easily, *S. arvensis* appearing to be less resistant to tillage operations than *Cnicus arvensis*.

A short rotation, with the free use of the hoe in two or three root crops, kills it, and it is destroyed by laying down the field to grass for a few years.

In Canada buckwheat appears to be a useful ally in keeping down this weed, and a writer has lately described the plan followed in order to keep down the

pest.¹ The infested land is "disked," cultivated, and harrowed when dry, and buckwheat sown afterwards in June, the resulting crop tending to smother the perennial Sow Thistle. Seeding is prevented; autumn ploughing follows, and any young plants (seedlings) are prevented from sending out lateral rootstocks. Following this, a mangold, turnip, or other crop, by which the growth of rootstocks can be prevented, is taken. In a lucerne crop the weed is prevented from seeding by cutting it down at least three times during summer.

CONVOLVULACEÆ

Field Bindweed (*Convolvulus arvensis* L.), known also as Small Bindweed, Bearbine or Bethbine, is a beautiful but very harmful perennial weed, occurring in corn-fields and waste places on almost all soils, especially those of a medium or sandy nature. The stem (Fig. 29) is slender, twining, and leafy, the leaves being rather variable, but always more or less arrow-head shaped; the large handsome and fragrant flowers are solitary or 2 to 3 together, an inch across, funnel-shaped, usually pink or whitish-pink, rarely white; the roundish capsules are two-celled, each cell containing two seeds. The rootstock is slender and brittle, and creeps extensively and deeply underground.

This weed trails along the ground over and among low-growing crops, robbing them of food, moisture, light and air, or climbs among corn and other tall crops, pulling them down, preventing the ripening of corn, and causing a reduced yield. It hampers harvesting operations, and in unsettled weather may cause much loss in view of the fact that stacking cannot take place until the weed is sufficiently dried in the sheaf.

¹ *Farmers' Advocate*, October 7, 1909.



Photo, 1909.

H. C. Long.

FIG. 29.—Field Bindweed (*Convolvulus arvensis* L.).

Great Bindweed or Bearbine (*Convolvulus sepium* L.) is somewhat similar to the last species, but the climbing stems are much longer, frequently over-topping hedges.

The creeping rootstock is stout and fleshy (Fig. 1, *b*), the leaves are 3 to 5 inches long, arrow-shaped or heart-shaped, with lobes at the base, and the large flowers, 2 inches in diameter, are usually white and solitary (Fig. 30). The flowers open in fine weather from June or July to October, chiefly in the earlier part of the day; with other species *C. sepium* is in North America aptly named "Morning Glory."

This Bindweed or Convolvulus is not so much a pest of the farm as of the garden, and, while its chaste beauty is deserving of a place in the "wild garden," it is most harmful in hedges and among garden crops, among which it climbs, strangling and starving them by the sheer vigour of its growth. Bush fruit trees, peas, broad beans, and similar crops are often observed to be covered with Great Bindweed, and in 1909 we saw a hedge which was almost hidden, and likely to be much damaged, by the foliage and climbing stems of the weed.

The rootstocks of these two pests run deeply in the soil, spreading in all directions, and breaking easily, each small piece soon becoming a fresh plant. It is only by the exhaustion or removal of the rootstocks that the weeds can be eradicated, and this necessitates much care, patience, and expense. In field cultivation the best means of destroying *C. arvensis* undoubtedly lie in short rotations with extra root crops, and persistent thorough hoeing to exhaust the root system and prevent seeding. During tillage operations, with deep ploughing and cultivating, many of the rootstocks can be collected by the harrows or by hand, after which they should be burnt. Small patches may be dug out with the fork; no small pieces should be left. The more the rootstocks can be turned up and sun-dried by fallowing in summer, the more likely will the pest be



FIG. 30.—Great Bindweed (*Convolvulus sepium* L.), $\times \frac{1}{2}$.

reduced. Only pure seed free from the seeds of Bindweed should be sown.

In regard to garden cultivation, although the Creeping Thistle and Couch appear to be killed by deep trenching, followed by continued good cultivation and the free use of the hoe, it is advisable to remove all the rootstocks of *C. sepium* that can be found every time the garden is dug. Between whiles thorough and frequent hoeing should be practised, and if the weed happen to climb a gooseberry bush or a raspberry cane it should be promptly cut off below before flowering is accomplished and seeds are shed.

BORAGINEÆ

Viper's Bugloss (*Echium vulgare* L.) is a handsome annual or biennial, sometimes plentiful on arable and waste land, more especially on calcareous and light soils. The root is spindle shaped; the stem is 1 to 3 feet high, erect, stout, and leafy; and the leaves at the base narrow and stalked, those on the stem sessile and lanceolate or oblong. The flowers, reddish in bud and bright blue when open in June to August, are $\frac{3}{4}$ inch long, tubular or funnel-shaped, with five rounded spreading lobes; they are in compound spikes, the small lateral components of which are curved and spring from the axils of the leaves. The whole plant is rough and bristly.

In Britain this plant is not perhaps usually very troublesome, but it is a "noxious" weed for the Dominion of Canada. It is easily destroyed by good cultivation and by hand pulling.

Bugloss (*Anchusa arvensis* Bieb.) is a rough, bristly annual, 6 to 18 inches high. The stem is simple and angular, the lower leaves stalked and somewhat lanceolate, while the upper are sessile, narrow, oblong, and waved and toothed; and the small blue flowers,

opening in June and July, are in terminal curved clusters. This weed occurs chiefly in cornfields and waste places, especially on light soils. Should it prove troublesome, hoeing and hand pulling will reduce it, as will surface cultivation in spring.

Corn Gromwell (*Lithospermum arvense* L.), or Grey Millet, is a small annual 1 to 1½ feet high, with a short stem, narrow, somewhat lanceolate hairy leaves, and short terminal clusters of small creamy-white flowers, which open from May to July. *L. arvense* is most frequent in cornfields and waste places; it can be reduced by the use of hoed crops, surface cultivation in spring, and by drilling spring corn in place of autumn grain.

Field Forget-me-not (*Myosotis arvensis* Hoffm.), or Scorpion Grass, is an annual or biennial weed which grows freely on arable land. It is 6 to 18 inches high, and rough, with spreading hairs; the lower leaves are small, oblong and stalked, and the upper are sessile; and the small, pale blue flowers, only ¼ inch in diameter, are on long slender stalks in terminal loose clusters. The flowers may be found from June to August. This is perhaps the commonest of the Forget-me-nots.

Parti-coloured Scorpion Grass (*Myosotis versicolor* Reich.) is under a foot high, much branched and leafy below, with linear-oblong sessile leaves and slender leafless stalks. It bears lengthened clusters of minute flowers, which are yellow at first and afterwards pale blue. It is an annual, and flowering occurs from April to June. It is found on arable land on all soils.

The seeds of the Forget-me-not, especially those of *M. arvensis*, occur as an impurity in clover and grass seed samples. These plants may be eradicated by the growth of hoed crops, and by surface cultivation in the spring months.

SOLANACEÆ

Black or Garden Nightshade (*Solanum nigrum* L.) is often very plentiful and troublesome in gardens which have not been well cared for. It grows rapidly from seed in spring and early summer; the earliest plants are in bloom by July, and bear fruit before August; flowering is prolonged until October. Seedlings continue to appear during the summer months. The plant is an annual, and the only work necessary in regard to its destruction is to hoe out all seedlings that appear and prevent seeding for some years, when the weed will disappear or be reduced so much that good gardening will keep it in abeyance. Corners and shady places must not be neglected, and rows of peas, runner beans, and potatoes particularly need well hoeing, as Black Nightshade grows well in shady positions, an odd plant here and there becoming very bushy and producing many seeds if it escapes observation. Should this weed be plentiful on the farm the growth of well-hoed root crops, with surface cultivation in the spring and early summer, will be the best means of reducing it. (See also p. 304.)

PLANTAGINEÆ

Ribwort Plantain (*Plantago lanceolata* L.) and **Broad-leaved Plantain** (*P. major* L.) (see pp. 196-8) are both common weeds of arable land, especially the latter. They are perhaps not usually very troublesome on arable land, though the seedlings of cultivated crops are liable to be destroyed by them, and in young "seeds," or clovers and grasses intended for seed crops, Plantains are often very harmful. Care should be taken that seed samples are free from the seeds of Plantains,

and wherever the weeds appear they should be spudded out. Thorough cultivation of root crops will reduce them.

SCROPHULARIACEÆ

Yellow Toadflax (*Linaria vulgaris* L.) is seldom very harmful, but occurs occasionally in arable land on damp loams, and if inclined to grow strongly may be some trouble, as it not only produces seeds, but is a perennial with a creeping rootstock. It is an erect plant 1 to 2 feet high, with narrow leaves 1 to 3 inches long, and rather large tubular, spurred, yellow flowers like those of the Snapdragon, with the upper and lower lips lobed. The flowers are in dense spike-like racemes, and appear from July to October. Yellow Toadflax is in many localities a common weed by roadsides, and in hedges and waste places. It should be prevented from seeding by cutting, hoeing, or hand pulling, and the creeping rootstocks should be removed during tillage operations.

Corn Speedwell (*Veronica agrestis* L.) is a low, spreading annual, slightly hairy, with very small, stalked, and somewhat heart-shaped serrated leaves; its small, pale blue flowers are borne singly in the axils of the leaves, and open between April and September.

Ivy-leaved Speedwell (*Veronica hederæfolia* L.) is of a similar habit and general appearance to the last species, but rather larger. The leaves are cordate, with five to seven large toothed lobes; the pale blue flowers appear between March and August.

Veronica Buxbaumii Ten. is a common colonist in cornfields. It has long hairy stems, stalked cordate-ovate leaves, and large handsome blue axillary flowers.

These weeds, associated with other species of Speedwell, commonly occur in arable land, especially corn-

fields, crowding round the lower parts of the stems of the cereals and other crops. The seeds of *Veronica* are found as impurities in clover and grass seed samples. Hoed crops and surface cultivation of corn crops in spring are perhaps the best means of reducing them ; clean seed should be sown.

LABIATÆ

Corn or Field Mint (*Mentha arvensis* L.) must be classed as, in some districts, one of the worst weeds of arable land. It is 1 to 2 feet high, with square stems bearing opposite branches ; the leaves are ovate, more or less serrate, shortly stalked, and opposite one another in pairs ; the small lilac labiate flowers, which open in August and September, are in dense whorls or clusters in the axils of the leaves. The whole plant (Fig. 31) is downy or hairy, has a strong smell, like garden mint, when crushed, and is rapidly propagated by extensively creeping rootstocks.

This weed grows freely in all damp soils, and is too commonly found in cornfields and arable land generally. It must be combated by draining ; by deep ploughing and cultivation, followed by harrowing to gather the creeping rootstocks, which should be burnt ; by the growth of two fallow crops—*e.g.* potatoes and mangolds—in succession, in order to give increased facilities for tillage operations and hoeing ; by a short rotation generally ; by smothering crops like vetches, or a heavy crop of maize in the southern counties ; and if necessary by paring and burning the surface soil. Fream says of this pest,¹ "It will always be best conquered by correcting those defects of the soil which encourage its growth—by draining and paring."

¹ *Complete Grazier*, p. 856.



Photo, 1909.

J. C. Varty-Smith.

FIG. 31.—Field Mint (*Mentha arvensis* L.).

Corn Woundwort (*Stachys arvensis* L.) is not commonly harmful, but is an annual found in cornfields and arable land, and it may occur too plentifully. It is 6 to 18 inches high, branched from the base, somewhat hairy, with small, nearly heart-shaped leaves under 1 inch long, the lower ones being stalked and the upper ones sessile, and small, pale pink flowers, four to six in a whorl, in terminal spikes. Flowering continues through a long period, April to November, and this necessitates attention for some months when the weed is plentiful. Surface cultivation in spring and early summer, hand pulling later in corn crops, and thorough hoeing of root crops should be all that is necessary to cope with this weed.

Hemp Nettle (*Galeopsis Tetrahit* L.) is sometimes plentiful in arable land, chiefly in cornfields, on sandy, calcareous, and loamy soils. It is an annual herb, 1 to 3 feet high, stout and hairy, especially at the nodes, which are thickened. The stem is square, the leaves 1 to 4 inches long, ovate-lanceolate and coarsely toothed, and on longish stalks; the tubular, lipped flowers are about 1 inch long, and usually rosy-purple and white, but variable. The flowers open between July and September. Closely allied to this species is *G. versicolor* Curt., with yellow flowers having a purple spot on the lower lip.

Red Dead Nettle (*Lamium purpureum* L.) occurs on all soils on cultivated ground. It is 6 to 18 inches high, with a square, often purplish stem, decumbent below and branched from the base; the leaves are stalked and more or less heart-shaped; and the flowers, which may be found from April to October, are about $\frac{1}{2}$ inch long, purple in colour, in crowded whorls at the top of the stem. Like the previous species, it is an annual.

Henbit or Henbit Dead Nettle (*Lamium amplexicaule* L.) occurs in arable land and waste places, especially on sandy soils. It is a small, branched annual, under a foot high, with the lower leaves roundish on long stalks, the upper kidney-shaped and clasping the stem—hence the specific name *amplexicaule*. The flowers, which open from May to August, are small, slender, downy, rosy or crimson, and in rather distant whorls.

White Dead Nettle (*Lamium album* L.) is closely related to the foregoing species, but the leaves are all stalked, the whole plant is more or less hairy, the flowers large, about 1 inch long, white, and in whorls of six to ten. The rootstock is branched and creeping. The flowers are found from May to December. This Dead Nettle is a common weed of arable land and waste places. It is perennial.

The four species described should all be eradicated by persistent hoeing, hand pulling, the use of root crops, and, in the case of *L. album*, the removal and destruction of the creeping rootstock. Surface cultivation will destroy large numbers of the seedlings.

PRIMULACEÆ

Scarlet Pimpernel (*Anagallis arvensis* L.), well known as the Poor-Man's Weather-glass, from the habit of the scarlet flowers of closing in dull and opening in fine weather, is a widely distributed and abundant annual of arable land, more especially on sandy and calcareous loams. The small branched plant has stems 6 to 18 inches long, smooth, and more or less prostrate. The leaves are small, sessile, nearly oval, and dotted beneath; the round scarlet flowers, opening in fine weather between May and October, grow from the axils of

the leaves on long slender stalks ; the seed capsule is the size of a small pea, and contains many triangular blackish or brownish seeds. The ordinary tillage operations are sufficient to keep this little weed within bounds on the farm ; if very plentiful, surface cultivation and one or two well-hoed root crops will reduce it. In gardens the free use of the hoe will suffice.

POLYGONACEÆ

Persicaria, Redshank (*Polygonum Persicaria* L.) is a large, freely-seeding annual, often very troublesome, both in gardens and among cultivated field crops. It occurs on most soils, especially those in good condition and fairly moist. Redshank (Fig. 32) is 1 to 2 feet high, smooth and shiny, branched, and has much swollen nodes, the stem being reddish above. The leaves are lanceolate, almost sessile on the stem, and frequently have a black blotch in the centre. The very small reddish or white flowers are in dense clusters or spikes $\frac{1}{2}$ to $1\frac{1}{2}$ inch long (Fig. 32, *e*), and appear between July and October.

In garden cultivation this weed must be kept under by the use of the hoe, and by hand pulling any tall plants which may escape by growing amongst potatoes and similar crops. The chief thing is to prevent seeding. In field cultivation well-hoed root crops, surface cultivation in spring and early summer, combined with hand pulling where necessary, will quickly materially reduce *Persicaria*. Care should be taken that the seeds are not introduced in dung or in clover and grass seeds. The seeds need little moisture to enable them to germinate. *Persicaria* is a nutritious plant, and has been given to horses and cattle as a green food. As shown at page 8, it contains a good



FIG. 32.—*Persicaria* or Redshank (*Polygonum Persicaria* L.); *a.* young seedling; *b.* seedling more advanced in growth; *c.* and *d.* flowering plant; *e.* raceme of flowers. All \times about $\frac{1}{2}$.

proportion of nitrogen, phosphoric acid, potash and lime. As to spraying, see p. 47.

Knotgrass (*Polygonum Aviculare* L.) may frequently

be extremely troublesome among both corn and root crops on practically all soils, while its seeds are commonly found in clover and grass seed samples. It is a smooth, prostrate annual, much branched from the base, the branches sometimes reaching 3 feet or so in length. The leaves are $\frac{1}{2}$ to $1\frac{1}{2}$ inch long, more or less lanceolate or oval, sessile or shortly stalked, with silvery, chaffy stipules at the base. Flowering continues from May to October, the flowers being minute, white, greenish, pink or crimson, and clustered in the axils of the leaves almost the whole length of the reddish stems.

Knotgrass or Knotweed (Fig. 33), known to farmers also as Surface Twitch, Red Robin, or Hogweed, seeds abundantly, and on some of the light sandy soils is often found in almost incredible quantity, while it also occurs in great abundance on soils highly manured by sheep.¹ Unless seeding be prevented it will be impossible to eradicate the weed. Where this weed is very plentiful a short rotation should be adopted for a few years, more frequent root or hoed crops affording an opportunity to prevent seeding. Two fallow crops in succession will be even better, and late turnips, or maize in the south, will especially allow of surface cultivation in the spring months to encourage the seeds to germinate for destruction with the harrows. Owing to the prostrate habit of the weed, hand pulling in corn is difficult after the month of May.

Black Bindweed or Climbing Buckwheat (*Polygonum Convolvulus* L.) is a most mischievous annual, often confused with the more serious pest Field Bindweed (*Convolvulus arvensis*) (see p. 102). The two weeds are very similar in habit, the species at present under consideration twining round the stems of cereals and other

¹ *Complete Grazier.*



FIG. 33.—Left : Knotweed (*Polygonum aviculare* L.). Right : Black Bindweed (*P. convolvulus* L.). Both $\times \frac{2}{3}$.

plants, dragging them down and choking them out. In root crops also Black Bindweed (Fig. 33) may be very troublesome.

The slender twining angular stems are 1 to 4 feet long; the leaves are somewhat heart- or arrow-shaped, 1 to 4 inches long, and shortly stalked, with two thin stipules where the stalk joins the stem; and the flowers, appearing from July to September, are very small, greenish-white, in four- to ten-flowered loose terminal or axillary clusters, each flower being on a very short slender stalk, and giving rise to a rough, black, triangular fruit or "seed." The flowers are quite different from those of Field Bindweed, and the roots are fibrous, not creeping as in the latter weed. The seeds are too frequently found in samples of cereal grain, and as many of them ripen long before harvest, they are also plentifully shed in the field and reproduce the weed in another year. "The seeds have considerable value as feed for stock, for which reason screenings containing these and other weed seeds are often carried back from the elevators by farmers and fed without grinding or scalding, which is a dangerous practice."¹

Black Bindweed may be combated in several ways: (1) By ensuring a pure seed supply; (2) by the surface cultivation of corn crops as long as possible in spring; (3) by the use of the seed-catching box (p. 30) on the reaper or binder at harvest time in order to destroy as many of the seeds as possible; (4) by harrowing the stubble immediately after harvest, some time before ploughing, in order to encourage the seeds to germinate, when the young seedlings may be destroyed; (5) by a short rotation, the hoeing of root crops destroying large quantities of the weed.

Docks (*Rumex* sp.), described at p. 201, are an espe-

¹ *Farm Weeds*, Dept. Agric., Ottawa.

cial bane of the farmer, and much time is required in many districts to collect and burn the large tap-roots which are turned up by ploughing and deep cultivation. The plan of bodily removing the weeds during the autumn cleaning, as well as during tillage operations in spring, is perhaps the best that can be carried out. In growing corn crops "docking," or pulling up the Docks by hand or by means of the docking iron, must be practised as long and as late as practicable. A short rotation, with thorough and regular hoeing of root crops, will materially reduce Docks, for, while well grown Docks have great vitality, seedlings (Fig. 59) are easily destroyed in hot sunny weather when loosened from the soil. Hoeing is especially necessary late in the year when seedlings are establishing themselves before winter; and Fream remarks that "were the hoe used in the root crops later in the year—in the autumn—seedling Docks and seedling Couch, which become established after that time, would have little chance of causing trouble."¹ The use of pure seed, free from Dock seed, is essential.

Sheep's Sorrel (*Rumex Acetosella* L.), described at p. 204, may sometimes be troublesome in arable land. In such a case thorough tillage in hot weather, with the removal of the creeping roots and a good dressing of lime (2 or 3 tons per acre), will reduce it. Hoeing should be regularly carried out to prevent seeding and to weaken the plants.

CHENOPODIACEÆ

Goosefoot (*Chenopodium album* L.), also called Fat Hen, Lamb's Quarters, or Meld-weed, and in Canada and in the United States Pig-weed, is an erect branched

¹ *Complete Grazier.*

annual 1 to 3 feet or more high (Fig. 34). The leaves vary from 1 to 3 inches in length, and are somewhat pointed, toothed, and narrow, with long slender stalks. The very small greenish flowers appear between July and September, and are borne in spiked



FIG. 34.—Goosefoot, Fat Hen (*Chenopodium album* L.), showing young plant (left), and flowering stem (right). Both $\times \frac{1}{2}$.

clusters at the end of the branches and in the axils of the leaves. The black and glossy seeds have been likened by Percival to a flattened bun. It should be observed that the whole plant is rather light green or whitish in colour, having the appearance of being powdered with a white or pinkish meal, due to small

hairs tipped with a round translucent cell. The seedlings also are of a silvery-green hue (Fig. 35).

Goosefoot is a gross feeder, and grows most rapidly, and attains its greatest size and vigour on good, well manured soils, although it grows quite freely in waste



Photo, 1909.

H. C. Long.

FIG. 35.—Seedlings of Goosefoot (*Chenopodium album* L.).

land. In gardens it is sometimes very plentiful, especially among potatoes and other root crops, and is liable to crowd and choke out all kinds of crops unless checked. In field cultivation root crops are too often overrun by this weed. An abundance of seed is produced, and much of it may lie dormant in the soil and germinate at unexpected times, while the seeds

are also found in samples of many species of clover and grass seeds.

Spreading Orache (*Atriplex patula* L.) is a variable mealy annual, occurring on all soils, and generally found in similar situations to the last species. It may be only 6 inches or as much as 3 feet high, "often with the central branch erect and the rest prostrate, appearing as if they had been bent down by force" (Johns); the somewhat triangular leaves have two lobes at the lower angles, or are entire and lanceolate; the small greenish flowers are in slender spikes of separate clusters, and appear from June to October. The seeds are very variable in size, the larger being dull, dark brown and compressed, and the smaller darker, smooth and shining.

Halberd-leaved Orache (*Atriplex hastata* L.) is an annual closely resembling *A. patula*, of which it is by some botanists considered a sub-species; the lower leaves are more halberd-shaped, and, as in the last species, there are larger brown rough seeds and others smaller, black and smooth.

These three species, together with several others more or less closely resembling them, may largely be destroyed in corn crops by surface cultivation in spring, the seedlings being easily loosened from the soil by harrows. Later, any plants which have escaped observation should be hand pulled before flowering and seeding takes place. In root and hoed crops generally frequent and vigorous hoeing in hot sunny weather when the plants are small, as in the seedling stage, will easily destroy them. Pure farm seeds should always be used.

EUPHORBIACEÆ

Several species of *Euphorbia* are troublesome either in field cultivation or in kitchen gardens. All are small herbs with a milky juice.



Photo, 1909.

H. C. Long.

FIG. 36.—Petty Spurge (*Euphorbia Peplus* L.). Seedling and full-grown plant.

Sun Spurge (*Euphorbia Helioscopia* L.) occurs chiefly in cultivated fields on sandy and clayey loams. It is a smooth annual, 6 to 18 inches high, with simple or three-branched stem. The leaves are somewhat oval, 1 to 2 inches long, rounded at the top; the small flowers, the male and female separate, are in golden-green, five-rayed umbels, which are often repeatedly forked. The seed capsules are three-lobed and three-seeded. Flowering takes place from June to October.

Petty Spurge (*E. Peplus* L.) is a small annual, often very plentiful in gardens or in field cultivation on loamy soils. This species (Fig. 36) is under a foot high, smooth, light green, with broadly ovate stalked or sessile leaves, and repeatedly forked three-rayed umbels of small greenish flowers, which appear from July to November.

Caper Spurge (*E. Lathyris* L.), described at p. 309, is a biennial which occurs both in garden and field.

Dwarf Spurge (*E. exigua* L.) commonly occurs in cornfields. It is an annual of about a foot high, very much branched from the base, with narrow leaves, and three- to five-rayed umbels of flowers appearing from June to October. The plant is very variable.

As regards eradication, it must be noted that all species are only propagated from seeds, being annual or biennial. Surface cultivation in spring and the free use of the hoe will in general keep these weeds in check, but it is important that seeding be prevented.

URTICACEÆ

The Great (Stinging) Nettle (*Urtica dioica* L.), dealt with more fully at p. 207, is often troublesome along the borders of arable fields and in gardens. It may best be destroyed by removing the extensively

creeping underground stems as thoroughly as possible and giving a liberal dressing of salt.

Small (Stinging) Nettle (*Urtica urens* L.) differs from the last species in being an annual, much smaller, and smooth except for the stinging hairs. The leaves are ovate-oblong and coarsely serrated, and the spikes of flowers are $\frac{1}{2}$ to 1 inch long. This is a common nettle, and should be attacked by regular cutting to prevent seeding.

LILIACEÆ

Crow Garlic or Wild Onion (*Allium vineale* L.), described at p. 209 as a serious pest in grass land, is quite as troublesome in arable land. We have been told of a stretch of country near Peterborough, miles in length, on which a variety of soils are badly affected with this weed, the farmers of the locality having tried all tillage operations in vain in their efforts to subdue the pest. Repeated and costly hoeing appeared to be useless. As will be observed at p. 209, the weed spreads with great rapidity.

In connection with the eradication of this pest, the following suggestions may be made: (1) In small areas the bulbs may be dug out by hand as fast as they appear—this will in the long run be better than a great extension of the pest; (2) two root crops in succession, say potatoes and mangolds, with both deep and shallow ploughing in the intervals, will give little or no rest for the Wild Onion, and thorough and repeated hoeing of the crops should go far to reduce it; (3) the growth of a heavy crop of vetches or maize would also greatly assist in checking it; (4) a heavy dressing of gas-lime worked into the land should be tried; (5) the Woburn experiments¹ showed that spray-

¹ *Jour. R.A.S.E.*, 1900, 1901, and 1902.

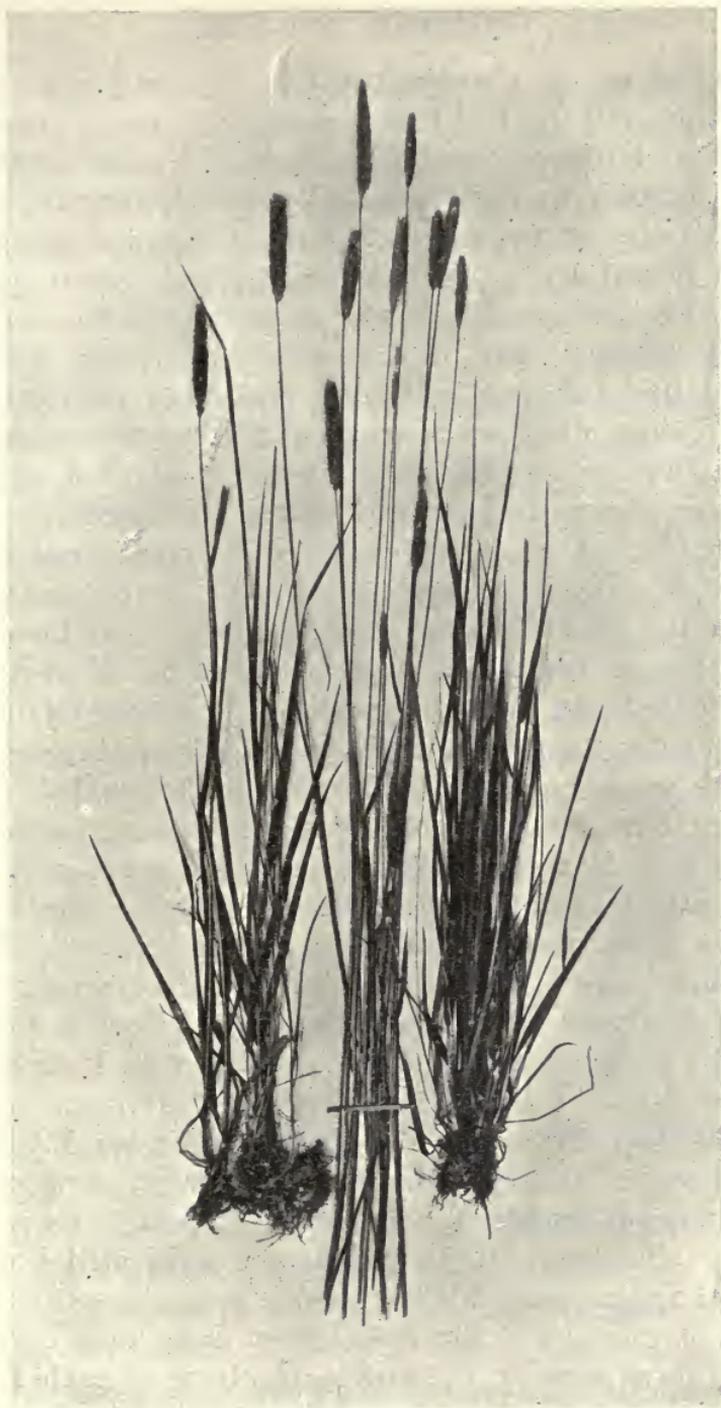
ing with a 5 per cent solution of pure carbolic acid is of value, and that Wild Onion on arable land may be destroyed, or at least largely reduced by treatment with such a solution, without injury to the soil for a subsequent corn crop. Pure carbolic acid (97 per cent) can be purchased at 2s. to 2s. 6d. per gallon according to quantity ordered, and if 100 gallons of the solution be necessary per acre the cost for material would be, say, 5 gallons of acid at 2s. 3d., or 11s. 3d.

Before treating a large area it would be well to experiment on half an acre, using a Charlock spraying machine to apply the liquid.

Field Garlic (*Allium oleraceum* L.) grows about a foot high, with slender, solid, semicircular or nearly flat leaves, and a loose head of pale green or brownish-pink flowers. This species is reproduced in the same manner as *A. vineale*, but is not usually a serious pest, growing chiefly on the borders of fields. Similar methods to those suggested for Wild Onion will probably get rid of it.

GRAMINEÆ

Slender or Field Foxtail (*Alopecurus agrestis* L.), also known as Black Bent or Hungerweed, is closely related to the valuable Meadow Foxtail (*A. pratensis* L.), but is annual. The spike-like panicle is frequently purplish, more slender, not softly hairy but rough to the touch, and each flowering glume bears a longish bent awn. This grass (Fig. 37) is chiefly a weed of arable land, especially cornfields on heavy soils, but will grow strongly on many kinds of land. Fream says: "Cases are recorded in which fields of wheat have been quite destroyed by this pest." It is an annual which flowers from May to October, ripening its seeds chiefly towards the end of summer.



Photo, 1909.

J. C. Varty-Smith.

FIG. 37.—Slender Foxtail (*Alopecurus agrestis* L.).

Owing to its slender growth, its long period of flowering, and the fact that it may occur freely amongst wheat and other corn crops, Slender Foxtail is somewhat difficult to cope with. Yet much may be done towards its eradication. Should a slender grass be found plentifully in a corn crop, it should, even before flowering, be submitted for examination to a competent botanist, and if found to be Slender Foxtail should be destroyed by hoeing and hand pulling. At harvest time many seeds are shed during the operation of binding or reaping; this may be guarded against to some extent by the use of the seed-catching box referred to at p. 30. In the subsequent root crop thorough cultivation and hoeing will destroy many of the young plants which appear; this is doubtless the chief means by which this troublesome weed grass may be reduced. As the seeds of Slender Foxtail not infrequently occur in samples of grass seeds, the sowing of such impure seeds should be carefully avoided.

Bent Grasses (*Agrostis* sp., especially *A. stolonifera* Koch. and *A. vulgaris* With.), described at p. 217, are often extremely abundant in arable land. The latter species is in some districts the only "Twitch" which is troublesome. Where these extensively creeping and harmful grasses occur, they should be attacked in the manner recommended in the case of true Couch (p. 132), but not by laying land down to pasture.

Wild Oat Grass or Havers (*Avena fatua* L.) is a troublesome annual weed in cornfields, and most noticeable in barley, as its presence among oats is not readily observed. It resembles the cultivated oat in general appearance, but the stem is smooth, with hairy nodes or joints, and the spikelets, 1 inch long, contain two to three flowers, the flowering glume of each bearing a long, stout, bent and twisted awn, the base of

the awned "seed" being covered with reddish-brown hairs. In the cultivated oat the spikelet contains two or three flowers, only the lower of which is awned, and that not always; when present, the awn is straight.

Closely resembling this weed is the Bristle-pointed Oat (*A. strigosa* Schreb.), the spikelets of which contain two flowers: its flowering glume is more deeply divided at the apex, the two segments being shortly awned. Both the above species flower from June to August.

It is of the utmost importance that only pure seed grain be sown, and seed corn from a field in which either of these weeds have occurred should be banned. Whenever they have been observed the succeeding root crop should be thoroughly cleaned, and the seeds which were shed before the corn crop was harvested encouraged to germinate, after which the young plants may be destroyed before they produce seed. Pure seed and thorough cultivation of root crops will exterminate these weeds. In a barley crop the Wild Oats may be removed by hand.

Annual Meadow Grass (*Poa annua* L.) is useful as a component of grass land, but is an exceedingly troublesome and ubiquitous weed on arable land, in gardens, and on gravel paths. This little grass (Fig. 38) is an annual, 6 to 12 inches high, with weak spreading stems, and green or purplish panicles, 1 to 3 inches long, of small, almost sessile spikelets. Seed is produced abundantly from April to September, or later. The plants are often so small, that flowering and seeding goes on among larger plants without being observed. In field cultivation, surface tillage encourages the seeds to germinate, after which harrowing in hot weather will kill the young plants. Hoeing of root crops usually keeps the weed within bounds. In gardens the continual use of the hoe should be practised, and care must be taken

to cut out every possible plant—none must be carelessly omitted. As to paths, see p. 349.



Photo, 1909.

H. C. Long.

FIG. 38.—Annual Meadow Grass (*Poa annua* L.).

Rye-like Brome Grass (*Bromus secalinus* L.) is an annual or biennial weed grass, troublesome in leys and corn crops. It is erect, 1 to 4 feet high, generally

smooth, with a spreading branched panicle 3 to 5 inches long, bearing oblong, smooth spikelets $\frac{1}{2}$ to $\frac{3}{4}$ inch long, containing five to ten awned flowers. Flowering and seeding occur in June to July or August; the seeds may lie dormant in the soil for several years, and as they require considerable moisture to enable them to germinate, they often spring up unexpectedly in damp seasons. The seed is also present as an impurity in cereal and grass seed samples; care should therefore be taken to sow only pure seed.

The seeds may germinate in spring or autumn, at which times an opportunity is offered to destroy the young plants by ploughing under, or by harrowing them out should dry, hot weather follow.

Smooth Brome Grass (*B. racemosus* L.) and **Field Brome Grass** (*B. arvensis* L.) may similarly be troublesome in corn crops.

Bulbous Oat Grass (*Arrhenatherum avenaceum* Beauv., var. *bulbosum* Lindl.), also termed Onion Couch, Knot Oat-grass or Pearl-grass, is a variety of Tall Oat Grass met with locally in different parts of the country. It is often extremely harmful in arable land, and especially in cornfields. The inflorescence is a panicle 6 to 12 inches long, with nearly erect roughish branches, and pale shining spikelets about the size and appearance of those of a small oat, the flowering glume bearing a dark, twisted, bent awn. The rootstock creeps a little, and is tuberous at the nodes, several "bulbs," "pearls," or "knots" occurring together like large beads on a string, each "bulb" sufficing, if detached, to produce a new plant. In addition, flowering occurs in June and July, or later, and the tall stems growing among corn crops readily scatter an abundance of seed, the sowing of which it is impossible wholly to prevent. As the "seeds" may be widely scattered at harvest

time, the precaution may be taken of using on the binder or reaper the seed-catching box referred to at p. 30

The chief means of reducing this pest, however, lies in the removal or destruction of the bulb-like roots. To accomplish this great care must be taken, as the individual "bulbs" are readily separated by harrowing and other tillage operations. All considered, it is perhaps best, before a corn crop, to pick out the weed by hand during autumn tillage operations, especial pains being taken to gather single "bulbs" with the rest. The same procedure may be adopted, if practicable, before sowing spring cereals, and with even greater certainty in the case of root crops. A short rotation, with extra root crops, may largely reduce this weed, for frequent stirring of the soil, and exposure of the "bulbs" in hot weather, or during alternate frost and thaw, lead to the destruction of much of the pest. Continued hoeing of root crops as late in summer and autumn as is possible will also do it much harm. At every possible opportunity, however, whether during tillage operations or when hand hoeing root crops, the "bulbs" should be hand picked. Should the pest be so plentiful as to overrun a field, paring and burning of the surface soil may in the long run prove the least troublesome and least expensive plan. Odd corners should not be neglected, or seeding may lead to reinfestation of a field.

Couch or Twitch (*Triticum repens* L.), commonly termed also Squitch, Scutch, Quack, or Whickens, is a perennial weed grass which is perhaps in most parts of Britain the worst weed of arable land. It seldom reaches the flowering stage in arable land, except in corn crops, but is recognisable by its extensive creeping rootstock or underground stems (Fig. 39), which bear

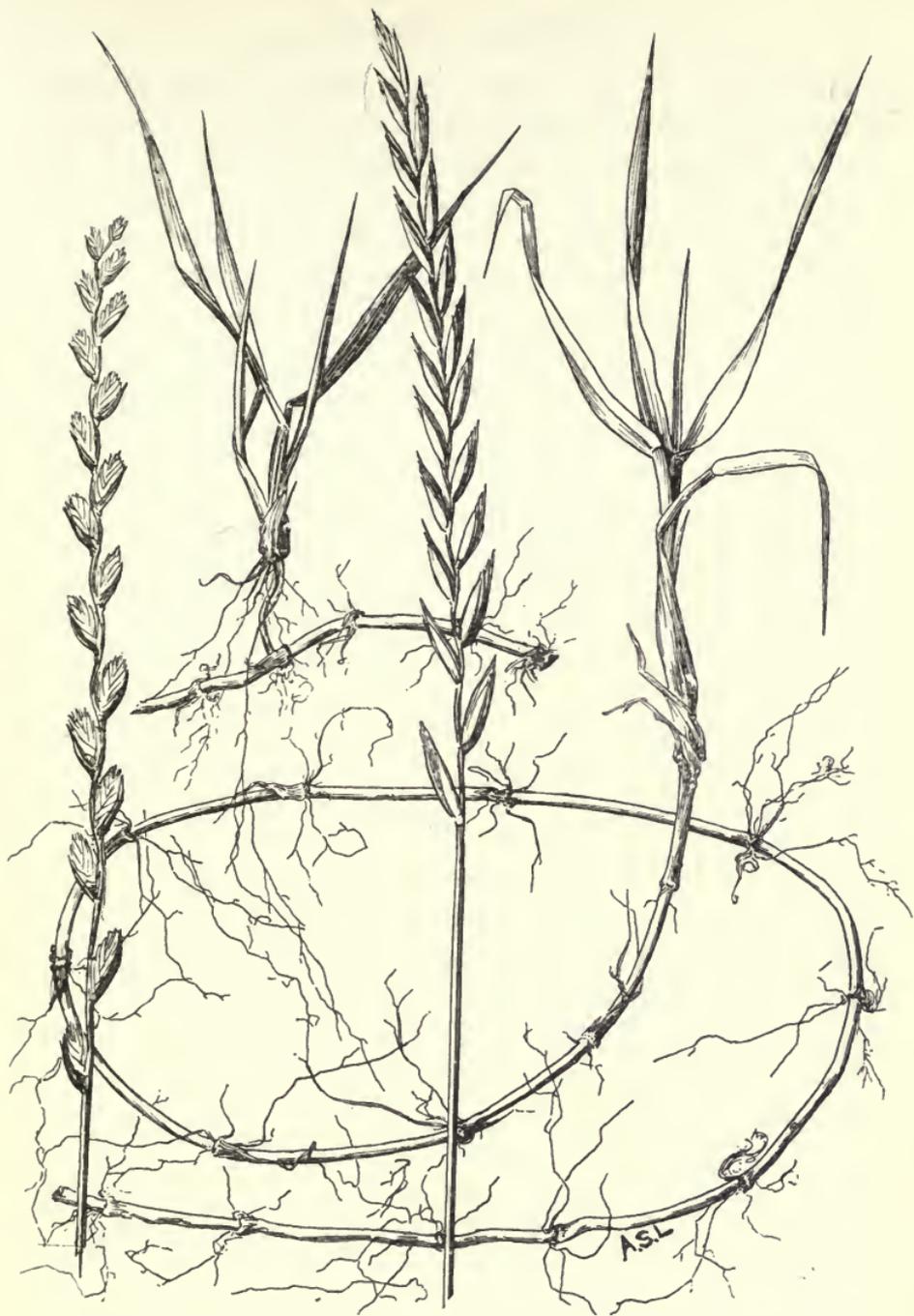


FIG. 39.—Couch Grass (*Triticum repens* L.), showing extensive creeping rootstock and flowering spike (centre), and for comparison the flowering spike of Perennial Ryegrass (*Lolium perenne* L.). All $\times \frac{3}{4}$.

fibrous roots at the joints or "nodes," from which flowering stems and leaves are sent up. Where Couch is left undisturbed, or not systematically attacked, it may form a thick mat or "couch" of these underground stems, which are white in colour, and of the thickness of coarse string. Such a mat of so-called "roots" may effectively compete with the sown crop, and even prevent more than a small yield being obtained. The flowering spikes are constructed like those of a wheat ear, but the spikelets are not so closely grouped. Unlike those of ryegrass, the spikelets are placed flat on the stem, and not sideways (Fig. 39).

Couch may be combated in two or three ways. The laying down of the land to pasture is the most radical and effective cure for Couch; M'Alpine and Wright say that in three years it will have totally disappeared after this treatment.¹

The general custom on the farm consists in frequent shallow ploughing, followed by the use of cultivators, heavy harrows, and chain harrows, in hot weather and in autumn, in order to bring the plants bodily to the surface, where they may be gathered together and burnt. As even very small pieces may take root and form new centres of infestation, great care should be taken to collect as much as possible, and carry none on implements to neighbouring fields. When the land is dry a heavy roller may be employed to crush the soil from the rhizomes. On heavy land this process of ploughing and cultivating should be arrested in wet or very dry weather, or more harm than good may be done, owing to the repeated breaking of the creeping stems.

Where Couch or Twitch is very plentiful thorough cleaning may usefully be followed by taking two root crops in succession, when the regular hoeing which

¹ *Trans. H. and Agric. Soc.*, 1894.

these should receive will help to weaken the young shoots of Couch which may appear. Fream suggests that were the hoe used in the root crops in the autumn, seedling Couch, which becomes established after that time, would have little chance of causing trouble.

Bare fallowing may in some cases be found necessary. The growth of heavy crops of vetches, rape, or maize has a good effect in reducing the weed by cutting off the supply of light.

In this connection an American farmer states¹ that "The great principle to be kept in view in destroying Quack Grass is shade. Shade during the dry weather of the late summer and early fall will take the life out of the roots and leave them to decay and fertilise the soil. . . . There are other valuable crops that do it, but corn (maize) is the one which, on the whole, does the best work. I think about 5 dollars per acre extra labour on the corn (maize) field will destroy all except a few small tufts of the Quack in one season. Then to make sure, follow with corn the next year under somewhat less rigorous, but still careful cultivation, and the eradication will be complete."

Seeding of Couch plants in hedgerows should be prevented by regular trimming.

In garden cultivation many advocate that Couch should be completely forked out and burnt; but if thorough and deep trenching be practised, and the Couch be placed at the bottom of the trench, it may be effectively smothered, as the writer has proved. The passage from *The Times*, quoted at p. 4, adequately supports this statement.

On extensive farm lands the Couch removed from the fields need not be burnt, so destroying much valuable organic matter, but may be built up into stacks and

¹ E. M. Barton in *The Breeders' Gazette*, July 21, 1909.

mixed with a proportion of lime to form a heap of useful compost.

See also *Agrostis* sp. (p. 128), and *Arrhenatherum avenaceum*, var. *bulbosum* (p. 131).

EQUISETACEÆ

Horse-tail (*Equisetum arvense* L.) is quite as troublesome in arable as in grass land (see p. 228). In arable land it must be attacked by deep draining if necessary, followed by a thorough system of cultivation. The regular and persistent cutting of the young spore-bearing shoots in March before fructification has occurred, and of the barren green stems later, will have some effect in reducing it. Deep draining and two heavily manured root crops, followed if need be by a smothering crop like vetches or maize, is perhaps the most satisfactory method of dealing with Horse-tail.

Weeds in Orchards on Arable Land.—The question of destroying weeds in tilled orchards is deserving of further consideration in particular instances. As a general principle such orchards in Britain should be regularly weeded ; but in tropical countries, where alternate influences of baking sun and heavy downpours of rain are experienced, the economy of thorough weeding has been questioned.¹ Dr. Watts drew attention to the good effect on the tilth of the land which is brought about in tropical orchards as the result of allowing the weeds to grow to a certain height and then cutting them down, leaving them as a surface mulch. It may be suggested that a similar practice would not be out of

¹ Dr. Francis Watts, "The Treatment of Soils in Orchard Cultivation in the Tropics": *West Indian Bulletin*, vol. ii. p. 96. Also *Agricultural News*, Barbados, June 12, 1909.

place in Great Britain in certain cases in which the orchard is situated on a slope and subjected to heavy rains during the heat of summer. The growth of a crop of this kind beneath the trees prevents undue "washing" of the soil and loss of plant food, while it adds steadily to the amount of humus present, and the roots open up the soil to atmospheric influences. There is certainly something to be said for such a procedure as that here referred to, but we think the orchardist can do better. Instead of allowing "weeds" to overrun his ground—and serious pests may arise unless care be exercised—he may usefully sow the seeds of rape, lupins, or similar quick-growing crop, which will serve quite as useful a purpose as the weeds, and if of a leguminous character, will, when dug or ploughed in, increase the stores of nitrogen in the soil.

"The face of Nature smiles serenely gay ;
And even the motley race of weeds enhance
Her rural charms: Yet let them not be spared ;
Still as they rise, unconquered, let the hoe
Or ploughshare crush them. In your fields permit
No wild-flower to expand its teeming bloom :
In wood and wild, there let them bud and blow
By haunted streamlet, where the wandering bee,
Humming from cup to bell, collects their sweets."

—JAMES GRAHAME, *British Georgics*, 1812.

CHAPTER V

WEEDS AND THE IMPROVEMENT OF GRASS LAND

IN the case of arable land almost any kind of method may be practised for the eradication of weeds, either at the time of ploughing, and during the subsequent tillage operations, or when the land is carrying a crop. Where grass land is concerned, however, the chief tillage operations are barred, and other methods must be resorted to.

Grass land is commonly termed *meadow* land or *pasture* land according as it is chiefly devoted to haymaking or grazing, although meadow land may be grazed to some extent, while in some districts the fields are alternately grazed and reserved for hay. In general, too, any grass land which has existed as such for many years comes under the term permanent pasture.

Composition of the Herbage of Grass Land

The composition of the herbage of any grass land will vary to a considerable extent, according as to whether it be meadow, pasture, or hill grazing lands, and also according to locality, variation in soil, and aspect. Alterations in the herbage also arise in consequence of good or bad management, and the mere grazing with one or other of the various classes of live stock may effect considerable alterations in the character of the herbage.

A considerable amount of investigation has been made at various times into the botanical composition of the herbage of permanent grass land, and it has been demonstrated that many of Britain's best pastures contain a considerable proportion of so-called weeds.

In an investigation conducted some twenty years ago,¹ the late Dr. Fream showed that the species of plants found growing in old pastures are not numerous. The plants to which he refers in his paper number 31 grasses, some of them, such as *Holcus lanatus*, being weeds, 8 leguminous plants, and 18 miscellaneous species of weeds not grasses or clovers. In his subsequent paper² he only found it necessary to mention 21 grasses, 5 leguminous plants, and 22 miscellaneous species or weeds. In the complete investigation, which involved the examination of 80 turves taken from pastures in 28 English counties, 6 Welsh counties, 8 Scotch counties, and 11 Irish counties, the following plants occurred the stated number of times in the 80 turves:—

Bent Grasses (<i>Agrostis</i> sp.)	76 times.
Yorkshire Fog (<i>Holcus lanatus</i>)	63 „
Buttercups (<i>Ranunculus</i> sp.)	66 „
Narrow-leaved Mouse-ear Chickweed (<i>Cerastium</i> <i>triviale</i>)	49 „
Common Sorrel, or Sour Dock (<i>Rumex Acetosa</i>)	32 „
Ribgrass, Ribwort, or Plantain (<i>Plantago lanceolata</i>)	25 „
Hawkbits (<i>Leontodon</i> sp.)	19 „
Self-heal (<i>Prunella vulgaris</i>)	14 „
Daisy (<i>Bellis perennis</i>)	11 „
Yarrow (<i>Achillea Millefolium</i>)	10 „

Excluding Yarrow, which under certain circumstances is a useful plant, the remaining species include the really significant weeds present in the pastures, others

¹ *Jour. R.A.S.E.*, 1888, pp. 415-447.

² *Ibid.*, 1890, pp. 359-392.

being in very small quantities and not of such agricultural interest. Many other weeds, however, were found more than once. The complete list of "miscellaneous" species mentioned, comprising "weeds" apart from grasses and leguminous plants, is as follows, in alphabetical order:—

<i>Achillea Millefolium</i> L.	Yarrow or Milfoil.
<i>Bellis perennis</i> L.	Daisy.
<i>Bunium flexuosum</i> With.	Earth-nut.
<i>Cardamine pratensis</i> L.	Cuckoo Flower.
<i>Carduus</i> sp.	Thistles.
<i>Carex</i> sp.	Sedge.
<i>Cerastium triviale</i> Link.	Narrow-leaved Mouse-ear Chickweed.
<i>Leontodon autumnalis</i> L.	Autumnal Hawkbit.
<i>Leontodon hispidus</i> L.	Rough Hawkbit.
<i>Luzula campestris</i> L.	Field Woodrush.
<i>Plantago lanceolata</i> L.	Ribgrass, Ribwort, or Plantain.
<i>Potentilla Anserina</i> L.	Silver-weed or Goose Tongue.
<i>Prunella vulgaris</i> L.	Self-heal.
<i>Ranunculus acris</i> L.	Upright Buttercup.
<i>Ranunculus bulbosus</i> L.	Bulbous Crowfoot or Buttercup.
<i>Ranunculus repens</i> L.	Creeping Crowfoot or Buttercup.
<i>Rhinanthus Crista-galli</i> L.	Yellow Rattle.
<i>Rumex Acetosa</i> L.	Common Sorrel or Sour Dock.
<i>Rumex crispus</i> L.	Curled Dock.
<i>Sonchus</i> sp.	Sow Thistle.
<i>Taraxacum officinale</i> Web.	Dandelion.
<i>Veronica Chamædrys</i> L.	Germander Speedwell.

The extent to which some of the weeds occurred in the pastures was also ascertained; it was found that 13 out of the 80 turves were composed to the extent of 50 per cent and upwards of "weeds," the highest being 89 per cent, and the average of the 13 no less than 65 per cent. On the other hand, 28 contained only from 0 to 5 per cent of "miscellaneous" or weed herbage, while the remainder (39) contained from 5 to 49 per cent. It must, however, be noted that the turves were growing under somewhat unnatural conditions, and the weeds often

tended to become exaggerated, especially in the case of *Rumex Acetosa*. In one case, 89 per cent of the herbage consisted of weeds, but Dr. Fream remarked, "This turf showed early signs of an abundant growth of *Achillea Millefolium*, and at length it became smothered with this plant to an extent which would never be possible in continuously grazed land." In several cases upwards of 70 per cent of the miscellaneous herbage was *Rumex Acetosa*. Yet we find it stated that 5 acres of a pasture in North Staffordshire, from which the turf examined consisted of 67 per cent "miscellaneous" herbage, the balance being 32 per cent grasses and 1 per cent leguminous, would "fatten four shorthorn barreners between the middle of May and the beginning or middle of August in a fairly good season; they will afterwards fatten, say, a dozen or fifteen wether sheep." In well grazed pastures, it appears, the bulky "miscellaneous" herbage is kept down, and "under the normal treading and grazing of stock, such species as *Achillea Millefolium*, *Leontodon* sp., *Rumex Acetosa*, would never make the display which characterised several of the turfs."

In a report of some observations and experiments on some English pastures¹ Mr. William Carruthers (Consulting Botanist to the Royal Agricultural Society) refers to the examination of some of the pastures from which Dr. Fream's turves were cut, and although he did not come to the same general conclusions as Dr. Fream, he found that weeds constituted in some cases a large proportion of the herbage. For example, a Dorset pasture carried 22 per cent of Ribgrass (*Plantago lanceolata*), 9 per cent of Bugle (*Ajuga reptans*), 8 per cent of Buttercup (*Ranunculus acris*), 4 per cent of

¹ *Jour. R.A.S.E.*, 1890, p. 95.

Yarrow (*Achillea Millefolium*), and 3 per cent of Knapweed (*Centaurea nigra*). In another case a Somerset pasture carried 63 per cent of Ribgrass and 8 per cent of other weeds. Mr. Carruthers concluded that of the fourteen pastures he visited, not one "is so good as it might easily be made. The extraordinary abundance of such objectionable grasses as Yorkshire Fog and Meadow Barley-grass in some of the pastures is surprising." He further says, "A plant of Nature's sowing on his (the farmer's) farm, where it should not be, is a weed to be eradicated. . . . In laying down land to pasture, as in sowing fields with wheat or any other crop, we must try to surpass Nature. We must bring together the most nutritious perennial plants which will supply palatable food for stock as far as possible all the year round, and we must exclude the weeds and worthless grasses which we have found too abundant in natural pastures."

A later investigation into the composition of the herbage of several types of pasture and meadow land, especially fine old pastures in the Market Harborough district of Leicester and Northampton, has been made by Mr. S. F. Armstrong. His conclusions are of considerable interest, and the more important points deserve notice here. They are as follows:¹—

1. That white clover and ryegrass form by far the greater part of the herbage of the best grazing lands—both old and recent in the English Midlands—and that the next most abundant species on these pastures are usually crested dogstail, fiorin (*A. stolonifera*), and rough-stalked meadow grass.

2. That the herbage of the inferior types of grass land in the same districts consists very largely of bent grass

¹ *Jour. Agric. Sci.*, December 1907.

(*A. vulgaris*) and various weeds, while white clover and ryegrass are present in comparatively small quantities.

3. That the only other species of grasses which are occasionally abundant in these pastures are cocksfoot and sheep's fescue in the better fields, Yorkshire fog and tufted hair-grass in the poorer ones.

4. That the herbage of a pasture varies botanically to a considerable extent during a season, this variation being, however, determined very largely by soil, situation, and weather.

5. That the choicest grazing land is invariably associated with soil rich in available phosphates.

6. That on soils suitable for permanent pasture, inferiority of the herbage is generally due either to (1) a deficiency of available phosphates, or (2) to their bad mechanical condition.

7. That herbage of the best grazing land may be twice as rich in nitrogen and phosphate as that of a poor pasture, and that this large difference appears to be directly determined chiefly by the proportion of white clover present, and indirectly by the percentage of available phosphates in the soil.

8. That from the early part of June onwards the percentage of nitrogen and phosphate in the herbage of a pasture gradually decreases, while the proportion of dry matter rapidly increases.

9. That the quantity of herbage available per acre for grazing depends much upon the density of the herbage, and that no plants appear to be more capable of producing a dense growth of herbage than white clover and ryegrass, providing the soil is suitable for them.

10. That the number of individual plants per acre on the best old pastures, and necessary for the production of a thick, close turf, is probably very much less than is usually supposed.

The Effect of Manures on Grass Land

In laying down land to permanent pasture the greatest possible care should be taken to ensure a clean pasture to start with, and thereafter much care should be continued with a view so to manage the pasture that "weeds"—worthless grasses and other plants—shall be kept down. Nearly 150 years ago Stillingfleet wrote: "If a farmer wants to lay down his land to grass, what does he do? He either takes his seeds indiscriminately from his own foul hay-rick or sends to his neighbour for a supply of a mixture of all sorts of rubbish. Arguments in support of ancient customs are never wanted. Some say that if you manure your ground properly good grasses will come of themselves. So they will; but how long may it be, and why be at the expense of sowing what you must afterwards try to kill by manuring, as is the case with seeds from the hay-loft." Stillingfleet's indictment of farmers for sowing bad seed is fortunately not so applicable at the present day, but his indication of the effect of manuring is still true. As he suggests, however, it is foolish to commence with a bad weedy pasture, on which much labour must be expended to get it into good condition.

Where, however, a permanent grass field is found to be in a weedy condition, much may usually be done to remedy matters and to convert it into a creditable field. Changes in manuring have a very great effect on the percentage composition of the herbage, and this has been conclusively demonstrated by experiment, while many practical farmers have proved it frequently for themselves.

Rothamsted Experiments.—In the Rothamsted experiments upon grass land mown for hay every year since

1856 and not grazed since 1874,¹ it has been observed that on the unmanured plots "there is no sign of approaching exhaustion or great falling off in crop from year to year." Yet there is an impoverishment which "is more to be seen in the character of the herbage than in the gross weight of the produce. Weeds of all descriptions occupy the land, and the relative proportion they bear to the grasses and clovers has increased from year to year; of late years weeds have formed nearly one-half of the herbage." The most prominent species among the weeds were Burnet, Hawkbit, and Black Knapweed.

Where *nitrate of soda* only was regularly applied, there appears to have been a gradual increase in the percentage of weeds present, weeds forming in 1905 40 per cent of the herbage, while leguminous plants were practically absent, and deep-rooting grasses, like meadow foxtail and downy oat-grass, were prominent. At the same time, there was a great increase in the yield of hay compared with the unmanured plots.

With a continual application of *ammonium salts* alone, the increase in crop, compared with the unmanured plots, has been much less than with nitrate of soda. In addition, shallow-rooted plants have been encouraged until "the plots receiving only ammonium salts are almost wholly occupied by Sheep's Fescue and Common Bent." On one plot Sorrel formed nearly 15 per cent of the whole herbage; and on this plot the continued action of the ammonium salts was so harmful, that the application was discontinued in 1897 "lest the turf should be entirely killed."

Three plots received *mineral manures only*, and where a supply of phosphoric acid, potash, magnesia, and soda has been given there has been no sign of declining fer-

¹ A. D. Hall, *The Book of the Rothamsted Experiments*, 1905.

tility, no doubt because the freely-growing leguminous plants (24 per cent of the herbage on the average) have provided an ample supply of nitrogen. There is, however, "a rather large proportion of Sorrel," and Yarrow is very abundant.

Where potash was omitted the average crop was less by about one-fourth, and little more than half of that on the plot to which potash was applied. The leguminous plants were much fewer than on the plot last mentioned, and there was a proportionate increase in weeds, the characteristic species being the Buttercup, Black Knapweed, Plantain, and Yarrow.

When superphosphate only was continuously applied the result has been disastrous, and Mr. Hall even goes so far as to say that "the aspect of this plot, where the most abundant grass is Quaking Grass, and where weeds, chiefly Hawkbit, Burnet, and Plantain, are unusually prominent, would seem to indicate that the land is more exhausted here than on the unmanured plot." Again, a nitrogenous manure alone is often thought exhausting, but probably the phosphatic manures used singly will even more quickly impoverish the soil.

We now come to consider the effect of a *complete artificial manure*. Where the complete phosphate-potash-ammonium manure was given, on two plots the average yields have been no less than 54 cwt. (ammonium salts=86 lb. of nitrogen) and 65 cwt. (ammonium salts=129 lb. of nitrogen) respectively. Yet the hay was not so good as on the plot receiving a complete mineral manure, *i.e.* without nitrogen only, because in the former case "the large amounts of nitrogen have so stimulated the development of the grasses that leguminous plants have disappeared entirely, and even the weeds are crowded out." On the plot receiving the complete artificial manure an excess of the nitrogenous

manure had been used. The character of the hay upon it may be judged when it is observed that 45 per cent of the herbage consisted of Yorkshire Fog, and 52 per cent of False Oat Grass and Meadow Foxtail.

With a phosphate-potash-nitrate of soda manure the result has been better than with the phosphate-potash-ammonium manure. Not only were the deeper-rooted plants encouraged, but the herbage was more varied, and the percentage of leguminous plants was higher. On the plot to which nitrate of soda = 86 lb. of nitrogen was applied, 23 per cent of the herbage consisted (1903) of Soft Brome Grass, and 10 per cent of Beaked Parsley.

The effect of *lime* was striking. On three plots, with varying artificials, there was a considerable increase in crop on the average of the first crops for three years. There was, however, "a great increase in the proportion of leguminous plants," the proportion on the three plots rising from 11, 22, and 3, to 20, 42, and 35 per cent respectively. The differences in the action of the lime were found to be due to the previous manuring of the respective plots. On a plot which had only received ammonium salts, and the herbage of which, as already stated, contained 15 per cent of Sorrel, a strip dressed with chalk in 1883 and 1887 was free from Sorrel. All grass land should receive an occasional dressing of lime, say 10 cwt., every three to five years.

In changing the artificials from ammonium salts to minerals, the immediate result was a great diminution in weeds and an increase in grasses, followed by a steady increase in leguminous plants and a corresponding decrease in grasses.

A change from nitrate of soda to mineral fertilisers had a similar result; but the change was even more

rapid than in the last case, and the leguminous plants attained a rather larger proportion.

The *practical conclusions* drawn from the results of the Rothamsted experiments are given by Mr. Hall as follows:—

“1. It is better to lay up the same land for hay each year, grazing the aftermath only, and, in the same way, always to graze other land rather than graze and hay in alternate years. In this way we obtain the fullest development of those grasses and clovers which are suited to haying and grazing respectively.

“2. For the same reason the system of manuring once adopted should be varied as little as possible, for even manures as similar as nitrate of soda and sulphate of ammonia encourage different kinds of grasses.

“3. On poor land any large expenditure on manures will be wasted. The character of the herbage must be slowly reformed. A full manuring is only utilised when there are plenty of strong and vigorous grasses or clovers among the vegetation.

“4. Land which is growing hay requires a manure which is mainly nitrogenous, whilst pasture requires a mineral manuring.

“5. On strong loams with a good mixed herbage a dressing of 10 to 15 tons of farmyard manure should be given every fifth year. In the other years a winter manuring (January or February) of 2 cwt. per acre of superphosphate (basic slag on strong clay soils), and 3 cwt. of kainit, with $1\frac{1}{2}$ cwt. of nitrate of soda when the grass begins to grow, will be remunerative.

“6. On light dry soils, either sandy or chalky, the nitrogenous manures are the most important. Dung and cake feeding the aftermath will best build up a vigorous herbage, and until this is done it will not be wise to spend much money on artificial manures;

1 cwt. of nitrate of soda, 1 cwt. of superphosphate, and 3 cwt. of kainit being about the best proportion in which to employ them.

“7. On all old grass land an occasional dressing of ground lime, at the rate of half a ton per acre, applied in the early winter (best in the year following the dunging), will sweeten the herbage and utilise the reserves of past manuring.”

In the case of some experiments conducted by Professor Somerville on permanent grass land in Cumberland,¹ nitrate of soda in conjunction with phosphate had a markedly repressing influence on species of *Agrostis*, which are usually numbered amongst the poorest grasses. Ribwort was also reduced, and so were leguminous plants; but Yorkshire Fog was greatly increased. Used alone, nitrate of soda tended to encourage an inferior type of herbage, and sulphate of ammonia produced more *Agrostis* and Ribwort. Superphosphate was found to reduce the percentage of *Agrostis* and Cocksfoot, but had no general influence on other plants. Kainit markedly increased the yield of leguminous plants, and “almost as markedly repressed the growth of *Agrostis*.” As regards lime, its application was found consistently to increase the yield of Ribwort, but considerably to reduce the percentage of *Agrostis* and Yorkshire Fog.

These experiments have been discussed at length on account of the extreme importance of the whole subject of the manuring of grass land and the changes in the character of the herbage which such manuring brings about.

The foregoing remarks conclusively show that very much may be done in the way of suppressing weeds in

¹ *Jour. Bd. Agric.*, vol. vii. No. 2.

grass land by means of judicious manuring. Indeed, Mr. Martin J. Sutton states¹ that from the Rothamsted experiments made by Sir J. B. Lawes and Sir J. H. Gilbert, and confirmed by his own experiments, "it has been demonstrated that most of the annual and not a few of the perennial weeds can be, for all practical purposes, eliminated from a pasture by applications of combined mineral and ammoniacal salts." The stronger grasses are encouraged and the weeds crowded out.

In general, farmyard manure should be spread on the meadows, or haying land, rather than on the pastures, which do not require nitrogen to the same extent owing to the more extensive feeding of stock thereon. Further, a judicious use of phosphates to encourage clovers is especially useful on most heavy soils, and leguminous plants will of themselves supply nitrogen for the grasses.

Some weeds, *e.g.* Ragwort, are freely eaten down in the young state by sheep, and cake feeding of stock, even to a moderate extent, will prove of great value in improving the type of herbage, and the treading of the stock is in itself of much advantage.

Tall weeds like Thistles and Rushes should be regularly mown or cut down with the thistle cutter, and a thorough harrowing before manurial treatment is resorted to is highly beneficial.

To ensure even growth of good herbage it is essential that all grazing land should be eaten bare at least once a year, in order to prevent the accumulation of coarse tufts of unpalatable grasses. The spreading of droppings should be thoroughly done as soon as possible, or the development of ugly patches which stock refuse to touch will certainly occur to the detriment of the pasture.

¹ *Permanent and Temporary Pastures*, 1908, p. 147.

Certain weeds have already been specified (p. 27) as indicative of damp soils, and where such weeds are prevalent it will often be found that draining is necessary before they can be eliminated. On damp, low-lying pastures and meadows draining is almost certain to effect an improvement in the herbage, especially in conjunction with liming and judicious manuring.

Another matter to which attention may be directed at this point is, that many weeds are practically intolerant of lime, which may therefore be effectively used against them. Among such weeds may be mentioned Sheep's Sorrel (*Rumex Acetosella*), Common Sorrel (*R. Acetosa*), Spurrey (*Spergula arvensis*), Corn Marigold (*Chrysanthemum segetum*), Bracken or "Fern" (*Pteris aquilina*), Heaths and Ling (*Erica* sp. and *Calluna vulgaris*), and Foxglove (*Digitalis purpurea*). Liming is also useful in reducing Mosses, Bent Grasses (*Agrostis* sp.), Yorkshire Fog (*Holcus lanatus*), and Wavy Hair Grass (*Aira flexuosa*).

The weeds of grass land are dealt with individually below.

It may be noted at the outset that the Natural Orders contributing the largest numbers of weeds are the *Ranunculaceæ*, *Cruciferæ*, *Caryophyllaceæ*, *Rosaceæ*, *Umbelliferæ*, and *Compositæ*, the last named being especially prolific in weeds of a harmful character. It is convenient to deal with the weeds under their Natural Orders: the latter are taken consecutively.

RANUNCULACEÆ

Traveller's Joy (*Clematis Vitalba* L.).—This well-known climbing plant is commonly termed Old Man's Beard, from the tufted feathery appearance of the fruiting stage; it can only be included as a weed because of

its occurrence in hedges to the disadvantage of the hedge proper. It appears to flourish best on chalky soils ; the sweet-scented, greenish-white flowers appear in July and August. It can in general be kept in hand by cutting it out regularly when the hedges are trimmed.

Meadow Rue (*Thalictrum flavum* L.).—Where this plant occurs plentifully it may be a nuisance, as it not only bears seeds, but is extended by a creeping root-stock. It is not commonly a pest, but may become troublesome in wet meadows and damp places near ditches, where it is chiefly found. Meadow Rue grows 2 to 4 feet high, has pinnate leaves, and pale yellow flowers crowded in pyramidal umbels, the flowers appearing in July and August. The plant is perennial. It should be exhausted by repeated cutting, and seeding must be prevented ; at the same time the damp land on which it occurs should if possible be drained.

Buttercups (*Ranunculus* sp.).—Four species of *Ranunculus* may be mentioned as occurring freely in pastures and meadows : Upright Crowfoot or Acrid Buttercup (*R. acris* L.), Bulbous Crowfoot or Buttercup (*R. bulbosus* L.), Creeping Crowfoot or Buttercup (*R. repens* L.), and Lesser Celandine or Pilewort (*R. Ficaria* L.). All have yellow flowers. The first named is a hairy perennial without runners, with straight fibrous root-stock, cylindrical flower stalks, and well opened flowers $\frac{3}{4}$ inch in diameter. It flowers from April to September, and occurs on nearly all soils.

R. bulbosus (Fig. 40) is a hairy erect perennial with a swollen bulb-like stem and no runners, and flowers $\frac{1}{2}$ to 1 inch in diameter, with the sepals reflexed so as to touch the stem. Flowering takes place in May to June—neither so early nor so late as *R. acris*. This species appears to favour the lighter and more cal-

careous soils. The Bulbous and Upright Crowfoots are the common Buttercups of grass land. *R. repens* (see p. 50) is chiefly a pest on arable land, but may occasionally quite suppress the ordinary herbage of grass land. It is easily distinguished from the foregoing by its rooting runners, by which it rapidly spreads (Fig. 8). *R. Ficaria* differs essentially from the three species already mentioned, in which the leaves are much lobed and segmented. In Lesser Celandine the leaves are chiefly heart-shaped, and largely spring from the base of the plant on long stalks. The golden-yellow star-like flowers are about $\frac{3}{4}$ inch across, and bear eight to twelve petals instead of five, as in the case of the other three species. The plant is perennial, and its flowers appear between March and May. This species is not often troublesome in grass land. (See also p. 280.)



FIG. 40.—Bulbous Buttercup or Crowfoot (*Ranunculus bulbosus* L.), $\times \frac{1}{3}$

There is a tradition that Buttercups impart a good colour to butter. They are, however, weeds, and out of

place in pastures and meadows, especially so in land that is not mown, for they are but seldom eaten by stock, and are of an acrid or poisonous character (see p. 278) in the green state. The milk of cows that eat them in a fresh state becomes tainted. When dried and included in hay they are freely taken and quite harmless. The sowing of their seeds in impure grass and clover seed mixtures should be avoided, and the tall flowering stems should be cut down with the mowing machine before seeding takes place. An attempt should be made to reduce them by encouraging good grasses and clovers by manurial treatment, and on heavy land 7 cwt. per acre of basic slag will do good; on lighter land superphosphate should be applied. Where *R. repens* occurs it should be dragged out with harrows, or be dug out by hand if the patch be small. In the case of wide-spread infestation by this species the only remedy is to plough up, clean thoroughly, and re-sow with a pure mixture of seeds.

Mr. Carruthers not long since¹ referred to the presence of Buttercups in pastures, remarking that all the species of *Ranunculus*, called Buttercups or Spearworts, possess acrid properties, and have not the slightest feeding value. "They are usually rejected by animals, but young stock not unfrequently eat them to their injury. Some farmers like to see Buttercups in a field. They consider them to be the sign of a good pasture. Buttercups no doubt show that the soil is fitted to grow plants, but every Buttercup is a distinct injury to the pasture. Being rejected by the stock, they flower and seed in abundance. Their numerous seeds are well protected, and remain ready to germinate under favourable conditions. Some of the more acrid increase by creeping stems that run above the ground or in the

¹ *Jour. R.A.S.E.*, 1906.

soil. The pasture becomes more and more filled with yellow Buttercup, and it loses half its value by the presence of acrid plants which cause every year injury to, if not the death of, some animals. It would be better and more profitable where land is burdened with Buttercups to plough it, carefully clean it, take at least one root crop off it, and then sow it with grasses and clover pure in quality and of good germination. Properly sown down and generously treated, a good feeding pasture has thus been secured within a year of the sowing."

Two other species of Buttercups, Lesser Spearwort (*R. Flammula* L.) and Celery-leaved Crowfoot (*R. sceleratus* L.), which occur in ditches and wet places, may also occur in wet meadows, and on account of their acrid, poisonous properties should be removed. (See p. 279.)

Hellebores (*Helleborus* sp.), which sometimes occur in woods, hedges, and pastures, are poisonous plants, and should be cut down. (See p. 280.)

Monkshood (*Aconitum Napellus* L.) may also occasionally be found in grass land in shady places, and being poisonous, should be eradicated. (See p. 276.)

BERBERIDACEÆ

Barberry (*Berberis vulgaris* L.).—The reason for including this shrub as a weed is that, occurring in hedgerows and similar places, it plays a part in the dissemination of Wheat Rust (*Puccinia graminis* Pers.), one stage in the life history of which is passed upon its leaves. The Barberry is a shrub which attains 4 to 6 feet in height, bearing alternate leaves 1 to 1½ inch in length, and forked spines; the small yellow flowers are borne in drooping clusters, and appear

in May and June, giving rise later to orange-red oblong berries $\frac{1}{2}$ inch in length. In wheat-growing districts it should be cut down and burnt.

CRUCIFERÆ

Lady's Smock (*Cardamine pratensis* L.), known also as Cuckoo Flower or Bitter Cress, is a common, well-known flower of damp meadows and pastures. It is about a foot high, with pinnate leaves; the conspicuous flowers are about $\frac{1}{2}$ inch across, lilac in colour, and, like other crucifers, the four petals are arranged in the form of a cross. The flowers appear in April to June. Perennial.

Should this plant occur in damp land in large quantity, drainage combined with judicious manuring to encourage better herbage will diminish it.

CARYOPHYLLACEÆ

Ragged Robin (*Lychnis Flos-cuculi* L.) is a well-known perennial, which flowers in May and June, the rosy blossoms with deeply-cut petals being especially handsome. It occurs freely in moist pastures and hedgerows and by ditches.

Bladder Champion (*Silene inflata* Sm.), **Red Champion** (*Lychnis diurna* Sibth.), and **White Champion** (*Lychnis vespertina* Sibth.) (see p. 69) also occur in meadows.

All these plants may be kept within bounds by regular cutting, sound treatment of the meadow land, and keeping hedgerows and ditches properly trimmed.

Mouse-ear Chickweed (*Cerastium triviale* Link.) is a frequent and prolific weed of meadows and pastures, and may occur on almost any kind of soil. It has been already stated (p. 69) that this weed was found forty-



FIG. 41.—Mouse-ear Chickweed (*Cerastium triviale* Link.), $\times \frac{2}{3}$, with flower and seed-vessel enlarged.

nine times in eighty turfs in Dr. Fream's investigations. It is to be found in plenty on grass land generally, perhaps more especially upon that which has been starved and upon poor wastes and commons. It is usually perennial, and is a slender, straggly, procumbent, downy plant (Fig. 41), with small oblong-lanceolate leaves placed opposite each other in pairs on the stem; its clusters of small white flowers are arranged on short stalks, and are open from April to August. This weed frequently occurs in patches, which should be mown close with the scythe before seeding takes place, and better grasses and clovers should be encouraged by manuring. The seeds of Mouse-ear Chickweed occur in samples of white clover and alsike seed, and in samples of many grass seeds.

MALVACEÆ

The Common Mallow (*Malva sylvestris* L.), which in some places occurs freely on waste spots of ground, damp meadows, and hedgerows, should be kept within bounds by the use of scythe and hook. It is a robust hairy plant of 2 to 3 feet in height, with showy lilac flowers of over 1 inch in diameter, opening between June and September. The soft green, unripe seed-vessels are well known among country children as "cheeses" or "bread and cheese." They are not unwholesome. The plant is biennial or perennial.

LINACEÆ

Bitter or Purging Flax (*Linum catharticum* L.) is a small annual plant occurring in pastures and meadows, especially those of a light calcareous nature. It is smooth and shiny, from 2 to 12 inches in height, very

slender, with small obovate or lanceolate leaves opposite each other in pairs, and small white flowers. As the plant is annual, the first object should be to prevent seeding by cutting it early in the flowering stage. Such a plan will, if repeated, have the effect of reducing the weed.

GERANIACEÆ

Meadow Crane's-bill (*Geranium pratense* L.) and **Dove's-foot Crane's-bill** (*G. molle* L.) occur in grass land, the former chiefly on the moister class of meadow or pasture, while the latter is principally harmful on arable land.

Cut-leaved Crane's-bill (*G. dissectum* L.) and **Herb Robert** (*G. Robertianum* L.) grow freely along hedge-rows and waste ground. (See p. 77.)

The Meadow Crane's-bill can at once be distinguished from the other three species by its very large purplish-blue flowers, which are 1 to $1\frac{1}{4}$ inch across, the other species each having flowers of no more than $\frac{1}{2}$ inch across. The species is a perennial, attaining sometimes 3 to 4 feet in height; it flowers from June to August. As in other species, the fruit is prolonged into a long "beak," resembling the bill of a crane. Where this plant inclines to be plentiful it should be regularly cut down before flowering.

LEGUMINOSÆ

Dyer's Green-weed (*Genista tinctoria* L.) is in some cases a serious trouble in grass land, especially clay pastures. It is a perennial plant of 1 to 2 feet in height, branched and shrubby, with smooth spineless branches, entire ovate-lanceolate leaves $\frac{1}{2}$ to 1 inch long, and, for the size of the plant, rather large yellow flowers, some-



FIG. 42.—Dyer's Green-weed (*Genista tinctoria* L.),
nat. size.

what like those of Broom or Gorse, in long racemes. The flowers appear in July to December (Fig. 42). It was formerly used as a yellow dye, and it is likely that it was the *planta genista* which formed the badge of the Plantagenets.

The weed has been recorded as causing much loss in the Malvern district, and we know a farm in Surrey where it has proved a nuisance. Stock do not usually appear to touch it, but "cows will sometimes eat this plant, and it communicates an unpleasant bitterness to their milk, and even to the butter and cheese made from it." ¹ Knapp ² states that

¹ Johnson and Sowerby, *Useful Plants of Great Britain*, p. 69.

² *Journal of a Naturalist*, 1829, p. 76.

this plant "is seldom eaten by cattle except in cases of great necessity, and remains untouched if other food be obtainable." It should be regularly cut to prevent seeding, or it may spread very rapidly. A good dressing of basic slag, 6 to 10 cwt. per acre, has been found beneficial in checking it.

Gorse, Furze, or Whin (*Ulex europæus* L.) is a well known and handsome spiny shrub or bush attaining several feet in height, and occurring freely on poor stony moorland, commons, and poor pastures, in the latter position frequently detracting greatly from the value of the grass.

Another species of Gorse, *U. nanus* Forster, occurs on heaths, commons, and stony pastures from Ayr southwards, and also in Ireland. It is much smaller than the last species, being only 1 to 3 feet high; and the flowers, which are more deeply orange in colour, appear from August to November. A sub-species, *U. Gallii* Planchon, grows somewhat larger and more erect than *U. nanus*. It occurs in similar positions, especially in the west from Ayr to Somerset, and in Ireland.

In order to eradicate Gorse the smaller plants may be grubbed out, and the larger ones burnt in dry weather, the roots being subsequently grubbed out, after which the bare patches should be harrowed over, sown with a suitable seed mixture, and judiciously manured later. All young plants which may appear should be removed at once. Gorse is frequently grown as a fodder crop on poor land in certain districts.

Broom (*Cytisus scoparius* Link.) may also be a nuisance on poor stony or sandy pastures and commons; and must be dealt with in a similar manner to Gorse. It has no spines; the branches are long, slender, and erect, the leaves small and scattered, and the yellow



Photo, 1909.

J. C. Varty-Smith.

FIG. 43.—Rest Harrow (*Ononis spinosa* L.).

flowers carried on the branches on short stalks. Flowering takes place in May and June.

Rest Harrow or Wild Liquorice (*Ononis spinosa* L.) is in some localities a very harmful pest in pastures on poor heavy land, and some forms of it also on dry, sandy, and gravelly soils. Rest Harrow is a viscid, hairy perennial, with erect shrubby stems 1 to 2 feet high, narrow, oblong, toothed leaflets, and handsome rosy-pink, vetch-like flowers, appearing singly in the axil of the leaves or in leafy racemes (Fig. 43). The plant is generally spinous, and among hay old dry plants have been mistaken for seedling gooseberries. A form or sub-species, *O. repens* L., possesses runners, is usually spineless, and has a strong, disagreeable scent. Rest Harrow is a pest in pastures, and is indicative of poor soils.

This weed must be attacked if in quantity by manuring, regular cutting, and close depasturing with stock; in bad cases it may be necessary to plough up the pasture, give a thorough cleaning and manuring, and again lay down to grass in the usual manner.

ROSACEÆ

Meadow-sweet, Queen of the Meadow (*Spiræa Ulmaria* L.) is a tall, handsome perennial, attaining to 4 feet in height; it sometimes occurs very freely in meadow land and damp places, such as water meadows. Meadow-sweet is herbaceous, with large leaves upwards of a foot long from the base of the plant, interruptedly pinnate, with serrate edges, and white and downy beneath. The flowers, which appear between June and August, are collected in large compound cymes 2 to 6 inches in diameter; each single flower is small, about $\frac{1}{4}$ inch in diameter, white or nearly so, and sweetly

fragrant. *Spiræa Ulmaria* is a favourite plant, and aptly named Queen of the Meadow.

The only plan of getting rid of an excessive quantity of this tall, stout plant is to cut it regularly, and by drainage, liming, and manurial treatment encourage more useful herbage, when the weed would probably be much reduced or entirely disappear.

Blackberry, Bramble (*Rubus fruticosus* L.).—This rapidly growing plant is one of the most common and well known ramblers of our hedges, commons, and waste lands, and needs no description here. It is an extremely variable plant, and different forms of it grow freely on all soils; these are troublesome in hedges, extending out into the fields and occupying ground which should be devoted to grass or a cultivated crop. In some parts of Australasia the Blackberry is a scheduled weed, and its destruction or restriction within bounds is enforced. The Bramble can only be kept down by means of grubbing it out by the roots or by repeated cutting.

Wood Avens or Herb Benet (*Geum urbanum* L.) is a pretty plant, common in hedgerows, on sides of ditches and borders of fields, and not usually much trouble. It is a soft, hairy perennial, 1 to 3 feet high, with bright yellow flowers which appear in June to August. The leaves at the base of the stem are pinnate, those above being small, oblong, and sessile. The heads of fruits bear hooked awns which enable them to adhere to passing animals, and so ensure distribution. This weed is generally cut down and reduced when hedges and ditches are trimmed.

Creeping Cinquefoil (*Potentilla reptans* L.) (see p. 79) may also occur in meadows, in which position it can only be combated by regular cutting and the encouragement of better herbage.

Tormentil (*Potentilla Tormentilla* Sibth.) is a perennial which occurs in pastures and meadows, especially on poor, dry soils. It is a slightly hairy plant, from 6 inches to 1 foot high, with solitary yellow flowers about $\frac{1}{2}$ inch in diameter, bearing usually only four petals. This plant is checked if a plentiful and close bottom herbage is produced.

Lady's Mantle (*Achemilla vulgaris* L.) is occasionally too common in moist pastures and meadows, and may occur on any soil, but it is not generally troublesome. Draining and manuring will tend to reduce it.

Agrimony (*Agrimonia Eupatoria* L.) is a very common weed of pastures and borders of fields. It is an erect, hairy, leafy plant, without branches, 1 to 2 feet high, with pinnate, toothed leaves, and shortly stalked, small, yellow flowers placed in a long, spike-like raceme. The plant is perennial, and flowering occurs between June and August.

Salad Burnet (*Poterium Sanguisorba* L.) is rejected by stock owing to its hard, woody character when well grown, and is therefore not desirable in excessive quantities. At the same time it is eaten in the young state by stock, and its large deep root system makes its presence in small amounts useful, as it opens up the soil to aerial influences, and thus promotes a healthy condition of the root system of other herbage. It is useful on dry calcareous pastures, where difficulty is frequently experienced in ensuring the growth of anything better. It is a perennial, flowering in June to August, is about $1\frac{1}{2}$ feet high, with slender, much branched stems. The leaves are pinnate, the five to ten pairs of leaflets being serrated and stalked. The small reddish-green flowers, without petals, are grouped in dense heads.

Greater Burnet (*Poterium officinale*, Hook. f.) is similar

in general appearance to the above, but larger. It grows in damp meadows, where it replaces better grasses, and should therefore be cut down, and if possible suppressed.

Dog Rose (*Rosa canina* L.).—This favourite and handsome hedgerow plant may be as great a nuisance as the Blackberry (p. 164). Where it is invading land, widening hedges, and rendering them bushy it must be grubbed and cut out. We have frequently seen hedges in which the Blackberry and Dog Rose have broadened the "hedgerow" by several feet, a wide strip of ground on either side of the hedge proper being thus rendered useless.

ONAGRACEÆ

The Willow Herbs (*Epilobium hirsutum* L. and *E. parviflorum* Schreb.) are two perennials which occur in damp fields and by streams and ditches, extending by both seeds and suckers or runners. The former species, the Great Willow Herb, known also as Codlins-and-Cream, has woolly stems which grow to a height of 3 to 5 feet. The leaves are 3 to 5 inches long, and oblong-lanceolate with incurved teeth, in opposite pairs. It bears a large number of funnel-shaped, rosy-purple flowers about $\frac{1}{2}$ to $\frac{3}{4}$ of an inch across. *E. parviflorum*, the Small-flowered Hairy Willow Herb, is a smaller plant, 1 to 3 feet high, with sessile, lanceolate leaves, 1 to 2 inches long, and many rosy-purple flowers one-third of an inch in diameter. Both species flower between July and August.

In order to reduce these weeds where they occur abundantly in damp soils, draining may be necessary; but this is not always feasible, owing to position near river or stream. In such a case the plants should be cut over as fast as they grow, and a good

bottom herbage encouraged by suitable manurial treatment.

CUCURBITACEÆ

Bryony (*Bryonia dioica* L.) occurs freely in hedges, and may occasionally, as we have seen during the past summer, extend by its climbing tendrils well out into grass fields reserved for hay. In such cases it is dangerous, and care should be taken to keep it cut back. (See p. 293.)

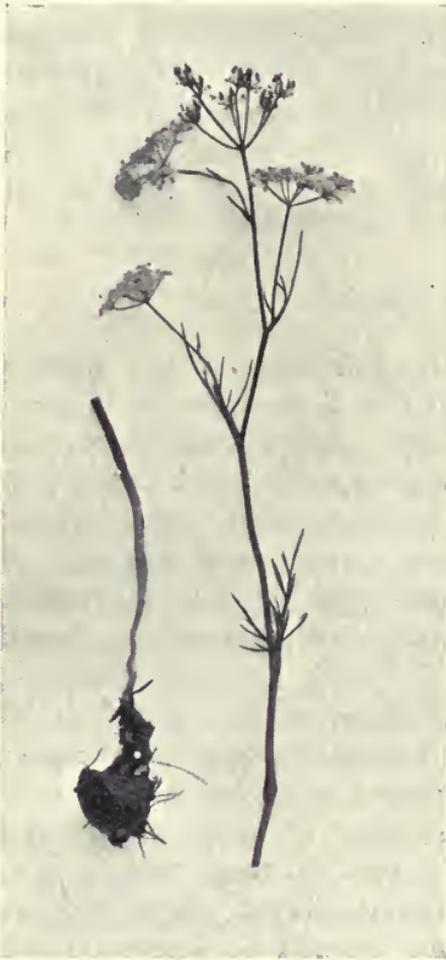
UMBELLIFERÆ

Marsh Pennywort (*Hydrocotyle vulgaris* L.), known also as White-rot, is a plant found, as its name implies, on marshy, boggy, damp land. It is a small perennial herb, with slender white creeping stems, with leaves $\frac{1}{2}$ to 2 inches long at the nodes on long stalks. The umbels of small pinkish-green flowers grow from the axil of the leaves on short stalks, and appear in May to August. Where it occurs in excess this weed may be combated by draining.

Goutweed (*Ægopodium Podagraria* L.), also termed Goat-Weed, Herb Gerard, occurs in damp and waste places. It has a hollow, grooved, branched stem, 1 to 2 feet in height; white, pungent, creeping rootstock; large leaves, divided or cut two or three times; and small white flowers in terminal umbels, these appearing from June to August. Should it encroach on any land where it is not wanted it must be cut down, and the creeping rootstocks preferably grubbed out.

Earth-nut (*Conopodium denudatum* Koch.), also given the names Pig-nut and Arnut, occurs freely in pastures on gravelly or sandy soils. It is a pretty, slender, little

plant (Fig. 44), usually 1 to 2 feet, although it may attain 3 feet in height. The leaves are comparatively few, and finely divided; the rootstock or tuber, which lies deeply



Photo, 1909.

H. C. Long.

FIG. 44.—Common Earth-nut (*Conopodium denudatum* Koch.).

beneath the surface of the ground, is rough, brown or purplish, often half the size of a walnut; the terminal umbels of small, white flowers appear in May and June, or later. It is almost impossible to do much in the case of this weed except take steps to improve the pasture and crowd it out. If in quantity, it may be combated by close grazing with sheep.

The Beaked Parsleys or Chervils (*Anthriscus vulgaris* Pers. and *A. sylvestris* Hoffm.) are common weeds on practically all soils, on hedge banks, by roadsides, and encroaching on grass land from hedgerows and waste land. The former species is an annual, 2 to 3 feet high, branched and leafy, with tripinnate

leaves; the minute white flowers appear in May to June, in umbels which grow from the side of the stem, on rather short stalks opposite the leaves. The small

fruits bear hooked bristles. Wild Chervil (*A. sylvestris*), on the other hand, is a perennial, flowering in April to June. The umbels of white flowers are terminal (Fig. 45), and the fruits smooth. Where these two plants are plentiful they should be regularly cut before seeding takes place, a plan which soon materially reduces them, for both are spread by seed. As the growth of *A. sylvestris* is stated¹ to be greatly promoted by nitrate of soda, the use of this manure should be avoided where the plant occurs. Superphosphate and kainit promote the growth of clover and certain grasses, which help to choke out the weed; 2 to 3 cwt. of each may be applied per acre. If the weeds occur in meadows, the hay should be cut as early as possible.

Cow Parsnip, Hogweed (*Heracleum Sphondylium* L.).—This (Fig. 46) is a common and well-

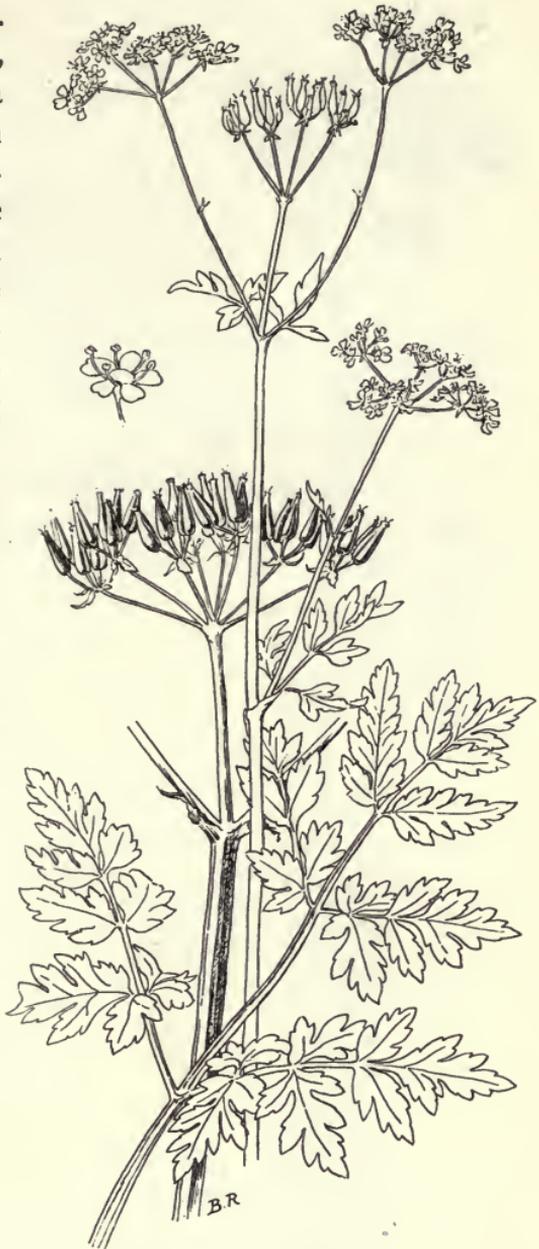


FIG. 45.—Beaked Parsley (*Anthriscus sylvestris* Hoffm.), \times about $\frac{2}{3}$. Flower enlarged.

¹ *Jour. Bd. Agric.*, 1907, p. 183.



FIG. 46.—Cow Parsnip, Hogweed (*Heracleum Sphondylium* L.), \times about $\frac{2}{3}$. Flower enlarged.

known perennial weed, which frequently attains a large size (3 to 6 feet in height). It is a rough, hairy, stout plant, with hollow stems and large leaves (1 to 3 feet), much less lobed and divided than most plants of the order. The leaves have large pale sheathing bases. The flowers are white or pink, the outer ones of the umbel irregular, one or more petals being considerably enlarged. This plant is not poisonous, like Hemlock, and cattle eat it with impunity; tame rabbits are regularly fed on it. It is common on hedge banks, roadsides, waste places, and pastures, and flowers in July. Where it occurs plentifully it may be reduced by regular cutting.

Wild Carrot (*Daucus Carota* L.) is a weed which occurs in both arable and pasture land, but is chiefly common on dry calcareous and

loamy pastures. Its seeds are sometimes found as an impurity in samples of red clover, alsike, trifolium, dogstail, and Italian ryegrass seeds. It is either annual or biennial, with tough, hard tap-root and stem, and much cut or pinnate leaves, the leaflets being many and small. The small flowers are white at the outside of the umbel, and reddish-purple towards the centre; in the fruiting stage the umbellules are arranged at different heights, giving the compound umbel the form of a cup-shaped structure resembling a miniature bird's nest. Flowering takes place from June to August. The scent and flavour resemble those of the cultivated carrot, which was derived from the wild form.

Wherever this plant occurs in meadow or pasture an endeavour should be made to get rid of it. This may be done in several ways: (1) By a general improvement in the pasture or meadow; (2) by cutting the weed regularly to prevent seeding; (3) by spudding the plants before flowering; and (4) in certain bad cases, perhaps, by ploughing up and taking a root crop, a practice which would not be favoured in the United Kingdom, although it is recommended by the Canadian Department of Agriculture ("meadow land infested with Wild Carrot should be broken up and re-seeded"); by the Ontario Agricultural College ("when the field becomes badly infested it should be ploughed and cultivated and treated to a hoed crop"), and by the United States Department of Agriculture ("grubbing in the fall; cultivation").

Upright Hedge Parsley (*Torilis Anthriscus* Gaert.) is an upright slender annual, 1 to 3 feet high, with leaves which are once or twice divided, the leaflets many and lobed. The umbels are five- to twelve-rayed, and the minute flowers are white or pink, and appear in July and August. This weed occurs in hedges and waste places,

and may encroach upon arable fields. It should be regularly cut down to prevent seeding, and in arable land should be hoed or hand pulled according to the stage of growth.

RUBIACEÆ

Yellow Bedstraw (*Galium verum* L.) is closely related to Common Cleavers or Goose Grass (see p. 83). It attains 1 to 3 feet in height, and has many slender angular stems, and rough, small linear leaves, arranged (8 to 12) in a whorl. The small golden-yellow flowers appear in June to September, and grow in dense cymes from the leaf axils and from the end of the stems. The plant is perennial, and is propagated by seeds and a stoloniferous rootstock. It occurs plentifully on grass land on sandy, loamy, and calcareous soils.

Cutting to exhaust the plant and prevent seeding is recommended, with manurial treatment to improve the condition of the herbage.

DIPSACEÆ

Wild Teazle (*Dipsacus sylvestris* L.) occurs plentifully in some districts in hedges, by ditches, and in rough damp meadow land, especially on clay and calcareous soils. It is a tall, stout, prickly plant, with large opposite sessile leaves which are prickly on the midrib beneath. The lilac flowers, appearing in August and September, occur in dense heads, which are large and conical, covered with straight bristly bracts. (In the cultivated Fuller's Teazle (*Dipsacus Fullonum* L.) the bracts are hooked.) This plant, being a biennial, is propagated by seeds; it disappears if regularly cut down before the flowers mature.

Field Scabious (*Scabiosa arvensis* L.) is a deep-rooted

perennial common on calcareous soils, both in grass and arable land. In grass land it must be combated, like so many other weeds of pastures, by judicious manuring.

Devil's Bit (*S. succisa* L.) is a common weed of meadows and pastures. The blue or purplish flowers are arranged in terminal button-shaped heads. The stems are unbranched, 1 to 3 feet high, with few or no leaves upon them. Where this plant is common, judicious manuring should be practised.

COMPOSITÆ

This order furnishes a larger number of weeds to both arable and grass land than any other, perhaps for the reason that it includes about one-tenth of all known flowering plants, many of which are spread by wind-borne, parachute-like "seeds."

The Burdock (*Arctium Lappa* L.) is an erect branched biennial, with stout stem, often 3 to 4 feet high, and large alternate, stalked, heart-shaped and pointed leaves, usually very cottony beneath, and frequently a foot long. The roots are strong and deep seated. The small purple flowers appear in July and August, grouped together into globose heads each about 1 inch in diameter; the heads have stiff, spiny, hooked bracts, and readily adhere to the clothes of man or the fur and hair of animals, thus securing their distribution. The name *Arctium* is derived from the Greek *arktos*, a bear, from the rough heads or "burs." The plant grows chiefly in waste places, by hedges and ditches, and in damp grass land on calcareous and clay soils.

The Burdock (Fig. 47) is a biennial spread by seeds, and should therefore be attacked by regular cutting early in the summer as soon as the plants begin



Photo, 1909.

J. C. Varty-Smith.

FIG. 47.—Burdock (*Arctium Lappa* L.).

to show up well, to prevent seeding. Where the pest is known to occur the first-year plants, which merely consist of the roots and a large rosette of leaves, should be thoroughly spudded and grubbed out, cutting them off well below the crown.

Knapweed (*Centaurea nigra* L.), known under a variety of names, as Hardheads, Hardhack, Black-head, is a too common weed of pastures and meadows, and occasionally present on lawns, occurring especially on clays, loams, and calcareous soils, particularly if in poor condition. It is a perennial plant, with a slender, grooved, usually branched and upright stem, with scattered variable hairy leaves, the upper ones narrow and tapering (Fig. 48). The small purple flowers appear in June to September, grouped together in dense globose heads of about 1 inch in diameter, hard and black or dark brown. The heads are not prickly, but roughish.

Knapweed is chiefly harmful on account of the fact that it is a useless plant in grass land, with tough, hard stems which are avoided by stock, although the young leaves are readily eaten by cattle and sheep. If allowed to seed it spreads and becomes very troublesome, rendering pastures unsightly, and usurping space which should be occupied by better herbage.

Where practicable, Hardhead should be combated by early cutting to prevent seeding, and the plants may be hand pulled in damp weather, though as the root system is large and the plant perennial, pieces are often left in the soil to grow again. The best method of dealing with it is to manure the land liberally so as to encourage better vegetation. A good dressing for this purpose is $\frac{3}{4}$ cwt. sulphate of ammonia, 3 to 4 cwt. superphosphate, 2 to 3 cwt. kainit per acre, which should be applied every year until the grasses

become improved and vigorous, when the Knapweed



Photo, 1909.

H. C. Long.

FIG. 48.—Knapweed, Hardheads (*Centaurea nigra* L.).

will be choked out. If farmyard manure is available, a dressing might be given in the second season instead of

the artificial manures named. On heavy land basic slag should be employed instead of superphosphate.

Field Scabious (*Centaurea Scabiosa* L.), also known as Hardheads, Great Knapweed, Matfellow, sometimes occurs abundantly on dry calcareous pastures. It is a perennial, with woody rootstock, grooved stem 2 to 3 feet high, and a covering of soft hairs. The leaves are large, 4 to 10 inches long, deeply cut and lobed; the heads of bright purple flowers are $1\frac{1}{2}$ inch or more in diameter, rayed, and with more spreading flowers than those of *C. nigra*. It flowers between June and September. In general this plant in pastures must be combated as in the case of *C. nigra*. It occurs also on arable land.

Thistles (*Cnicus* sp.) are among the worst and commonest weeds of grass land, and when they grow most luxuriantly are, like many other weeds, held to be a sign of good land. Thistles are common to both grass and arable land, and are almost equally troublesome in either. Not only do they crowd out the legitimate crop by taking up space, light, air, heat, water, and plant food, so reducing the yield of valuable produce, but they are a great trouble at the time of hay harvest, harming the mowing machine, pricking the hands of loaders, irritating horses, and in other ways objectionable. In corn crops too they are an unmitigated nuisance. When corn must be bound by hand they are a veritable pest; in the binder they are troublesome, as also at the time of stooking, carting, stacking, and thrashing. In these cases the presence of Thistles, as we know from practical experience, is a bugbear to master and men alike. Loose barley, for example, is not the pleasantest material to load when over-dried, but when full of Thistles it becomes much worse. In the returns given at p. 233, it will be

observed that Thistles are placed at the head of the list as the worst weeds of grass land.

As all the species of Thistles occur in grass land, it will be convenient to refer to them here.

The Spear Thistle (*Cnicus lanceolatus* Hoffm.) is a large, strong, purple-flowered plant (Fig. 49), blooming in July and August. The flower-heads are upwards of an inch in diameter, either single or placed two or three together, the whole plant being well provided with short spines. Seeds are plentifully produced, and, attached to the feathery pappus or down, are borne away from the parent plant and distributed by the wind. Percival says that the seeds "germinate very easily in two or three days when they are placed in suitable soil. The Spear Thistle, as met with in the fields, is usually a biennial. I have, however, flowered seedlings in one season, but such plants did not ripen seeds satisfactorily, and were destroyed by frost in the autumn." In the first year the Spear Thistle produces a compact rosette of leaves, flowers and produces seed in the second year, and then dies. The root system is in the form of a deep tap-root.

The Marsh Thistle (*Cnicus palustris* Hoffm.) is found chiefly in damp, undrained pastures and meadows. It is a biennial, and grows in a manner similar to the Spear Thistle. The root system is much divided, the stem branched, and the plant very spinous. The leaves are hairy on both surfaces, the heads are three-fourths of an inch in diameter in leafy clusters, the flowers themselves being dark purple. The seeds, says Percival, "only germinate under the peculiar acid conditions of marshy, damp soil."

The Stemless Thistle (*Cnicus acaulis* Hoffm.), sometimes termed the Chalk Thistle, is more troublesome than is commonly recognised. It is a perennial which,



Photo, 1909.

J. H. Crabtree.

FIG. 49.—Spear Thistle (*Cnicus lanceolatus* Hoffm.).

according to Hooker, occurs on gravelly and chalky pastures in England, from Chester and Lincoln southwards. The flat rosette of leaves destroys the patch of grass upon which it lies. As its name implies, it is usually stemless, and bears sessile or shortly stalked heads an inch or more in length. At the same time it has an extensively creeping rootstock, which makes it difficult to eradicate.

The Creeping Thistle (*Cnicus arvensis* Hoffm.) is undoubtedly the worst of all Thistles, and is by some held to be the commonest weed pest of agriculture. Not only is it perennial, but to complicate matters it spreads rapidly by means of an extensive creeping root system (Fig. 50) which develops in all directions; broken pieces of the rootstock easily take root and give rise to new plants. Flowering stems are sent up from buds which are produced at intervals on the creeping roots, which are whitish or earthy-coloured, and of the thickness of a small quill. Vast numbers of plants of this kind of Thistle produce down in the flower-heads, but no perfectly formed seeds. This has led many farmers to believe that the seeds of the Creeping Thistle do not germinate; such, however, is not the case, as certain plants produce ripe seeds which germinate and grow into new plants quite readily. The Creeping Thistle occurs both in grass and arable land, and is difficult to eradicate in either. All four of these species of Thistle flower between July and September or October.

Where Thistles occur in grass land they must be attacked with vigour and persistence. Since the Spear and Marsh Thistles are biennials, they may readily be reduced in numbers by regular cutting and spudding to prevent flowering and seeding, and to this end the spud, sickle, scythe, or thistle cutter (Fig. 4), or in

some cases an old grass mower, may be brought into requisition in June and July. Thorough work is necessary, and the ground should be covered a second time



Photo, 1909.

H. C. Long.

FIG. 50.—Creeping Thistle (*Cnicus arvensis* Hoffm.), showing extensively creeping roots.

after an interval of two or three weeks wherever possible. The seedlings appear as rosettes of leaves in the autumn and early spring, at which times the

young plants should be thoroughly spudded and removed from their position to make certain that the roots are severed.

The Stemless Thistle must be combated by regular spudding as soon as the flower-heads begin to show, no other mechanical means being practicable ; a pinch of sulphate of ammonia or sulphate of copper (bluestone) may be applied with advantage to the cut surface of each plant spudded, one worker spudding and a second applying the powdered material. Both the bluestone and sulphate of ammonia should be applied carefully, and not dropped on the surrounding grass. At the same time manuring should be practised to aid other herbage to crowd out the Thistle.

In the case of the Creeping Thistle one, or even two cuttings will be insufficient, owing to the extensive creeping root system, the reserves of food stored there serving to produce fresh shoots after repeated cutting. Cutting, therefore, must be repeated from early spring until late summer, giving this pest no chance to produce seed, and exhausting it as much as possible. "Faithful, systematic cutting with the spud or scythe in meadows and pastures throughout two seasons . . . is a sure plan of getting rid of this most troublesome agricultural pest."¹

Cotton Thistle (*Onopordon Acanthium* L.), known also as the Scotch Thistle, is a stout, tall, hoary, or "cottony" plant, with branched stem, wavy divided leaves, and many large, roundish, "cobwebby" heads of pale purple flowers, which appear in July to September. It is a biennial, and where it occurs should be dealt with in the same way as the Spear and Marsh Thistles (p. 180).

Butter-bur (*Petasites vulgaris* Desf.) is a perennial

¹ Leaflet No. 166, Board of Agriculture.



Photo, 1909.

J. C. Varty-Smith.

FIG. 51.—Butter-bur (*Petasites vulgaris* Desf.), in July.

plant, with an extensively creeping, fleshy rootstock (Fig. 51), from which flowering stems are sent up during the early spring months (February to May) before the leaves appear. The flowers are pinkish or dull lilac, in head-like panicles on a short, fleshy stalk. The male and female flowers are usually in different heads. As in the case of Coltsfoot, the leaves follow the flowers; they are very large—up to 3 feet across—resembling those of rhubarb, and borne on long stalks; they are white and cottony beneath. The common name is said to have been derived from the fact that the large leaves were formerly used for the purpose of wrapping up butter, but there are no “burs” on the plant.

The Butter-bur occurs in damp, wet meadows, in low-lying land near streams and rivers, especially on sandy and clayey soils, where it is sometimes a serious pest. It has been described as “the largest, and, where it abounds, the most pernicious of all the weeds which this country produces” (Johns).

This weed must be attacked by cutting down the flowering stems to prevent seeding, and later by persistent cutting of the large leaves to prevent the manufacture and storage of food for the future use of the plants. Cut surfaces after spudding might be treated with a pinch of sulphate of ammonia, sulphate of iron, or sulphate of copper (bluestone). Where it can be carried out, drainage is of use; very small patches may be grubbed out, but as the root system is extensive and deep seated, this plan is too costly on large areas; spraying with a solution of copper sulphate might be tried, as the leaves are so large and rough they would be likely to retain the liquid, but cutting is probably simpler and quicker. Improvement of the herbage by manurial treatment tends to reduce the weed.

Coltsfoot (*Tussilago Farfara* L.) is chiefly a weed of arable land (see p. 87), but often occurs in pastures and meadows. Sutton says that pastures on poor, stiff clays are not infrequently overrun by it. In such cases the flowering stems should be cut in February to April, when they appear before the leaves, and later the half-grown leaves should be cut, thus weakening the plants. The pest can be gradually reduced and largely destroyed by the use of nitrogenous manures, such as nitrate of soda and farmyard manure. As this weed occurs freely in damp clays, and in damp sandy soils overlying impervious clays, draining is of great value.

The Common Daisy (*Bellis perennis* L.), or "Day's Eye," is too well known to need description here. It occurs on almost all soils in poor pastures and meadows and on lawns, flowering almost all the year round. The rosettes of leaves lying flat on the ground prevent the growth of grasses and clovers, as may at once be seen on cutting off a Daisy plant below the crown and removing it, a bare round patch being left. When very plentiful in pastures much loss of good herbage occurs. The best plan of dealing with this weed is to encourage clovers and better grasses by manurial treatment, thus smothering it out by taller and more useful herbage. (As to Daisies on lawns, see Chap. X.)

Yarrow or Milfoil (*Achillea Millefolium* L.), although readily eaten by sheep, is inclined to overrun grass land on poor soils, and must therefore be included here as a weed. Its good qualities when kept in check by grazing has led to its inclusion as a constituent of seed mixtures for laying down permanent pasture. It must, however, be utilised in this manner with great care if at all, as the extensive creeping rootstock enables it to

spread rapidly. When the produce is to be mown it should not be included in seed mixtures, as the grown plants are woody in character, refused by stock, and of no value in hay.

Yarrow occurs on many soils, but is most abundant on those of a dry or loamy character. It grows from 1 foot to nearly 3 feet in height, with furrowed and leafy stems. The leaves are 2 to 6 inches long, and very finely divided. The flowers, which are white or pinkish, appear between May and September; they occur in small heads arranged in corymbs which roughly resemble umbels. If it be desired to reduce this plant where it occurs in meadows, manuring with farmyard manure, nitrate of soda, or sulphate of ammonia should be practised.

Ox-eye Daisy (*Chrysanthemum Leucanthemum* L.), sometimes called "Dog Daisy," is an erect perennial with branched stems bearing large white daisy-like flowers, 1 to 2 inches across. It is most common in grass land in poor condition, especially on clays and calcareous loams; it may also occur in arable land. It flowers from June to August. The free use of farmyard and other manure to improve the condition of the land has the effect of greatly diminishing the Ox-eye Daisy. The use of salt is also recommended by the U.S. Department of Agriculture (*Farmers' Bull.* 28). As the seeds of this weed are a common impurity in grass seeds, it is necessary again to advise the use of only pure seeds. In Canada the Ox-eye Daisy is called Poverty Weed, and it is stated that it "can be got rid of only by breaking up the sod."¹ The Canadian Department of Agriculture recommend² ploughing, and a short rotation

¹ *Bull.* 128, Ont. Agric. Coll.

² *Farm Weeds*, Dept. of Agric., Ottawa.

including seeding down to clover at short intervals, as probably the best method of cleaning land of this weed. Early cutting of grass for hay may be practised to prevent seeding.

Marsh Cudweed (*Gnaphalium uliginosum* L.) is an annual of damp light soils; if too plentiful it should be reduced by preventing seeding, and by encouraging taller and better herbage. (See also p. 96.)

Ragwort or Ragweed (*Senecio Jacobæa* L.) is a perennial of dry pastures and meadows, on light, medium, and calcareous soils. It is a tall, handsome plant, 2 to 4 feet high, with a fleshy tap-root, smooth stem, and irregularly cut leaves which give it a "ragged" appearance (Fig. 52). The flower heads are golden-yellow, resembling yellow daisies, about 1 inch in diameter, and grouped in dense clusters or corymbs. Flowering takes place between June and September. It is closely related to Groundsel (*S. vulgaris*), a well-known common weed of gardens and arable land.

Ragwort is extremely plentiful in some pastures, and is usually avoided by cattle in this country. In the young state, however, it is greedily eaten by sheep, so much so that sheep are held by many to be the chief means of eradicating it by the process of close depasturing. In the old state, about the time of flowering, the plant is tough and hard. In Canada this weed has been shown to be the cause of the Pictou cattle disease, or hepatic cirrhosis, a curious and fatal disease of the liver, which has given considerable trouble during the last few years.¹ In New Zealand also the same trouble has been experienced, and much loss appears to have been caused by it.² Sheep were closely pastured on

¹ *Farm Weeds*, Dept. of Agric., Ottawa.

² *Ann. Repts.*, N. Z. Dept. Agric., 1903 and 1904.

an area of about 4000 acres, with the object of eradicat-



Photo, 1909.

J. C. Varty-Smith.

FIG. 52.—Ragwort (*Senecio Jacobæa* L.).

ing it, and at first seemed to do well; after a year, however, considerable mortality ensued. Mr. Gilruth,

Chief Veterinarian, concluded that if Ragwort does not monopolise the ground sheep may, with few exceptions, eat it daily without suffering any ill effects, and prove a decided check upon its growth, if they do not lead to its almost complete eradication. Cattle and horses avoided it when possible. In South Africa, also, the Molteno Cattle Sickness (also cirrhosis of the liver) has been traced to a weed of the Ragwort variety (*Senecio latifolius*), and from specimens examined at the Imperial Institute two new crystalline alkaloids (senecifoline and senecifolidine) have been isolated, 1.20 per cent being present in the plant before flowering, and 0.49 per cent after flowering. No disease of this character appears to have been observed in the United Kingdom, and, the conditions being different from those prevailing in Canada and New Zealand, it is doubtful whether the plant is likely to prove injurious here. It is, however, a worthless weed in grass land, replacing better herbage, and should be eradicated.

The best plan of dealing with Ragwort consists in feeding it off with sheep in spring and early summer, thus weakening the plants and preventing seeding. Where the flowering plants are seen they may be readily pulled up after rain. In Canada there is good evidence that where it has been mowed systematically it has in a short time disappeared. McAlpine and Wright state that "the best method is, when cutting off the heads, to leave a sufficient length of the lower part of the stem untouched. In the autumn, when the ground has been softened by rain and the roots have shrunk and hardened, they may be quite easily pulled out by hand." "The simplest means of exterminating the Ragwort is, however, to graze the land with sheep in the early summer. . . . On land regularly



FIG. 53.—Cat's-ear (*Hypochoeris radicata* L.), $\times \frac{2}{3}$.

stocked with sheep not a single Ragwort can be seen." ¹

Cat's-ear (*Hypochaeris radicata* L.) is a perennial weed of grass land found on almost all soils. The leaves, growing from the rootstock, vary in length from 3 or 4 to about 10 inches, are rough and wavy, and, like the rest of the plant, somewhat rough. The yellow flowers, which appear in June to September, resemble those of the Dandelion, and are over 1 inch in diameter, borne at the end of a branched stalk nearly a foot high (Fig. 53). The fruits are readily scattered by the wind, and occur also in many grass seed samples.

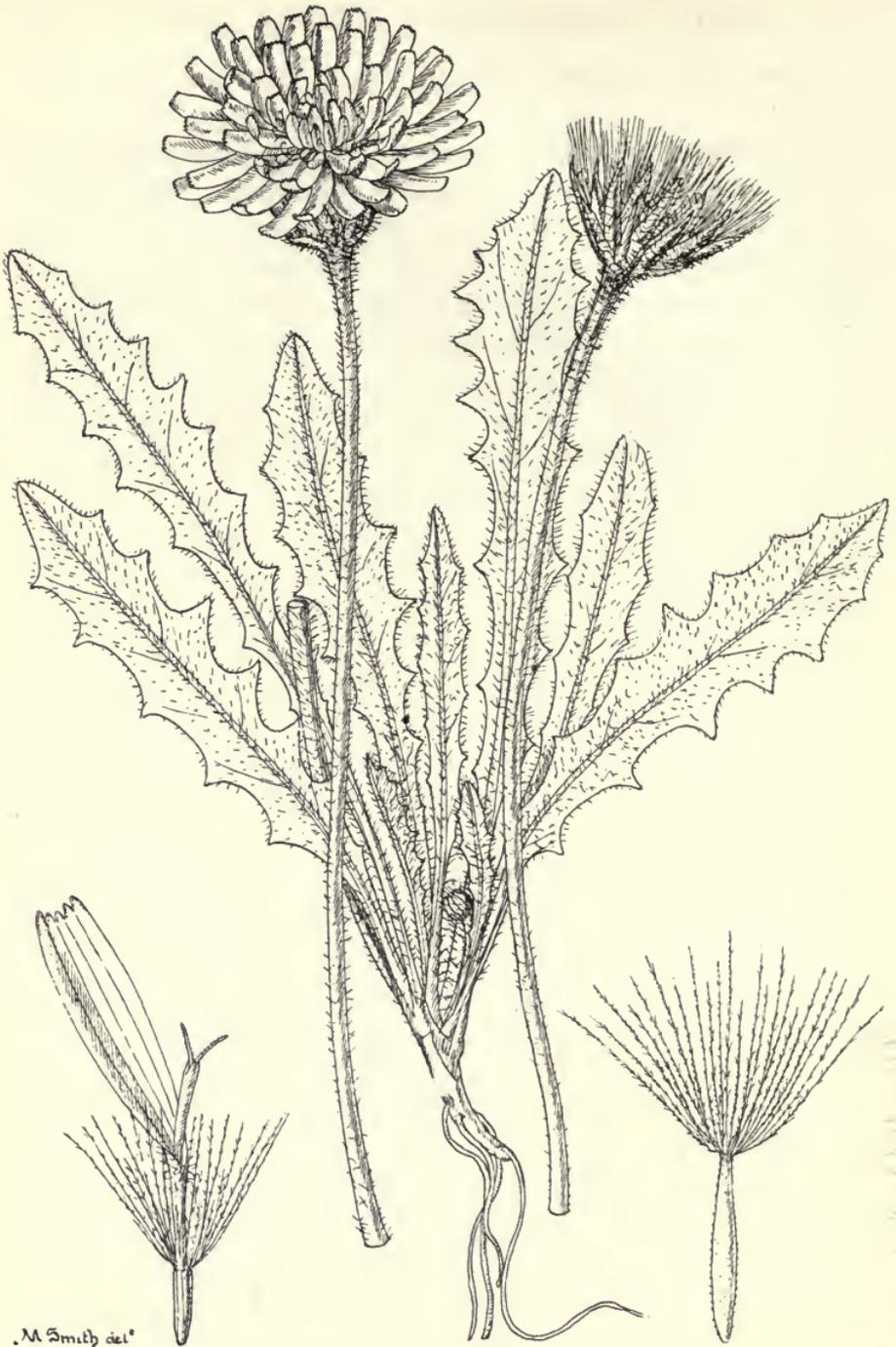
Goat's-beard (*Tragopogon pratensis* L.) is an erect perennial plant, from 1 to 2 feet high, with sheath-like leaves clasping the stem, and contracting from below upwards until linear near the tip. The flowers are yellow, and $\frac{1}{2}$ to 2 inches in diameter, appearing in June to July. Hooker says that the root is edible, and the flowers close at noon. It occurs in pastures and meadows as well as arable land, especially on medium and heavy soils.

Rough Hawkbit (*Leontodon hispidus*) has oblong-lanceolate leaves resembling those of Cat's-ear, about 3 to 5 inches long; the yellow heads are nearly $1\frac{1}{2}$ inch across, borne on long unbranched stems (Fig. 54). Flowering takes place in June to September. The plant is perennial. The whole weed is covered with rough harsh hairs. It occurs in pastures and meadows on dry soils.

Autumnal Hawkbit (*Leontodon autumnalis* L.) in general resembles *L. hispidus*, but the leaves are smooth, and the flowering stalks branched. It occurs in similar positions to the last species, and is perennial.

The four last-mentioned weeds are all spread by

¹ *Trans. Highland and Agric. Soc.*, 1894.



M. Smith del.

FIG. 54.—Rough Hawkbit (*Leontodon hispidus* L.), $\times \frac{2}{3}$; with floret (left) and achene (right) enlarged.

seeds scattered by the wind; seeding should therefore be prevented as far as possible. Regular and persistent spudding will reduce them; at the same time an effort should be made to encourage clovers and grasses to choke them out.

Dandelion (*Taraxacum officinale* Wigg. or *Leontodon Taraxacum* L.) is one of the commonest weeds of grass land, and needs little description. It possesses very deep-seated roots, and as the plant is a perennial, this makes it very difficult to eradicate by the use of the spud. If a Dandelion plant be examined it will be observed that the dense mass of leaves lie almost flat on the ground, cover comparatively a large area, and tend to smother out good grasses and clovers. The Dandelion does more harm in this way than is commonly believed.

Flowering takes place from early spring until the autumn, *i.e.* from March to October, and if the flowers are allowed to come to maturity large numbers of seeds are produced and distributed by the wind by means of the pappus attachment. The author has a record of a plant bearing twenty-seven flowering heads, one of which bore 200 seeds, giving a total of 5400 seeds on a single plant.

The Dandelion should be repeatedly attacked by means of the spud, by which it should be deeply cut off. The use at the same time of a complete artificial manure to encourage a better type of herbage does much to suppress the weed. A pinch of sulphate of ammonia placed on the cut surface of each plant after spudding will kill the roots, but this is too tedious and expensive a process, except in the case of small areas, especially lawns. In Dr. Frank's experiments¹ it was found that Dandelions, sprayed when full

¹ *Arb. aus der Biol. Abth. für Land. und Forstw.*, I Band, 1900.

grown on June 20th with a 15 per cent solution of sulphate of iron (60 lb. in 40 gallons of water) became quite black and were killed; as gramineous plants are but little damaged by such a solution, this method might be tried where Dandelions are specially plentiful. Experiment in both the United States and Germany, also, has shown that a 5 per cent solution of copper sulphate applied as a spray at the rate of 160 gallons per acre has largely destroyed the leaves and flowering stems of Dandelions, preventing them from seeding. A small plot should be treated at first as an experiment to watch the effect under local conditions. As regards lawns, &c., see p. 345.

Mouse-ear Hawkweed (*Hieracium Pilosella* L.) is a softly hairy perennial, with leafless stems about a foot in height, solitary yellow flower-heads nearly 1 inch across, oblong-lanceolate leaves 2 to 4 inches long, and a stoloniferous or creeping rootstock. Flowering, May to August.

Orange Hawkweed (*H. aurantiacum* L.) resembles the last species, but is larger, very hairy, and the flowers are orange-red. It is a naturalised perennial, propagated by both seed and creeping rootstock. This is the Devil's Paint-brush of Canada, where it is a "noxious" weed for the Dominion. Flowering, June to August.

Both of these weeds occur in dry pastures, and should be cut down to prevent seeding, and the pasture improved. It has been found in Canada that the Orange Hawkweed may be killed by broad-casting dry salt at the rate of $1\frac{1}{2}$ tons per acre.

CAMPANULACEÆ

Sheep's Scabious (*Jasione montana* L.), known also as Sheep's-bit, is an upright branched weed of dry hilly pastures on heathy light soils. It grows to a height of 1 to 1½ feet, is somewhat hairy, with few leaves, about ½ to 1 inch long, and several heads of blue or lilac-blue flowers over ½ inch across, superficially resembling a scabious. It flowers in June to September. Seeding should be prevented, and the soil improved by manures.

ERICACEÆ

Cross-leaved Heath (*Erica Tetralix* L.), a common and well-known Heath, in which the leaves are placed crosswise, four in a whorl; the rose-coloured flowers are in drooping terminal clusters or heads. It grows 1 to 1½ feet high, and flowers in July to September.

Common Heather or Ling (*Calluna vulgaris* Salisb.) is also one of our commonest plants in many districts. It is from 1 to 2 feet high, woody and branched, with very small smooth, almost linear leaves. Many small rose-coloured or white flowers on very short stalks are produced, persisting long after the fruit is ripe. Flowering, July to September.

Both of these plants are perennials, which occur on heathy moorland soils and on upland pastures or rough grazing land. If it be required to reduce them, burning, with grubbing or cultivation, is necessary; an application of lime checks further growth of all the Heaths.

GENTIANACEÆ

Common Centaury (*Erythræa Centaurium* Pers.) is an erect, smooth, branched plant of 1 foot or more in height, with radical, elliptic-oblong leaves ½ to 2 inches

long, the upper ones being acute. The pink or reddish flowers, $\frac{1}{4}$ to $\frac{1}{2}$ inch across, are in terminal cymes. The plant blooms between June and September, and occurs in dry calcareous and sandy pastures and waste land. It is a very bitter annual; regular cutting to prevent seeding reduces it.

Field Gentian (*Gentiana campestris* L.), an annual of 6 to 12 inches in height, produces in July to October panicles of stalked lilac or bluish flowers $\frac{1}{4}$ to $\frac{1}{2}$ inch in diameter. The leaves are opposite and lanceolate. This plant is sometimes very common on hilly pastures. If too plentiful, regular cutting to prevent seeding will reduce it.

BORAGINEÆ

Common Comfrey (*Symphytum officinale* L.) is a coarse, rough perennial herb 1 to 3 feet in height, with branched, fleshy, brittle roots, pieces of which will grow when broken off. The stem is branched and angular, with ovate-lanceolate leaves 4 to 8 inches long. The flowers may be white, pink, or purple, and are in drooping clusters. Flowering, May to June. This plant grows most freely in damp soils near streams and in gardens. The root system renders it difficult of eradication, and in grass land it must be regularly and persistently mown down and better herbage encouraged. In gardens, good cultivation and careful removal of the roots must be practised. Horses and other stock are fond of the plant in a green state.

PLANTAGINEÆ

Plantains (*Plantago* sp.) are well known to most farmers and gardeners. The following three species are very troublesome in grass land:—

1. **The Ribwort Plantain or Rib-grass** (*P. lanceolata*

L.), with long (3 to 12 inches), narrow, ribbed, more or less lanceolate leaves, tapering rootstock, and short,



Photo, 1903.

G. Parkin.

FIG. 55.—Ribwort Plantain (*Plantago lanceolata* L.).

globose or cylindrical heads at the end of long, angular stalks (Fig. 55). Flowering takes place between May

and October. This Plantain is known to children under the name of "Cocks and Hens." The brown, shining seeds resemble small date stones, and are a common impurity in many kinds of clover and grass seeds. In America this species is known as Buckhorn.

2. **Broad-leaved Plantain** (*P. major* L.), also termed Greater Plantain or Way-bread, has broadly-oblong ribbed leaves on long channelled stalks, and a stout truncate rootstock; the flowers are in very long, slender spikes, and when in fruit are often given to cage birds. Flowering occurs between May and September.

3. **Hoary Plantain, Lamb's Tongue** (*P. media* L.) has downy, sub-sessile, broadly elliptical, ribbed leaves, with short, flat stalks, the leaves lying very close to the ground (in the two former species the leaves are rather ascending) and destroying all vegetation beneath, leaving a bare patch if the plant be removed. The rootstock is tapering, and the flowers are packed in a close cylindrical spike, shorter than in *P. major*, but on a longer footstalk or stem. The flowers are fragrant, and somewhat conspicuous owing to the lilac bracts. They appear during June to October.

These three Plantains are perennial, and all are common to grass land on practically all soils, although *P. media* is perhaps more frequent on dry calcareous soils. They are very troublesome in lawns (see p. 345). Where these weeds are very plentiful they may be spudded out, or removed with the docking iron. Pure seed, free from the seed of Plantains, should invariably be sown for leys and permanent pasture. It should be remarked here that Rib-grass is frequently included in grass mixtures, but why so it is difficult to understand, unless solely because the roots open up the soil to air, as it certainly replaces a large quantity of better herbage. As regards arable land, see p. 108.

SCROPHULARIACEÆ

Common or Germander Speedwell (*Veronica Chamædris* L.) is a perennial which occurs on practically all soils in grass land, but is usually little trouble. It has hairy ascending stems, almost sessile ovate leaves, and axillary racemes of bright blue roundish flowers $\frac{1}{2}$ inch across, which appear in May and June.

Red Bartsia (*Bartsia Odontites* Huds.) and **Yellow or Viscid Bartsia** (*B. viscosa* L.) sometimes occur abundantly in grass land. (They are described at p. 272.)

In order to reduce these two species of *Bartsia* regular cutting to prevent seeding must be practised, and close grazing with sheep, combined with manuring, will reduce them. *B. Odontites* is frequently found in arable land, where it may be successfully combated by thorough cultivation.

LABIATÆ

Self-heal (*Prunella vulgaris* L.) is sometimes very troublesome in pastures and meadows. It is a somewhat hairy perennial, 6 to 12 inches high, with a square stem, almost oblong opposite leaves, the lower pairs of which are stalked and the upper sessile. The plant has a creeping rootstock. The small, reddish-purple, two-lipped flowers occur in whorls in dense terminal heads (Fig. 56), and open in July to September. Samples of clover seeds often contain the almost egg-shaped seeds of Self-heal as an impurity. The latter may therefore



FIG. 56. — Self-heal (*Prunella vulgaris* L.), $\times \frac{3}{4}$.

be sown, unless care be taken to ensure pure clover seed. The plant also occurs naturally in damp grass land. It is held to indicate poor, sterile land, and in Scotland is known by the name "Blaw-weary." Close grazing with sheep receiving cake, or sound judicious



Photo, 1909.

H. C. Long.

FIG. 57.—Common Bugle (*Ajuga reptans* L.),
in a pasture.

manurial treatment, will effect an improvement in the herbage and a reduction in the weed. On heavy land basic slag is useful in checking it, and on light soils superphosphate.

Common Bugle (*Ajuga reptans* L.) is another perennial, somewhat similar to Self-heal, the stems being 6 to 12 inches high, and the leaves sessile and ovate. The blue flowers are

arranged in loose whorls in longish spikes (2 to 8 inches long). They open in May to July. The plant, which is common by roadsides and in grass land, is spread by seed and by stolons or runners (Fig. 57). It may be combated in the same way as Self-heal.

PRIMULACEÆ

The Cowslip (*Primula veris* L.), so well known to all country people, is a perennial which grows in meadows and pastures, especially on sticky calcareous loams. The flowers appear in April and May. Manuring and close grazing, combined with regular cutting, tend to reduce it.

POLYGONACEÆ

The only members of this order to be considered here are the Docks and Sorrels, than which few weeds are more troublesome, both on the farm and in the garden. All are perennials, and most of them difficult to eradicate.

The Common or Broad-leaved Dock (*Rumex obtusifolius* L.) is a stout erect plant 2 to 3 feet high, with a strong tapering root descending deeply into the soil. The radical leaves are large, often a foot long. They are oblong-lanceolate, borne on a slender stalk, and have a somewhat wavy margin. The small flowers, on slender pedicels, are produced in large numbers on a narrow panicle, which is leafy towards the base. They produce brownish, triangular fruits, resembling buckwheat, which are enclosed in toothed or serrated sepals. Flowering takes place in August and September, and the panicle has a reddish-brown tinge. This Dock is practically ubiquitous, and is troublesome in both arable and grass land.

Curled Dock (*Rumex crispus* L.) may also be described as ubiquitous. The stem is branched and 1 to 3 feet high, and there is a fleshy tap-root. It much resembles *R. obtusifolius*, but the leaves are narrower, lanceolate, and more waved or crisped along the edges. The small reddish or greenish flowers are in crowded



Photo, 1909.

H. C. Long.

FIG. 58.—Curled Dock (*Rumex crispus* L.): note the rootstock, right-hand portion of which has been broken off.

whorls in erect, branched panicles (Fig. 58), and the brown, triangular fruit is surrounded by fruiting sepals, which have entire or only slightly toothed margins. Flowering is continued longer than in the last species, namely, from June to October. In connection with



Photo, 1909.

H. C. Long.

FIG. 59.—Seedlings of Dock (*Rumex* sp.).

arable land it is important to note the appearance of the seedling Dock (Fig. 59).

Several other species (*R. pratensis* L., *R. sanguineus* L., and, in damp grass land, *R. aquaticus* L.) may prove harmful and a nuisance both on arable and grass land. Docks are common to almost all soils, and are not easily got rid of. They are unfortunately able to produce adventitious buds on almost any part of the root which may be severed from the crown; hence if

the flowering stem and crown be removed the part remaining in the soil will quickly give rise to a new stem, while the part removed may, if left lying on the ground, live and produce flowers and seed. The seeds are too commonly found in grass and clover seed samples; and Mr. Martin J. Sutton says¹ that "comparatively few samples of clover harvested in this country are entirely free from Dock seed, but it is true economy to ensure a pure sample."

Wherever Docks occur in grass land they should be removed with the docking iron when the ground is soft, although the fleshy roots are so deeply seated that it is nearly impossible to lift them completely. They may also be reduced by regular spudding every time they show signs of renewed vitality; the operation should always be carried out before flowering is advanced. Every portion removed should be burnt, and not carelessly thrown in the hedge or ditch as is frequently done, for such pieces may take root in damp places, produce adventitious buds, and then flower and seed. When a Dock has been cut off near or below the crown a pinch of sulphate of ammonia placed on the cut surface generally kills the root. (As regards Docks on arable land, see p. 118.)

Sheep's Sorrel (*Rumex Acetosella* L.) is a slender perennial 6 to 20 inches high, with an extensively creeping rootstock (Fig. 60). It has a smooth branched stem, and hastate or somewhat arrow-head shaped radical leaves borne on long stalks, the upper or stem leaves being sessile and narrowly lanceolate or linear. The small male and female flowers are borne on separate plants in branched, leafless panicles of several inches in length, appearing from May to August. In late summer and autumn Sheep's Sorrel becomes of a

¹ *Permanent and Temporary Pastures*, 1908.



Photo, 1903.

J. C. Varty-Smith.

FIG. 60.—Sheep's Sorrel (*Rumex Acetosella* L.).

beautiful reddish colour. The fruits are triangular and yellowish-brown, and occur as common impurities in badly cleaned samples of clover and grass seeds. The plant has an acid taste, due to acid oxalates, and has been accused of poisoning live stock. (See p. 308.)

Sheep's Sorrel is an undesirable plant in grass land, and should be got rid of. It is typically a weed of poor dry pastures, and is regarded as a sign of sour land. It is very common in meadows, and occurs also on arable land. Hall states¹ that in arable land the presence of this plant is a pretty sure sign of the absence of lime. The best way to reduce it is by improving the condition of the land; to this end systematic manuring should be practised, and an application of lime made at the rate of 1 ton per acre on light land, or up to 2 tons per acre on heavy or wet land. On heavy land basic slag will be useful, both on account of the lime which it contains and the encouragement it gives to the growth of clovers.

Common Sorrel (*Rumex Acetosa* L.) is larger than Sheep's Sorrel. It has a slender, simple stem, 1 to 2 feet high, with larger leaves on longer stalks than those of *R. Acetosella*; the rootstock does not creep below ground as in the latter species, but is a slender tufted tap-root. The small flowers open in May to August, the male and female ones being on separate plants in branched, leafless panicles. This plant is also known as Sourock or Sour Dock, and the leaves are eaten by children on account of their pleasantly acid taste: the practice is not to be recommended. It occurs in most meadows, sometimes in great quantity, but is of no value. If in small quantity only it may be spudded or regularly cut down, but if in quantity it should be mown early. It was found at Rothamsted (see p. 147)

¹ A. D. Hall, *Fertilisers and Manures*, 1909.

that Sorrel was much decreased by an application of lime. Dressings of mineral manures weaken Sorrel, and also encourage better herbage to choke out the weed. Manurial treatment, however, should be practised in conjunction with regular cutting.

URTICACEÆ

The Great (Stinging) Nettle (*Urtica dioica* L.) is frequently a serious pest in certain parts of grass fields, but usually only in patches. It is a hairy perennial, 2 to 4 feet or more in height, with large, heart-shaped serrated and pointed leaves placed opposite one another in pairs on the stem, and covered with stinging hairs. The flowers are borne in long clusters or panicles (Fig. 61) in the axils of the leaves. It quickly invades adjacent soil by means of its extensively creeping underground stems. It grows on most kinds of soil and in almost any position, but thrives best on good land, such as well manured gardens and paddocks.



FIG. 61.—Stinging Nettle (*Urtica dioica* L.), $\times \frac{2}{3}$, with flower enlarged.

Nettles may be best destroyed by digging them out by hand and burning them, but on large areas this is impracticable, and regular mowing must be resorted to, the successive cuttings taking place as soon as the

shoots attain 6 inches to a foot in height. A liberal dressing of salt should be given when the Nettles are first cut down in spring. The use of tarred paper in the manner referred to at p. 41 may also be useful on small areas.

CANNABACEÆ

Wild Hop (*Humulus Lupulus* L.) is a perennial which occurs in many parts of the country in hedges and bushy places, and may occasionally cause harm by climbing among corn crops or grass laid up for mowing. The stems and leaves are rough, with strong hooked hairs which enable the plant to cling to a support, thus aiding the climbing or twining habit. The seeds are easily distributed by the wind in autumn, and young plants appear in the next spring. Although the Hop appears to be indigenous in Britain, many of the so-called Wild Hops are probably escapes from cultivation.

Where the Hop is found to be a nuisance much may be done to prevent trouble in the future by regular trimming of hedgerows and ditches, so cutting off the plants at the base and preventing seeding.

ORCHIDACEÆ

The Purple Orchis (*Orchis mascula* L.) and the **Spotted Orchis** (*O. maculata* L.) are frequently very plentiful in grass land.

The Purple Orchis is a foot or more in height, has elliptic-lanceolate leaves usually spotted with purple-black, and somewhat spotted reddish-purple flowers in lax spikes; the tubers are ovoid.

The Spotted Orchis is also about a foot high, and the leaves are narrow oblong-lanceolate, and generally

bear a number of dark squarish spots. The flowers are pale purple marked with dark lines and spots, and in dense, somewhat pyramidal, spikes; the tuber has somewhat the shape of a hand. The former species occurs on many kinds of soil, and especially on sterile clays (Buckman); the latter in damp meadows. In the case of *O. mascula* a general improvement in the herbage will reduce it, while for a reduction of *O. maculata* drainage may be necessary.

LILIACEÆ

Crow Garlic or Wild Onion (*Allium vineale* L.) is one of the most troublesome of weeds, and very difficult to eradicate. In the young stage from early winter until late spring it closely resembles a young onion (Fig. 62), with round, hollow, pointed leaves. The globose heads of reddish flowers are produced in summer. The flowering heads also produce "bulbils," or small, fleshy bodies which effectively reproduce the Wild Onion. *Allium vineale* is therefore reproduced in three ways: by seed, by bulbils, and by the "splitting" of the parent bulbs.

This pest occurs both in arable and grass land. In the latter position it usurps the place of better herbage, and is otherwise very harmful on account of the fact that it taints the milk of cows which may be at pasture, and also the butter which is produced from such milk. On a dairy farm, indeed, a pasture may be rendered almost useless for milking cows owing to the Wild Onion. It may be reduced by spraying with a 5 per cent solution of carbolic acid.¹ If only in small areas, the bulbs may be dug up and picked out by hand. Sutton says that the onion-like leaves appear to be

¹ *Jour. Roy. Agric. Soc.*, 1900, 1901, and 1902.

very tempting to milch cows, and that "persistent hand pulling of the bulbous roots early in the year is



Photo, 1909.

H. C. Long.

FIG. 62.—Wild Onion (*Allium vineale* L.), in young state—taken from wheat in December, 1908.

the only way of ridding pastures of Crow Garlic." The Woburn experiments showed that "when the stem

is thrown up it is almost impossible to pull the stem and bulb up together. But, as the season advances, the bulb seems to work up to the surface, and about June it is quite easy to pull up stem and bulb together."

The presence of the Wild Onion in excessive quantity over a small area may render it advisable to pare and burn the surface soil containing the bulbs, and then re-seed the patches. (See also p: 125.)

Ramsons or Broad-leaved Garlic (*Allium ursinum* L.) is a fairly common plant in woods, moist shady places, and by the sides of streams. It is 1 to 2 feet high, with large, flat, broad leaves, resembling those of the lily-of-the-valley. The stems are triangular, and bear a flat-topped umbel of white flowers, which appear in May and June. If crushed, the whole plant emits a strong characteristic smell of garlic. Ramsons is chiefly troublesome where milch cows may eat it, as they frequently do, when the offensive odour and taste characteristic of the plant is communicated to the milk and the dairy produce prepared from it. Where cattle may get at it this weed should be cut down or the bulbs dug out.

JUNCACEÆ

The Common Rushes, *Juncus effusus* L., *J. glaucus* Sibth., *J. conglomeratus* L., and some other species, are very plentiful in water meadows, damp meadows by streams and rivers, and similar situations. They are in general perennial plants, with an extensive and deep-seated creeping rootstock, erect, simple, pointed stems containing pith, and leaves which may be slender and flat or round, resembling the stem. The flowers are brownish or green, somewhat star-like, and in axillary or terminal cymes or clusters.

Rushes generally occur in damp soils, and even

when the surface appears fairly dry their presence indicates a wet subsoil, possibly some feet down. The only plan for getting rid of Rushes is thorough drainage, but they may be much reduced by frequent close mowing. Draining and cutting in conjunction with liming and manuring will destroy them.



FIG. 63.—Wood-rush (*Luzula campestris* Willd.), $\times \frac{2}{3}$.

Wood Rushes.—The genus *Luzula* includes a number of species of plants belonging to the order

Juncaceæ, spoken of generally as Wood Rushes on account of their occurring frequently in thickets, woods, and shady places. Some of them, however, are found on poor open pastures and heaths. One of the latter type is *Luzula campestris* Willd., a small grass-like plant (Fig. 63), which is common on dry meadows and pastures on almost all soils. (A tall sub-species of this plant (*L. multiflora* Lej.) is common on wet pastures.) It is a perennial spread by means of both seeds and a creeping rootstock; it grows from 4 to 12 inches high, and has flat, hairy, grass-like leaves—the long whitish hairs being very prominent—and dense clusters of small pale or dark star-like flowers.

Where very plentiful, a general improvement in the herbage by manuring, or by drainage in the case of *L. multiflora*, is necessary to check Wood Rushes.

CYPERACEÆ

Common Cotton Grass (*Eriophorum angustifolium* Roth.) and **Hare's-tail Cotton Grass** (*E. vaginatum* L.) are perennial plants common on moors, bogs, and water meadows, being sometimes troublesome in the last-named position. The former species is about 1 foot high, and has solitary solid stems and terminal clusters of flowers, the inner clusters being sessile and the outer on slender stalks. The flowers appear in May and June. Hare's-tail Cotton Grass is somewhat similar, with many tufted stems and solitary terminal spikelets, which flower in April and May. In both species the floral envelope is formed of many long cottony hairs, the clusters when ripe appearing as a dense cottony tuft or head, 1 to 2 inches long and 1 inch in diameter. The "cotton" is sometimes collected and used for stuffing pillows.

The Cotton Grasses may be reduced by cutting and by thorough drainage.

Sedges.—In general, Sedges somewhat resemble grasses, both in the leaves and spikelets. A large number of species are known; they vary widely in their habitat, some favouring the driest soils and others the wettest.

Common Sedge (*Carex vulgaris* Fries.) and other species of *Carex* are common, useless plants of damp meadows and pastures, water meadows, and by the sides of ditches and rivers. The Common Sedge (Fig. 64) is a perennial, with narrow erect leaves, and a rough, slender, stiff stem 1 to 2 feet high. The spikelets are sessile, from $\frac{1}{4}$ to 1 inch in length, and placed three to five together on the axis or stem. The rootstock often creeps extensively.

On wet soils Sedges may be reduced by draining, regular mowing, and the use of lime and manures.

Sedges of other species (e.g. *Carex præcox* Jacq.) occur on dry pastures and moors, and may have a tufted or creeping rootstock. They more or less resemble the foregoing species. Several kinds with bluish-green leaves, resembling those of the carnation, are termed "Carnation-grasses" by farmers. On dry pastures Sedges should be cut with regularity, and the herbage should be improved by manurial treatment.

GRAMINEÆ

A large number of grasses must be regarded as weeds, many of them, such as Couch, Fine Bent, and Wild Oat, being directly troublesome in arable farming; while a large number are worthless members of meadows and pastures, replacing better herbage, and being avoided by stock when richer, more succulent



Photo, 1909.

J. C. Varty-Smith.

FIG. 64.—Common Sedge (*Carex vulgaris* Fries.).



FIG. 65.—Mat-grass (*Nardus stricta* L.),
nat. size, with enlarged spikelet.

food is available. All such useless or harmful grasses should, where possible, be reduced, and an effort made to improve pastures and meadows, so that they yield the maximum of good herbage.

Mat-weed (*Nardus stricta* L.), also known as Mat-grass, is a small perennial only a few inches high, with densely tufted slender leaves and creeping rootstock, an erect wiry stem and solitary spikes, with all the spikelets on one side (Fig. 65). Flowering occurs in June and July. This grass is common upon heaths and dry upland pastures, and on account of its hard, wiry character is refused by sheep.

Floating Foxtail (*Alopecurus geniculatus* L.) is occasionally troublesome on damp and wet meadows and in ditches and ponds, growing so freely that shallow ponds may almost be filled up by it. It is a smooth

perennial, flowering between May and August, 1 to 2 feet high, with a procumbent stem, which takes root at the nodes, thus covering the ground very rapidly. The panicle is more slender than that of common Meadow Foxtail (*A. pratensis* L.), one of the best meadow and pasture grasses.

Draining will reduce this grass, and when it encroaches upon ponds it may be necessary to drain off the water and clear out the weed, giving one good dressing of salt, and if need be a second dressing, killing out the weed before permitting the pond to refill.

Marsh Bent-grass or **Fiorin** (*Agrostis alba* L.) is a very variable perennial occurring on most soils both in arable and grass land, often replacing good grasses in the latter case. It is 1 to 2 feet high, with or without stolons, and the stem more or less prostrate below. The panicles (Fig. 66), flowering in July to September, vary considerably in size, being 2 to 8 inches long; the spikelets are very small, and when the seeds are ripe the branches of the panicle lie close to the



FIG. 66.—Marsh Bent-grass (*Agrostis alba* L.), $\times \frac{1}{2}$.

main axis or stem. The stoloniferous plant is often confounded with true "Couch," and, like *A. vulgaris* (below), is commonly included in the term "couch," "twitch," or "squitch."

The grass more generally known as Fiorin is Creeping Bent-grass, a variety named *Agrostis stolonifera* Koch. closely resembling *A. alba*, but with more pronounced stolons, rooting at the nodes of the procumbent stems and rapidly spreading. On moist soils, wet meadows, and near rivers, it quickly crowds out other grasses. This grass is sometimes recommended as a useful species in moist mountainous districts, especially on account of its late growth in autumn, but as it may crowd out other species, and the seed is difficult to obtain pure, it should in general be avoided. It may sometimes be useful in a pasture, but is objectionable in the hay-field.

Fine Bent-grass or Black Couch (*Agrostis vulgaris* With.) closely resembles the species already described, but the branches of the fruiting panicle are spreading. It is quite as useless as *A. alba*, and owing to its creeping stems is nearly as troublesome as true Couch in arable land. (See p. 132.)

Brown Bent-grass (*Agrostis canina* L.) grows on wet peaty soils and heaths. It differs from the three grasses mentioned above in having an awn on the flowering glume.

In grass land the Bent-grasses are only reduced by constant manuring and good management, and the application of lime (see p. 149). (As regards arable land, see p. 128.)

Wavy Hair-grass (*Aira flexuosa* L.) often occurs abundantly on dry pastures and sandy heaths. It is an erect, slender perennial of about 1 to 2 feet high, with short, narrow, curved leaves. The panicles of



Photo, 1909.

J. C. Varty-Smith.

FIG. 67.—Tufted Hair-grass (*Aira caespitosa* L.).

shiny brownish-green or purplish spikelets are 2 to 5 inches long, and the branches wavy or flexuous. The flowering glumes are awned. Flowering takes place between June and August. The "seeds" were formerly used to adulterate those of Golden Oat-grass.

Tufted Hair-grass (*Aira cæspitosa* L.) is a perennial commonly known as Tussac or Tussock grass, or Hassock grass, owing to the fact that it grows in dense close tufts which stand out as hummocks among the surrounding herbage. This grass (Fig. 67) occurs chiefly in damp pastures and meadows and in woods. It grows from 2 to 4 feet high, with erect, stout, leafy stems, flat rough leaves which cut like razors, and nodding panicles with flexuous branches of spikelets resembling those of *A. flexuosa*, but with a shorter awn to the flowering glume. It flowers in June and July. This grass is seldom touched by cattle. In some districts the tufts are named "bull faces" or "bull pates."¹

Tufted Hair-grass may be reduced by draining and manuring. The tufts should be dug up, and left to wither or be thrown upon the compost heap. More commonly the hassocks are chopped out with an adze. This grass is also reduced by the use of lime.

Yorkshire Fog (*Holcus linatus* L.) is one of the most common and widely distributed of grasses. It is reproduced freely and rapidly from seed, and occurs plentifully in meadows and pastures, water meadows and inferior hay-fields on many soils, perhaps especially on calcareous loams. Yorkshire Fog (Fig. 68) is a densely tufted perennial, 1 to 2 feet high, and covered with soft woolly down or hairs. The slender stems are upright and leafy, the leaves flat and soft. The panicle is branched, 2 to 5 inches long, and in the early stages

¹ *The Complete Grazier.*



Photo, 1909.

J. C. Varty-Smith.

FIG. 68.—Yorkshire Fog (*Holcus lanatus* L.).

somewhat compact, opening widely when in full flower (June to July); the spikelets are much flattened and two-flowered, the upper flower being male and the lower bisexual. The colour of the panicles of Yorkshire Fog is very variable, many shades of green, pink, and purple being common, the whole blending so characteristically in infested pastures as to give rise to the name "Fog," such pastures being termed "Fogged" or "Foggy."

Yorkshire Fog, like other hairy grasses, is generally refused by stock. It should be discouraged and reduced in favour of better grasses, or its introduction prevented. This may be carried out: (1) By consistent manuring, as the pest is less plentiful in rich pastures; (2) by preventing seeding, by running the mower over infested pastures with the knives set high to take off only the weed, which is generally well above the pasture grass in June; and (3) by preventing the introduction of the "seeds" in grass mixtures for sowing, either for leys or permanent pasture. On damp land Yorkshire Fog is less hairy, and is readily eaten by cattle, which thrive upon it. Some good pastures in Norfolk and in Holland consist largely of this grass.

Creeping Soft Grass (*Holcus mollis* L.) much resembles the last species, but is much less common, being usually found in hedges, thickets, and shady places. It is sometimes met with in the open pastures on poor sandy soils. In contrast with *H. lanatus*, which has tufted fibrous roots, the Creeping Soft Grass has an extensive creeping rootstock; it is not so hairy, except at the nodes of the stem.

Quaking Grass (*Briza media* L.) is one of the best known perennial grasses, and frequently gathered for decorative purposes. Its loose spreading panicles of spikelets, variegated with purple and green, appear to be always moving or trembling—hence the names

Quaking, Toddling, or Totter Grass. This grass has solitary, upright stems 1 to 1½ feet high, creeping below. Flowering takes place in June. Quaking Grass is a typical weed of poor pastures and meadows on light dry soils, and is a useless constituent of the herbage. Where it is abundant or even moderately plentiful, good dressings of manure should be applied to the land.

Soft Brome Grass (*Bromus mollis* L.) is an annual or biennial weed, which is frequently very plentiful in meadows and leys, in water meadows, and by roadsides, but is not often found in old pastures. It is a handsome grass (Fig. 69), with beautiful lance-shaped downy spikelets containing five or more flowers, each flowering glume being awned. This grass flowers early, between May and June, and its seeds, by means of which it is propagated, are shed in the hay-field by June. Soft Brome Grass is useless to stock, and replaces better grasses. In meadows it may be reduced by early mowing for two or three years to cut it before seeding takes place, and it is reduced in pastures by a dressing of mixed nitrogenous and mineral manures.

Sterile or Barren Brome Grass (*Bromus sterilis* L.) is an erect annual, about 2 feet high, with narrow leaves, and very large open nodding panicles with drooping branches; the spikelets, at the end of long slender pedicels, are about 1 inch in length, slender awns adding perhaps another inch. This grass is common by roadsides, fences and hedges, in fields and waste places. Cutting before seeding in June and July will reduce it where troublesome.

Meadow Barley Grass (*Hordeum pratense* Huds.) is a perennial with slender stems 1 to 2 feet high, and having a general resemblance to a diminutive specimen of ordinary barley. The spikes are 1 to 3 inches long,



Photo, 1909.

J. C. Varty-Smith.

FIG. 69.—Soft Brome Grass (*Bromus mollis* L.).

nearly half an inch broad, and yellow-green in colour, and the spikelets rough and awned. The rootstock is



Photo, 1909.

H. C. Long.

FIG. 70.—Wall Barley Grass (*Hordeum murinum* L.).

creeping. Meadow Barley Grass occurs in damp meadows and pastures, but is not often abundant. In pastures it is sometimes considered useful if not allowed

to flower, but the rough spikes are unpleasant, and may be injurious to stock, and the grass is therefore objectionable in meadows.

Wall Barley Grass, or Waybent (*Hordeum murinum* L.) is an annual with fibrous roots (Fig. 70), and much resembles *H. pratense*. It is not generally troublesome, but is often plentiful on dry soils by footpaths, roadsides, and waste places. Cutting before seeding will reduce it.

FILICES

Bracken or Brake Fern (*Pteris aquilina* L.), often simply termed "Fern," is frequently very troublesome on dry upland pastures and rough grazing land. It is especially harmful in Scotland, and even attempts to usurp many good grazings. It is too well known to need much description here. It is a perennial, which spreads by means of an extensively creeping rootstock and also by spores, the latter being scattered in July and August. Bracken has been found one of the most difficult pests to extirpate, and has in the past few years given rise to much discussion. The following means of reducing it have been suggested:—

(1) "If the surface of the ground admits of it, the best method of dealing with Bracken on a large scale is to run chain harrows over the ground at the time the fronds are making their appearance. If this is done thoroughly and persisted in, the plants are greatly weakened."¹

(2) Cutting with the scythe as soon as the Bracken is well grown, say early in June, and repeating the process for several years, weakens the growth of the plants, and the Bracken gradually diminishes in numbers, but the plan must be persisted in, for "to drive

¹ *Four. Bd. Agric.*, Sept. 1906, p. 378.

this usurper from our hillsides is a hard task, requiring men, money, time, and patience." It has been stated that in four years' time Bracken can be reduced to such an extent that it is not worth cutting. Beating down the tender young shoots with sticks or canes, thus severely bruising them rather than cutting them clean off, has been recommended in place of cutting. Where Bracken grows in woods a proportion of it is required for game cover, the rest being cut and largely used for bedding stock. In such cases there is little or no diminution in the "fern" year by year, because it is rarely cut in the same place two years in succession. In some districts the cutting of the "fern" is jealously guarded by the keepers, who regulate the cutting to ensure cover.

(3) Some authorities, especially in Scotland, are of opinion that close grazing with cattle tends to reduce Bracken, the animals not only eating it when young, but trampling it down or lying on it. There is reason to believe that this method is of value, and cases have been quoted which appear to justify the belief. On the other hand, cases to the contrary are also quoted, in which grazing with cattle has had no appreciable effect on the Bracken.

(4) In cases where it has been possible to practise it, irrigation with spring water is said to have been adopted for clearing ground of Bracken with complete success, although in some cases it has been a failure.

(5) The growth of Bracken on waste land is perhaps a certain sign of the absence of lime, and where lime is to be obtained at a reasonable cost an application of 1 to 2 tons per acre to the land after the fern has been cut will very greatly reduce it, if not destroy it altogether.

(6) Bracken may be eradicated by breaking up the land and cultivating it.

Bracken forms an excellent litter for cattle, horses, and pigs, and has been found quite useful on occasion for fodder. It has also been successfully converted into silage, and has a high manurial value when used as a litter, comparing with wheat straw as 150 to 100.¹

EQUISETACEÆ

Horse-tail (*Equisetum arvense* L.), known also under the various names Mare's-tail, Cat's-tail, Toad-pipe,



Photo, 1909.

J. C. Varty-Smith.

FIG. 71.—Horse-tail (*Equisetum arvense* L.), showing barren stems and creeping rootstock.

Paddock-pipes, is a common and serious pest of both

¹ *Jour. Bd. Agric.*, Oct. 1908, p. 487. (See also *Jour. Board of Agric.*, Oct. 1908, p. 481; and Feb. 1909, p. 844; M'K. in *The Scottish Farmer*, Nov. 14, 1908; Report of a Lecture by Mr. A. P. M'Dougall, *ibid.*, Dec. 12, 1908, and subsequent correspondence; J. S. in *The Field*, Nov. 16, 1907.)

arable and grass land, flourishing most on damp land. The spore-bearing or fructifying stout stems, with club-shaped heads, resembling young asparagus, appear in April. These are followed from May onwards by erect or decumbent barren leafy stems (Fig. 71), with simple branches in whorls, and ending in a long, naked point. Horse-tail has extensively creeping, deep-lying rhizomes, often lying several feet below the surface, quite out of reach of plough, cultivator, or spade. The plant is refused by stock. Another species, *E. palustre* L., is regarded as being poisonous to cattle. As Horse-tail favours damp soils, it can only be reduced completely by draining. Ditches should be kept clean and clear of weeds to allow of the free passage of water, and the land should be limed. (See also p. 136.) Both spore-bearing and barren stems should be regularly cut.

MUSCI

Mosses (*Hypnum*, *Funaria*, *Sphagnum*, &c.) are frequently troublesome in pastures, and are an indication that the land is damp or in poor condition. The general methods recommended for the eradication of Mosses are: (1) drainage, followed by (2) manurial treatment, including an application of lime. Before manures are applied it is advisable to pass the harrows over the ground, so as to tear out much of the Moss and loosen the surface soil and open it up to air, light, moisture, and manures. Mossy pastures on heavy clay land should receive 10 cwt. of lime per acre and 6 cwt. of basic slag, both applied in autumn, and in the following spring a dressing of 1 cwt. nitrate of soda per acre in April or May. Lighter lands may be given 10 cwt. lime and $2\frac{1}{2}$ cwt. of kainit per acre in autumn, 3 to 5 cwt. good superphosphate in March, and 1 cwt. nitrate of soda in the middle of April. Combined with drainage and the

use of the harrow, such treatment will effect a great change and get rid of most of the Moss.

Where Moss appears on pastures and meadows which are known to be well drained, manurial treatment alone should be resorted to. In the case of temporary pastures, subsoiling will prove a useful measure when the next arable crop is taken. Moss seldom appears on arable land, but if so, similar remedial measures must be followed.

On thin pastures resting on a light loam, with chalk not many inches below, at the South-Eastern Agricultural College, Wye, Kent, a dense growth of Moss appeared in winter, though there was no sourness, deficient aeration, or great poverty of the soil. Experiments made¹ to discover the best treatment showed that in this case chemical treatment had on the whole little or no effect, though superphosphate seemed to feed the grass a little and keep the Moss down. On the other hand, "the effects of the mechanical treatment are, however, very manifest; the continual rolling has been as beneficial as the opening of the soil has been harmful. Clearly, the prevalence of moss on this class of land is associated with the open texture of the soil, in which the worms work very freely, and continually lift the surface; constant rolling and harrowing, with the treading of sheep, are the only ways of keeping the moss down."

Some experiments have been carried out by the West of Scotland Agricultural College² on mossy land which, after being drained, reclaimed, and cropped, had lain for ten or twelve years under pasture, and the grass was poor and innutritious. Three plots of over 3 acres each

¹ A. D. Hall, *Jour. S.E. Agric. Coll.*, No. 9, 1900.

² "Manuring of Moss Land": Report of a Lecture by Professor R. Patrick Wright, 1909.

were set aside for experiment, one being untreated, one receiving 10 cwt. 92 lb. of basic slag per acre, and the third the same amount of basic slag and 8 cwt. of kainit. The manures were applied in the winter of 1903-4, and the experiment has been continued since that date. Sheep were grazed on the plots for twenty weeks in summer, and the improvement judged by the live-weight increase of these; cattle were grazed when necessary to eat down the grass left by the sheep on the manured plots. The general results are as follows:—The total live-weight increases on the plots in the five years 1904-8 were 258 lb. per acre on the untreated plot, 422 lb. on the basic slag plot, and 516 lb. on the basic slag and kainit plot. Even in the fifth year the manures had a remarkable effect, and the great increase on the treated plots over the untreated plots is conclusive evidence as to the improvement effected. A calculation of the results in cash showed that the slag and kainit plot has, in the five years, given a gross return per acre in excess of the unmanured plot of £5, 8s. 6d. per acre, or deducting £1, 18s. 6d., the cost of the manures, a net profit of £3, 10s. per acre in the five years, while the effects of the manures were evidently not yet exhausted. At the same time it must be remembered that thirty-two weeks of the year were not considered, the experiment being confined to twenty weeks in the summer months, and this fact makes the result the more important.

FUNGI

Fairy Rings frequently occur in pastures, and are both harmful and unsightly. They may be dealt with as described at p. 347.

CHAPTER VI

WHAT ARE THE WORST WEEDS? OPINIONS OF AUTHORITIES AS TO THE TWELVE WORST WEEDS IN VARIOUS DISTRICTS

THE species of weeds which are generally troublesome differ considerably in various districts, and it was thought that it might serve a useful purpose if some attempt were made to ascertain, more or less approximately, what weeds are found most harmful and difficult to combat in a series of localities. A number of practical agriculturists were therefore asked to state what they considered the six worst weeds of arable and grass land respectively in their neighbourhood, and what were the means best suited to cope with them. The replies are given below in the form of a table, and are of considerable interest. Most of the common names are generally known, but in many cases the specific names have been given. Further information on the various species will be found in other chapters.

In the table the returns have been so arranged that they commence with the north of Scotland and end at the south coast of England, this being perhaps a better plan than that of taking them in alphabetical order. Ireland is unfortunately not included.

An analysis of the replies shows that in twenty-nine returns referring to arable land the species in

the following list are mentioned the stated number of times:—

Couch or Twitch ¹	32
Charlock and Runch	28
Docks	16
Thistles	16
Coltsfoot	13
Chickweed	9
Bindweeds	8
Spurrey	7
Poppies and Corn Buttercup (" Burrs" or " Scratch Burrs")	each 6
Wild Oat	5
Knotweed and Fat Hen	each 4
Redshank	3
Groundsel, Fumitory, Corn Marigold, <i>Alopecurus agrestis</i> , <i>Poa annua</i> , and Nettles	each 2
Self-heal, Herb Gerard, Hemp Nettle, Wild Mint, Mayweed, Cleavers, Horsetail, Speedwell, Broom-rape, Dodder, Pepperwort, Wild Carrot, Yellow Toad-flax, Shepherd's Purse, Annual Knawel, Speedwell (<i>V. agrestis</i>), Mugwort, Wart Cress and Thale Cress	each 1

In the case of grass land an analysis shows that the following species are the worst weeds in the stated number of instances:—

Thistles	22
Buttercups	16
<i>Holcus lanatus</i> and <i>H. mollis</i>	9
Docks	8
Daisy	7
Plantain	6
Soft Brome	6
Yellow Rattle, Sorrels, Dandelion, <i>Agrostis</i> sp.	each 5
Knapweed, Rushes, Nettles	each 4
Ragwort, Hassock Grass, Rest Harrow	each 3
Moss, Self-heal, Sedges, Hawkweed (<i>Hieracium</i>), Bracken, Mountain Flax, Scabious, Meadow Saffron	each 2

¹ Including *Triticum repens*, *Agrostis* sp., and *Arrhenatherum avenaceum*, var. *bulbosum*, as these are all termed Twitch, Wicks, Wickens, Couch, &c. Two of these species are, however, given in some returns, and these are included in the figures quoted.

Sweet Vernal, Rough-stalked Meadow- grass, Mouse-ear Chickweed, Couch, Ox-eye Daisy, Pig-nut (<i>Conopodium</i>), Cow Parsley (<i>Petroselinum</i>), Meadow Barley-grass, Cat's-ear, Corn Marigold, Stinking Mayweed, Wild Carrot, Cow- slip, Broom, Gorse, Dyer's Green-weed, Silver-weed.	}	each 1
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Many of the weeds only mentioned once or twice may prove very serious pests, and the fact that only one or two farmers named in the list have found them troublesome is sufficient evidence to show that where they occur an endeavour should be made to keep them down. It is clear that the methods of attacking a given weed vary somewhat in different districts, while in some cases uncertainty exists, or no practical plan of eradication or prevention is known or suggested. The practical notes written by the authorities who have supplied the returns deserve every consideration.

THE WORST WEEDS IN CERTAIN DISTRICTS

Name of Correspondent.	District.	Six Worst Weeds of Arable Land.	Best Methods of Eradication or Prevention.	Six Worst Weeds of Grass Land.	Best Methods of Eradication or Prevention.	Remarks.
Alex. Fraser, B.Sc., Forres.	Morayshire and neighbouring counties.	<p>Bulbous Oat-grass (<i>Arrhenatherum avenaceum</i>, var. <i>bulbosum</i>). Very tenacious of life and rapid in growth.</p> <p>Dock (<i>Rumex obtusifolius</i>).</p> <p>Couch Grass, Quickens, or Twitch (<i>Triticum repens</i>). Much less tenacious of life than Bulbous Oat-grass. The gathered "roots" are useful.</p> <p>Thistle (<i>Cnicus</i> sp.).</p> <p>Wild Oats (<i>Avena fatua</i>).</p> <p>Charlock and Runch.</p>	<p>Careful cultivation to avoid breaking up the bunches, then gathering (by hand if necessary) and removing or burning.</p> <p>Hand pulling from the corn-fields in early summer particularly; remove completely. Examine clover and grass seeds.</p> <p>Cultivation with plough or cultivator or both, harrow and chain harrow.</p> <p>Burn, remove, or plough in deeply when withered.</p> <p>Pulling in early summer or cutting just before seeding. No practicable method. Confined to certain soils.</p> <p>Early ploughing and late sowing. Harrowing. Spraying.</p>	<p>Moss or "Fog."</p> <p>Yorkshire Fog (<i>Holcus lanatus</i>).</p>	<p>Harrowing has been tried with small success. Slag is being tried more hopefully.</p> <p>Early and close grazing. Slag would probably be helpful.</p>	<p>The chief difficulty with pastures in this district. Other grasses become practically weeds, e.g. Crested Dogtail, if in too great abundance and allowed to grow coarse.</p>

THE WORST WEEDS IN CERTAIN DISTRICTS—Continued

Name of Correspondent.	District.	Six Worst Weeds of Arable Land.	Best Methods of Eradication or Prevention.	Six Worst Weeds of Grass Land.	Best Methods of Eradication or Prevention.	Remarks.
Dr. R. Shurra Gibb.	West Berwickshire.	Charlock. Twitch. Day Nettle (<i>Galeopsis Tetrahit</i> and <i>G. versicolor</i>). Chickweed. Spurrey. Groundsel.	Two fallow crops in succession. Cleaning, before seeding. Growing root and green crops which allow of sufficient hoeing before these plants seed.	<i>Agrostis vulgaris</i> . <i>Holcus mollis</i> . <i>Ranunculus repens</i> or <i>acris</i> . <i>Bellis perennis</i> . <i>Plantago lanceolata</i> . Various Thistles.	Spudding up when it is likely to pay, or cutting seed stems before maturity.	
Prof. A. N. M'Alpine, W. of Scotland Agric. Coll.	South of Scotland.	Charlock. Runch. Spurrey. Bulbous Tall Oat-grass. Couch. Redshank.	Spraying. Do. Improved tillage, liming, and manuring. Good tillage and land to be left longer in grass. Do. do. Good tillage, and liming.	Common Bent-grass. Yorkshire Fog. Sweet Vernal. Rough-stalked Meadow Grass. Self-heal. Buttercup.	Reduce Ryegrass and sow useful large grasses. Enrich the land, and lime. Drainage.	The dung should be kept clean, and seed-mixtures pure.
John Speir, Kt. St. O., Newton Farm, Newton, Glasgow.	South-west of Scotland. All over this district the soil varies	On arable land the worst and probably the most general is <i>Triticum repens</i>	Root weeds are most easily kept in control by spring and autumn cultivation and gathering of	On pasture land the worst root weeds are <i>Agrostis vulgaris</i> , <i>Crowfoot</i> or	<i>Triticum</i> , <i>Agrostis</i> , <i>Tussock</i> , and Annual Poa in great part all disappear if land is kept long	On some classes of light land Sorrel or Sourrock is often very troublesome. As a rule this plant

<p>very quickly, and with it the prevailing weeds.</p>	<p>a m o n g r o o t weeds, followed by Wild Oat-grass (bulbous), also called Knot-grass and Pearl-grass. Coltsfoot (<i>Tussilago Farfara</i>) and <i>Agrostis vulgaris</i> come next.</p> <p>Among seed weeds the worst and most prevalent is Wild Mustard, and in some districts Wild Radish, Annual Poa, Spurrey (<i>Spergularia arvensis</i>), Chickweed or Stitchwort, and Groundsel (<i>Senecio vulgaris</i>). The prevalence of either of these weeds is not only influenced by the nature of the soil, but the cropping and manuring to which it has been subjected.</p>	<p>the roots before any crop is put in, liberal manuring, and persistent cleaning of the crop while it is growing, particularly in the young stage. All annuals and seed weeds are most easily kept in check by repeated harrowings or hoeings when the seedlings are small, and, above all, the prevention of the plants from seeding.</p>
<p>enough in pasture, and well fed in the interval. Thistles should be cut when in flower, and also Ragweed. If no seeding is allowed, a few years' cutting will clear any land of Ragweed, and if in addition sheep are kept on the land in spring, they will eat the centre out of the young plants.</p>	<p>Buttercup (<i>Ranunculus</i>), Thistles of various kinds, but the creeping rooted variety is the worst, Docks, and Ragwort (<i>Senecio Jacobaea</i>).</p> <p>Among seed weeds the worst is the Wild Daisy, which on many poor pastures is very prevalent.</p>	<p>only thrives on land poor in lime, and if lime is freely used along with careful weeding in the green crop, it will disappear. For the destruction of weeds generally, particularly root weeds, a green crop two or more years in succession is the best method of cure.</p>

THE WORST WEEDS IN CERTAIN DISTRICTS—Continued

Name of Correspondent.	District.	Six Worst Weeds of Arable Land.	Best Methods of Eradication or Prevention.	Six Worst Weeds of Grass Land.	Best Methods of Eradication or Prevention.	Remarks.
T. Brown Hewetson, Record Keeper, Northumber- land Agri- cultural Experimental Station.	"Cockle Park," Morpeth.	Couch Grass (<i>Triticum re- pens</i>). Chickweed (<i>Stel- laria media</i>).	Cultivate thoroughly and bring to sur- face, roll together with chain harrows, and collect and burn, or may be carted off. Keep the land clean by good cultiva- tion. The hoe and harrow should be kept at work dur- ing the summer months, so that the sun will kill the plants. Same as Chickweed, also spraying. Pull with clips when growing in corn. Cut out with hoe and drill grubber on turnip and swede land. Same as Chickweed.	Scotch or Cotton Thistle (<i>Ono- pordon Acan- thium</i>). Daisy (<i>Bellis per- ennis</i>). Dandelion (<i>Tar- axacum offici- nale</i>). Ribwort (<i>Plantago lanceolata</i>). Mouse-ear Chick- weed (<i>Cerastium sp.</i>). Hawkweed (<i>Hier- acium alpinum</i>).	Mow with grass cutter or with scythe before flowering. Manure judiciously and liberally. Do. Do. Do. Do.	Pastures might be well chain har- rowed before manures are ap- plied and also afterwards. This destroys a lot of weeds by break- ing and pulling them out. The surface soil is also made more loose, and thus the manures can act better and quicker upon the plants which it is desir- able to cultivate. The arable land ought to be ploughed early, and thoroughly cleaned during the spring before the crops are sown.

George John Bell.	Wigton, Cumberland.	Couch Grass. Coltsfoot. Bishop's Weed or Herb Gerard. Nettles. Thistles. Chickweed. Mugwort.	Ploughing and cultivating. Hand gathering after liberal horse work.	Couch Grass. Yorkshire Fog. Docks. Dandelions.	A good dose of quicklime, with ground rock-salt about a year after, with basic slag and kainit if on strong land, but superphosphate and kainit if on light soil.
W. T. Lawrence, Manager, Cumberland and Westmorland Farm School.	Penrith—border of Cumberland and Westmorland.	Couch Grass (<i>Triticum repens</i>). Spurrey (<i>Spergula arvensis</i>). Knotweed (<i>Polygonum Aviculare</i>). Charlock (<i>Sinapis arvensis</i>). Thistle (<i>Carduus</i> sp.). Bugle or Self-heal (<i>Prunella vulgaris</i>).	Stubble - ploughing early. Thorough cleaning in spring. Good use of horse hoe. Growing heavy crops.	Yorkshire Fog (<i>Holcus lanatus</i>). Bent (<i>Agrostis vulgaris</i>). Buttercup (<i>Ranunculus repens</i>). Knapweed (<i>Centaurea nigra</i>). Pig-nut (<i>Conopodium denudatum</i>). Cow Parsley (<i>Petroselinum</i> sp.). Ox-eye (<i>Chrysanthemum Leucanthemum</i>).	Flavour with salt to get them eaten down early in autumn. Encourage clover by slag and kainit. No method, but sheep will eat it in early summer. Constant cutting. No cure. No method, but sheep will eat it early in the year. Difficult to get rid of, but potash and phosphatic manure without nitrogen seem to lessen it.

THE WORST WEEDS IN CERTAIN DISTRICTS—Continued

Name of Correspondent.	District.	Six Worst Weeds of Arable Land.	Best Methods of Eradication or Prevention.	Six Worst Weeds of Grass Land.	Best Methods of Eradication or Prevention.	Remarks.
Edward Porter, B.Sc., F.A.C. (Glas.), Secretary of Agriculture, County Offices, Preston.	Preston.	<p>"Wicks" (<i>Agrostis</i> sp. and <i>Triticum repens</i>), Thistles (<i>Cnicus</i> and <i>Sonchus</i> sp.), Corn Marigold (<i>Chrysanthemum segetum</i>), Docks (<i>Rumex</i> sp.), "Yarr" or Spurrey (<i>Spergularia arvensis</i>), Charlock (<i>Sinapis arvensis</i>).</p>	<p>Separation from soil and exposure to hot sun until killed. Spudding for fibrous-rooted Thistles. For other Thistles as for "Wicks." Fallow crop for two or three years. Removal of fleshy root from the soil. Liming. Surface cultivation to promote germination. Subsequently plants are destroyed by harrows, &c., and ploughed in. Spraying with copper sulphate.</p>	<p>Thistles (<i>Cnicus</i> sp.). Buttercups (<i>Ranunculus</i> sp.).</p>	<p>Thorough mowing about the end of June or early in July. Some farmers are of the opinion that the Buttercups are reduced considerably by being grazed in early spring by sheep. Mowing before seed falls is also recommended. Much improved by liming, also by applications of phosphates (slag and boiled bones). In some cases it seems to be eradicated by this treatment. Sometimes mown off in autumn. Draining the land, and also by mowing down. Liming.</p>	
				<p>Bent (<i>Agrostis</i> sp.). Rushes (<i>Juncus</i> sp.). Sorrel (<i>Rumex</i> sp.). Brome Grass (<i>Bromus mollis</i>).</p>		<p>Mowing before the seed falls, and also by continuous grazing to prevent seed formation.</p>

<p>T. J. Young, F.S.I., Principal, College of Agriculture, Holmes Chapel, Cheshire.</p>	<p>Mid-Cheshire.</p>	<p>Charlock. Couch Grass. Bindweed. <i>Polygonum Persi-</i> <i>caria.</i> Knotg. ass. <i>Poa annua.</i></p>	<p>Spraying and cultivation. Digging out. Surface cultivation in green crop.</p>	<p>Rush. Buttercup. Broad-leaved Plantain. <i>Bromus mollis.</i></p>	<p>Liming and draining. Cutting with machine in June. Avoidance of winter pasturing, which renders land "poached" by cattle.</p>
<p>W. C. Brown.</p>	<p>North Lincolnshire.</p>	<p>Twitch (<i>Triticum repens</i>).</p>	<p>In the old four-course days, turnips, barley, seeds, wheat, land was difficult to keep clean, especially if wet fell in May and June, but since potatoes have been grown on the Lime-stone, the weed has disappeared. Bad on limestones in wheat; must be hoed before June 1. Bad, especially if a crop fail here and there. Found in our damper places. Much in evidence on our low alluvium, and difficult to eradicate.</p>	<p>Hassocks (<i>Aira caespitosa</i>).</p>	<p>On my grass land on the level of the river Ancholme this is the worst enemy, its dense tufts being very crude cattle food, indeed not eaten except under scarcity. Enormous harrows have been used with some (?) success, their teeth cutting through the mass, rooks afterwards helping to complete the process in search of grubs, but really nothing is so effective as the paring spade, costing 12s. to 20s. per acre, and after a few dry days</p>

THE WORST WEEDS IN CERTAIN DISTRICTS—Continued

Name of Correspondent.	District.	Six Worst Weeds of Arable Land.	Best Methods of Eradication or Prevention.	Six Worst Weeds of Grass Land.	Best Methods of Eradication or Prevention.	Remarks.
W. C. Brown —Continued.	North Lincolnshire.	Chickweed.	Much in evidence last season amongst potatoes with little top. In the days when Up-to-Dates were sown, this and all other weeds were perforce crowded out by the tops.	Yorkshire Fog (<i>Holcus lanatus</i>).	heaping and burning; this is not a complete cure, but has to be done again and again, at intervals of a few years. At the best only an undesirable weed, and there is much about. Cannot eradicate. This must be spudded when a few inches high, before commencing to flower. If not mown very often, must be run over before middle of July. On damp, sour grass. Lime.	
Thomas Milburn, Ph.D., Mid. Agr. College.	Midland Agr. College District.	Poppy (<i>Papaver Rhoeas</i>). Charlock (<i>Sinapis arvensis</i>).	Prevent seeding. Harrowing at intervals. Spraying. Pulling.	Buck or Jack Thistle (<i>Cnicus lanceolatus</i>). Common or Creeping Thistle (<i>Cnicus arvensis</i>). Sorrel (<i>Rumex Acetosa</i>).	Spud, or mow before seeding. Pasture the land for several years.	

Kingston, Derby.	Twitch (<i>Triticum repens</i>), Dock (<i>Rumex</i> sp.), Thistle (<i>Carduus</i> sp.), Coltsfoot (<i>Tussilago Farfara</i>).	Cultivate. Harrow. Collect. Draw before seeding. Plough in spring. Spud in corn. Prevent seeding. Improve land. Plough well.	<i>deum pratense</i> . Tussock Grass (<i>Aira caespitosa</i>). Buttercup (<i>Ranunculus</i> sp.). Yellow Rattle (<i>Rhinanthus Crista-galli</i>).	Drain, dig out. Improve land and pasture well.	In one or two cases slag has good effect. Possibly lime might have a similar effect. Its influence in reducing Sorrel and Spurrey has been shown in many cases, and much valuable information could be gained by trials in this direction.
Prof. R. H. Biffen, M.A., Cambridge University.	<i>Triticum repens</i> . <i>Convolutus arvensis</i> . <i>Tussilago Farfara</i> . <i>Sinapis arvensis</i> . <i>Avena fatua</i> . <i>Ranunculus arvensis</i> .	Harrow and hoe. In the case of Charlock, spraying with 2 per cent solution of copper sulphate is now generally carried out in the district.	<i>Urtica dioica</i> . <i>Rumex crispus</i> . <i>Senecio Jacobaea</i> . <i>Cnicus arvensis</i> . <i>Bromus mollis</i> . <i>Aira caespitosa</i> .	Keep cutting. Pull in wet weather. Sheep early, or pull. Pull, or keep cutting. Cut early. Drain.	
E. Druce, F.C.S., Principal, Agric. Institute, Ridgmont.	Woburn, Beds. Twitch. Docks. Scratch Burrs, or Corn Buttercup. Spurrey (on sandy soils).	Cultivation. Do. Hoeing in spring. Liming.	Thistles. Nettles.	Cutting in July. Cutting.	
P. Hedworth Foulkes, B.Sc., Principal, Harper-Adams Agric. Coll., Newport.	Newport, Salop. Docks. Twitch.	Forking. After harvest most stubbles are cultivated with heavy cultivator, working out, and then burning.	Creeping Thistles. Sour Dock.	Frequent cutting. If only cut once, best cut when in flower. Cutting and manured. Lime is supposed to be beneficial.	

THE WORST WEEDS IN CERTAIN DISTRICTS—Continued

Name of Correspondent.	District.	Six Worst Weeds of Arable Land.	Best Methods of Eradication or Prevention.	Six Worst Weeds of Grass Land.	Best Methods of Eradication or Prevention.	Remarks.
P. Hedworth Foulkes, B.Sc. —Continued.	Newport, Salop.	Thistle. Coltsfoot. Charlock. Poppies.	Deep and thorough cultivation. Draining and deep cultivation. Spraying. Surface cultivation to cause seeds to germinate. Hand weeding in growing crops. Common in wheat; sowing wide and hoeing in spring.	Yorkshire Fog. Buttercups.	Salt and manures (superphosphate and slag) to encourage finer grasses. Mowing for one or two seasons.	
Drysedale Turner, P.A.S.I., Professor of Agriculture, Roy. Agric. Coll., Cirencester.	Gloucestershire.	Cotswold Hills— Charlock (<i>Sinapis arvensis</i>). Couch Grass (<i>Triticum repens</i>). Dock (<i>Rumex crispus</i> and <i>R. obtusifolius</i>). Chickweed (<i>Stellaria media</i>). Mayweed (<i>Anthemis Cotula</i>).	Spraying with copper sulphate. Dragged out with repeated cultivations and burnt. Smother by good cultivation. Dig out and burn. Best removed by hoe and surface cultivation. By use of hoe.	Vale— Buttercups (<i>Ranunculus acris</i> , <i>R. bulbosus</i> , and <i>R. repens</i>). Creeping Thistle (<i>Cnicus arvensis</i>). Knapweed (<i>Centaurea nigra</i>). Yellow Rattle (<i>Rhinanthus Crista-galli</i>).	Gradually crowd out by liberal treatment of pastures, and encouragement of better herbage. Cutting systematically, starting early in the season. Improvement of herbage by dressing with basic slag, &c. Do.	On some soils, especially in the Vale, dressings of basic slag have a very marked effect in improving the herbage of worn-out pastures by encouraging a growth of the better clovers and grasses; weeds which before usurped the surface are then

Cleavers or Goose Grass (<i>Galium aparine</i>). Speedwell (<i>Veronica agrestis</i> and <i>V. Buxbaumii</i>).	Do. By use of hoe and surface cultivation.	Dyer's Green-weed (<i>Genista tinctoria</i>). Rest Harrow (<i>Ononis arvensis</i>).	Do. Do.	crowded out and smothered.
Vale— Charlock (<i>Sinapis arvensis</i>). Couch Grass (<i>Triticum repens</i>). Dock (<i>Rumex crispus</i> and <i>R. obtusifolius</i>). Corn - convolvulus (<i>Convolvulus arvensis</i>). Coltsfoot (<i>Tussilago farfara</i>). Corn-crowfoot (<i>Ranunculus arvensis</i>).	As above. Do. Do. Constant use of hoe. Smother by good cultivation. Draining and liberal treatment. Thorough use of hoe.	Thistles. Yellow Rattle. Daisy. Buttercup. Knapweed. Silver-weed.	Continuous cutting early. Manuring, liming, ploughing up. Manuring. Liming. Liming and high manuring; early grazing by sheep. Manuring.	Clean seed of great importance in all cases.
Charlock. Coltsfoot. Fat Hen. Dock. Fumitory.	Spraying. Good cultivation and thorough tillage and cleaning. Pull up by hand. As for Chickweed.	Mid-Cardiganshire.	Prof. C. Bryner Jones, M.Sc., Univ. Coll. of Wales, Aberystwyth.	

diminish the quantity of weeds in same.	These are all the weeds I have been troubled with.	Mow them twice in the summer. Draw them by hand, or by a little fork for the purpose. Cut them in May with a hoe, or spud close to the ground. Cut them in June with the scythe, and follow it up for a number of years, when they will all disappear.	Cut early, and roll ground with heavy roller.	Cut before seeding; or better, if field could be kept for hay and mown.	Cut before seeding; if this should fail, uproot.	Should be uprooted. Cut down, and give a good dressing of farmyard manure; repeat if necessary. Drain, and dress with lime or basic slag.
Common Thistle.	Dcck.	Drawing them by the roots. The same. If very bad, lay the field down for a number of years.	Hand weeding.	Crowfoot. Cat's-tail or Horse-tail.	No arable land.	Maesy-cwmmr, near Cardiff.
D. James.	Llanelen, Abergavenny.	Docks. Thistles. Charlock.	Crowfoot. Cat's-tail or Horse-tail.	No arable land.	Maesy-cwmmr, near Cardiff.	Richard Edwards.

THE WORST WEEDS IN CERTAIN DISTRICTS—Continued

Name of Correspondent.	District.	Six Worst Weeds of Arable Land.	Best Methods of Eradication or Prevention.	Six Worst Weeds of Grass Land.	Best Methods of Eradication or Prevention.	Remarks.
E. Wood.	Monmouth.	Docks. Charlock. Thistles. Bindweed or Bearbine. Couch Grass. Chickweed.	Good cultivation.	Meadow Saffron. Thistles. Docks. Carnation Grass. Mountain Flax. Scabious (Hard-head).	Good cultivation.	
J. W. Davies.	Mitcheltroy, near Monmouth.	Charlock. Couch. Coltsfoot. Dodder. Docks. Bindweed or Wild Convolvulus.	Skim ploughing and light cultivation afterwards in the autumn, as soon after the corn is hauled as possible.	Thistles. Docks. Broom. Mountain Flax. Yellow Rattle. Blue Heads.	Manuring with slag, kainit, and superphosphate, and mowing, if possible, alternate years.	
John Treadwell.	Aylesbury.	Burrs. Wild Oats. Charlock.	Hoe out the Burrs and Wild Oats, and hoe and top the Charlock.	Thistles.	Mow frequently or let them get in flower and mow before seeding. They do not come so much in fields that are generally mown for hay.	I have tried all sorts of plans to kill the Thistles, but cannot get rid of them on the pasture land that is always grazed. Have pulled them for years, some time ago, but still they come.

Saml. Kidner.	Milverton, Somerset.	Couch.	By working on surface and picking up, care being taken not to break it up; good and deep ploughing has as good an effect as anything.	Thistles.	Cutting at the right time; early cutting appears to encourage the growth. The best time is when the purple is showing on the stems; this is instanced by the few seen in meadows mown annually about that time.
		Wild Oats.	By fallowing and growing green crops, and, when within compass, picking them out of corn crops. The great difficulty with these is the uncertainty of their growth when apparently favourable conditions are offered.		
		Charlock.	Careful pulling when within compass, otherwise growing green crops or fallowing, with spraying to check.		
		Thistles.	Probably varying the depth of ploughing as much as possible.		
		Poppies. Coltsfoot.	Best got rid of by high cultivation.		

THE WORST WEEDS IN CERTAIN DISTRICTS—Continued

Name of Correspondent.	District.	Six Worst Weeds of Arable Land.	Best Methods of Eradication or Prevention.	Six Worst Weeds of Grass Land.	Best Methods of Eradication or Prevention.	Remarks.
W. A. Prout, B.A.	Sawbridge- worth, Herts.	Twitch or Couch (<i>Triticum repens</i>). Great arable pest. Black Bent-grass (<i>Agrostis vulgaris</i>). <i>Alopecurus agrestis</i> . Charlock, Cher- lock, Ketlock (<i>Sinapis arvensis</i>). Too common every- where. Curled Dock (<i>Rumex crispus</i>). Corn or Creeping Thistle (<i>Cnicus arvensis</i>). Poppy (<i>Papaver Rhæas</i>) on light land.	Bare fallow. Bare fallow. Spraying with sul- phate of copper. Docking with spud or digging. Cutting in April and May.	Bulbous Butter- cup (<i>Ranunculus bulbosus</i>). Cowslip (<i>Primula veris</i>). Marsh Thistle (<i>Cnicus palustris</i>). Upright Crowfoot (<i>Ranunculus acris</i>). Daisy (<i>Bellis perennis</i>). Broad-leaved Plantain (<i>Plan- tago media</i>).		With reference to the destruction of Poppy, I had a field of 14 acres on light land which was a mass of Poppies. By grow- ing a crop on it every year for thir- teen years, I have smothered them. The seeds may be there, but they have had no chance to grow.
P. M'Connell, B.Sc.	Dengie Hundred, Essex.	Wild Oat. Thistles. Water Grass (<i>Ag- rostis canina</i>). Docks. Black Grass (<i>Alo- pecurus agrestis</i>).	Fallow and hoe. Spud out. Deep ploughing. Dig out. Deep ploughing or fallow.	Thistles. Buttercups. Yorkshire Fog. Wild Carrot. Rest Harrow. Soft Brome.	Chop and spud. None. Slag the pasture. None. Dig out. Slag the pasture.	

<p>Professor John Wrightson, Charford Manor, Downton, Salisbury.</p>	<p>Avon Valley, New Forest Division of S. Hampshire.</p>	<p>Couch (<i>Triticum repens</i>). Charlock (<i>Sinapis arvensis</i>). Pepperwort (<i>Lepidium campestris</i>). Couch or Twitch (<i>Triticum repens</i> and <i>Agrostis nigra</i>, <i>A. alba</i>, and <i>A. canina</i>). Stone-weed (<i>Polygonum Aviculare</i>). Wild Spinach (<i>Chenopodium</i>). Wild Carrot. Charlock. Red Poppy. Yellow Toadflax. Broom-rape. Bindweed (<i>Convolvulus</i>).</p>	<p>Fallow. Spray and hoe. No treatment yet found; getting worse year by year. Good cultivation. Hand and horse hoeing. Do. Appears in clover fields. Encouraging early germination and destroying it by harrowing, also pulling and judicious cropping. It seldom appears in winter-sown crops. Generally appears in thin crops of corn, and is seldom a trouble in luxuriant crops. It also affects hot gravelly soils.</p>	<p>Thistles. <i>Bromus mollis</i>. Buttercup. Rest Harrow (<i>Ononis arvensis</i>). Stinking Mayweed (<i>Anthemis Crotula</i>). Yellow Ox-eye (<i>Chrysanthemum segetum</i>). Common Ragwort (<i>Senecio Jacobaea</i>). Dandelion. Hawkweeds. Plantain.</p>	<p>Cutting them at flowering time. Liberal treatment and cake feeding are more effective than any direct steps towards eradication.</p>	<p>It is easy to give six weeds, but more difficult to select which are the worst. I might mention Shepherd's Purse and Venus' Needle for arable land, and Chickweed is a great nuisance, as also is Scorpion Grass (<i>Myosotis</i>).</p>
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THE WORST WEEDS IN CERTAIN DISTRICTS—Continued

Name of Correspondent.	District.	Six Worst Weeds of Arable Land.	Best Methods of Eradication or Prevention.	Six Worst Weeds of Grass Land.	Best Methods of Eradication or Prevention.	Remarks.
J. C. Newsham, Headmaster, Hampshire Farm School, Basing.	Hampshire.	<p>Dock (<i>Rumex obtusifolius</i>).</p> <p>Field Buttercup (<i>Ranunculus arvensis</i>).</p> <p>Couch (<i>Triticum repens</i>).</p> <p>Spear Thistle (<i>Cnicus lanceolatus</i>).</p>	<p>When in clover-ley, shallow ploughing. Hand gathering when working ground down for sowing.</p> <p>With dock digger in corn crops.</p> <p>By following the ground during periods of drought, or hoeing in the case of growing crops.</p> <p>If ground is badly infested, summer fallow, collect, and burn rootstocks.</p> <p>Good cultivation and hoeing.</p> <p>Hoeing and "spudding" in corn crops to prevent seeding, when corn is about 6 to 8 inches high. Although the Thistles may flower,</p>	<p>Buttercup (<i>Ranunculus bulbosus</i>).</p> <p>Sheep's Sorrel (<i>Rumex Acetosella</i>).</p> <p>Dandelion (<i>Taraxacum officinale</i>).</p> <p>Ribwort (<i>Plantago lanceolata</i>).</p> <p>Dwarf Thistle (<i>Cnicus acutis</i>).</p> <p>Daisy (<i>Bellis perennis</i>).</p>	<p>There is practically no means of clearing meadows of these weeds, other than high-class cultivation, i.e. feeding concentrated foods to cattle when grazing, or manuring with farmyard manure from the heap, or with artificial. Good drainage is also essential, and any method of cultivation, as harrowing in spring to admit air, and remove moss. In fact anything to encourage the growth of the finer herbs and grasses at the expense of rank growing weeds.</p>	<p>Wherever land is badly drained and the farming poor, the greater is the variety and number of weeds; this is particularly noticeable in neglected water-meadows, also on pastures that become worn out by continuous grazing without supplying manurial dressings.</p> <p>On arable land the larger proportion of weeds appear to find their way to the land through the medium of the dirty straw and other forms of fodder, and on woodland farms very rapidly in wet, showery</p>

<p>seasons, when hoeing cannot be satisfactorily performed.</p>				
	<p>the seed will not ripen. Hoeing in fallow crops, and well cultivating stubbles in dry weather. Harrowing seed beds before sowing, having first allowed the Charlock seeds to germinate. Spraying in corn crops. Hoeing by horse or hand.</p>	<p>Yorkshire Fog. Knapweed. Yellow Rattle. Buttercup. Sorrel.</p>	<p>If in corn, spray with a 3 per cent solution of sulphate of copper; use 50 to 60 gallons per acre. Draining; frequent spudding; collecting underground stems. Summer catching, cropping with mustard and rape. Dig up in spring; collect stalks carefully at harvest time. Harrow corn in spring, also stubbles directly after harvest and some time before ploughing.</p>	<p>W. Southworth, F. L. S. (late Lecturer in Agriculture, Agric. and Hort. Coll., Uckfield).</p>
<p>Bindweed (<i>Convolvulus arvensis</i>).</p>				
<p>Charlock (<i>Sinapis arvensis</i>).</p>				
<p>Charlock.</p>				
<p>Coltsfoot.</p>				
<p>Black Bent.</p>				
<p>Common Dock.</p>				
<p>Speedwell.</p>				
				<p>For the eradication of Yorkshire Fog and annual weeds in meadow land, the importance of early mowing and close-grazing the after-grass cannot be too strongly enforced; also the practice of mowing and close-grazing in alternate years has been found to produce a much better quality of herbage than continuous mowing.</p> <p>Mow early; graze closely; harrow in winter or early spring. Applications of fresh gas-lime followed by mixed artificials. Good manuring with mixed artificials or well-rotted farm-yard manure; close grazing. Draining; applications of freshly-made high-grade superphosphate with sulphate of ammonia and kainit. Lime, or lime compost followed by mixed artificials.</p>

THE WORST WEEDS IN CERTAIN DISTRICTS—Continued

Name of Correspondent.	District.	Six Worst Weeds of Arable Land.	Best Methods of Eradication or Prevention.	Six Worst Weeds of Grass Land.	Best Methods of Eradication or Prevention.	Remarks.
W. Southworth, F.L.S.—Continued.	East Sussex.	Couch Grass.	After corn, autumn cultivation and burning; after seeds, trench plough, using a skinn coulter.	Rushes and Sedges.	Draining, liming, and good manuring.	
Fred. J. Chittenden, F.L.S., Roy. Hort. Soc. Gardens, Wisley.	Wisley, Ripley, Surrey (Bagshot Sand).	Gardens— Spurrey (<i>Spergula arvensis</i>), Corn Marigold (<i>Chrysanthemum segetum</i>), Twitch (<i>Triticum repens</i>), Goosefoot (<i>Chenopodium album</i>).	Hoing constantly. Liming. Hoing. Forking out all the stolons and burning, where heavily manured with farmyard manure.	Lawns— Daisy (<i>Bellis perennis</i>), Self-heal (<i>Prunella vulgaris</i>), in the wetter places. Dandelion (<i>Taraxacum officinale</i>), Cat's-ear (<i>Hypochaeris radicata</i>), In moist parts Mosses and Lichens.		
		*Knotgrass (<i>Polygonum Aviculare</i>), *Chickweed (<i>Stellaria media</i>), *Knawel (<i>Scieranthus annuus</i>).	Especially where manure applied.			

*Shepherd's Purse
(*Capsella Bursa-*
Pastoris).

*Persicaria or Red-
shank (*Poly-*
gonum Persi-
caria).

*Wart Cress (*Sen-*
bierra didyma).
(Rarely on this soil

S. Coronopus.)
*Thale Cress (*Sis-*
ymbrium Thali-
ana).

Most abundant after
manuring.

*These weeds are
very troublesome
on seed beds where
there is delay in
germination; but
where hoeing can
be done, they are
easily kept down.
Occasionally Thistles
are troublesome,
and often the Small
Stinging Nettle
(*Urtica urens*).
On this soil, there-
fore, the weeds are
mostly annual.

CHAPTER VII

PARASITIC PLANTS

A considerable number of weeds are parasitic or semi-parasitic in character, subsisting wholly or in part upon the food material elaborated by the "host" plant for its own use. One or two of these parasites are serious pests, and frequently do much damage.

CONVOLVULACEÆ

Dodder (*Cuscuta* sp.) is one of the most troublesome of weed pests with which the farmer has to contend, chiefly on account of the damage it does to red clover. Many species of Dodder are harmful, and some eighty species are known to science, several occurring in Britain. These parasites are mostly annuals, growing from seed sown with farm seeds or self-sown in a former year, and they subsist on plants of a higher order.

The various species of Dodder closely resemble one another in their life history and manner of growth. The seed contains a simple, thread-like embryo which is coiled spirally round the fleshy albumen, and the radicle end is thickened. A damp season appears most suited to the requirements of the Dodder seed, and at a proper temperature the seed germinates in five to eight days. The thread-like coil gradually un-

winds and the radicle end takes root in the soil, but should the lengthening stem not meet with a suitable host plant the seedling dies. Should the stem reach a host plant it twines itself round the stem of the latter, attaching itself firmly by means of suckers or *haustoria*. It now loses its connection with the soil, and, unless checked, extends its thread-like stems to neighbouring plants, rapidly spreading in all directions and drawing its food supplies wholly from the host plant. Large patches may in this way be rapidly overcome by the Dodder, the host plants becoming strangled and exhausted.

It may be observed that Dodder possesses no chloroplasts, and is unable to take up carbon dioxide from the air like an ordinary green plant, but, as already stated, draws its sustenance from the ready-made products which it absorbs from the host plant by means of its *haustoria*, or suckers.

If it be not attacked the Dodder spreads quickly, produces flowers and seeds, and the soil is re-sown. Dodder may also be spread by small fragments of the stems, which are veritable cuttings, and may establish new centres of infestation by attaching themselves to new plants. It appears also that, in some cases at least, Dodder may be spread by means of little tubercles, which are formed in winter,¹ although in general the pest is spread by seed, and chiefly, perhaps, as an impurity in agricultural seeds. An idea of the rapidity with which Dodder spreads may be formed from M. Marre's statement, that in three months a single stem may kill all the clover or lucerne plants on an area of 28 square metres (say, 30 square yards), and so complete is the destruction that one would say a fire had passed over the spot.

¹ E. Marre, *La Lutte contre la Cuscuté*.

The seeds of Dodder (Plate II., Figs. 51 and 52) are in general quite small, roundish, and angled. Being, with one or two exceptions, much smaller than the seeds of red clover, they are easily separated by seed-cleaning machinery. Although Dodder seeds may be recognised as such by the farmer, the species can only be identified by the expert, and then not invariably perhaps. In 1905 no less than 11 per cent of the clover seed samples examined by the Consulting Botanist (Mr. W. Carruthers, F.R.S.) to the Royal Agricultural Society were found to contain Dodder seeds, two samples containing 6 per cent. In 1908 the same authority called attention to "the difficulty of securing the seeds of any variety of red clover this year free from Dodder. Last year's harvest of seed in Britain had been so short and unsatisfactory that the market had had to be supplied by seed imported from the Continent and America, and it was very difficult to obtain seed free from Dodder. In many samples that had been examined there had been as much as 1000 Dodder seeds in a pound of clover seed." This makes it abundantly clear that the seeds of Dodder must be very commonly sown with clover samples in Britain. Dodder is similarly a pest in the Colonies and in the United States of America, France, Germany, Hungary, Italy, Russia, Chile, and other countries.

Cuscuta Trifolii Bab., generally termed Clover Dodder, and according to Hooker a variety of *C. Epithymum*, is the most common species met with on the farm. It is leafless, but produces numerous clusters of minute white bell-shaped flowers (Fig. 72). Each flower gives rise to a two-celled capsule, each cell containing two minute seeds, which are roundish, dull in appearance, and grey, brown, olive-brown, or yellowish-brown in colour. This species is most commonly found on

clover and lucerne in Great Britain, but, according to Frank and Marre, it has been found on a large number of other plants—*e.g.* vetches, lupines, potatoes, beet, carrots, fennel, aniseed.

C. Epithymum Murr. (*C. minor* Lam.), or Lesser Dodder, occurs in Britain from Ayr southwards. The flowers are variable in colour, $\frac{1}{4}$ to $\frac{3}{4}$ inch in diameter, and open in July to October. The reddish stems are very slender. It is found on furze, thyme, ling, heaths. The seeds are round-oval in shape, and yellowish-brown in colour.

C. europæa L. is not common in Britain, but occurs on vetches and nettles, and on the Continent on hops, hemp, vetches, potatoes, sugar-beet, and other plants. The stems are reddish or yellow in colour and as thick as twine, and the flowers, tinged with red, appear in the summer months.

C. Epilinum Weihe., or Flax Dodder, chiefly attacks flax, occurring sporadically in Great Britain and Ireland. On the Continent it has been found to attack hemp and camelina. It is paler and more succulent than the last species, and flowers during summer.

C. Gronovii Willd. appears to have been introduced into Europe from North America. Although this



FIG. 72.—Clover Dodder (*Cuscuta Trifolii* Bab.) on Red Clover (*Trifolium pratense*), $\times \frac{1}{2}$, with flower enlarged.

species probably does not ripen its seeds in Britain, the seeds germinate when sown, as they may be, with lucerne seeds. This is an exceptional species, in which the seeds are larger than usual, about the same size as those of lucerne, and hence not so readily separated from the latter as other species of Dodder seed. Potatoes, beet, and chicory are stated to be infested by it, in addition to lucerne and other leguminous plants.

Dodder is a most serious pest, and the utmost pains should be taken to prevent its entry to the farm in seed samples for sowing, or to eradicate it if unfortunately found attacking a crop. Several means may be noted by which it may be combated:—

1. Pure seed, absolutely free from Dodder, should be insisted on, and the seed merchant should be asked for a guarantee to this effect. Should a doubt be entertained as to seeds already purchased, a sample should be submitted to an expert botanist for examination, and if Dodder be found, the only thing to be done is to sift the seed before use, shaking it thoroughly in a sieve composed of a 20-mesh wire screen (No. 32 English gauge round wire). With a wooden frame 12 inches square and 3 inches deep covered by such a wire screen a man may deal with 5 to 10 bushels per day, shaking $\frac{1}{2}$ lb. at a time vigorously for half a minute.

2. Should a patch of Dodder be found on a clover crop it should never be torn out with a rake, as this only serves to break up the Dodder into small pieces and distribute it. The best plan is to cut the crop and Dodder together with a scythe, heap the whole together in the centre of the patch, cover it with chaff, straw, or light dry rubbish, and burn it on the spot. Care should be taken to cut the crop well beyond the apparent limit of the Dodder, as it is better to sacrifice

a portion of the crop than risk infestation another year. Further, the whole of the area cut over should be covered several inches deep with chaff and burnt over.

3. It is recommended by Thaer that infested spots be surrounded by a small trench beyond the outermost threads of Dodder, the soil from the trench being used to cover the patch.

4. A somewhat similar plan is suggested by Frank : covering the patch with a layer 3 inches deep of chaff, tan, or gypsum, with an inch or so of fine soil on the top, the whole being saturated with liquid manure or sprinkled with powdered quicklime in winter. Such a method usually allows the clover to break through the covering, but the Dodder will be unable to do so.

5. A plan which appears to have been successfully practised¹ consisted in "removing the surface of the affected spots with a plate-spade and burning the material (earth, Dodder, &c.) mixed with old thatch in the centre of each patch, followed by burning a layer of waste straw on the top of the cleared patches, taking care to put it well round the edge, even sacrificing a portion of the unaffected crop round the edge." The cost for thus treating twenty-five patches three to six paces in diameter on an area of 7 acres was perhaps five shillings.

6. Should an infestation be very extensive it will probably be best to plough the whole crop under, but this must be done *before the seeds ripen*, and if possible before they are formed.

7. As the seeds may lie dormant in the soil for five or six years, a field that has been attacked by Dodder should not again be sown with clover for seven or eight years.

¹ *Jour. Bd. Agric.*, June, 1909, p. 209.

8. Since it has been shown that the seeds of Dodder may pass through the digestive system unharmed, an infested crop should not be fed to stock. Frank records a case in which a field was actually infested with Dodder by means of manure from young cattle which were fed on rape and linseed cake containing Dodder seed which had not been destroyed.

9. It has been found in Germany by Dr. Hiltner,¹ Director of the Agricultural Botanical Institute at Munich, that spraying with a solution of sulphate of iron destroys Dodder, but not the clover, although the leaves of the latter turn black, and it appears as if ruined at first, sprouting strongly afterwards however. A 15 per cent solution should be employed, and applied with a sprayer in such a manner that the liquid falls with some force on the ground, wetting both the plants and the surface soil. The solution should also be applied after rain or when the dew is on the leaf and in the early stage of the infestation.

10. The use of arsenite of soda has been found satisfactory for the destruction of Dodder in lucerne in Cape Colony.² The solution recommended is $\frac{1}{2}$ lb. arsenite of soda to 5 gallons of water. It is stated that there is no fear of killing the lucerne, and if sprayed properly one application will suffice.

[See also *Jour. Board of Agric.*, Sept. 1906; *Leaflet* No. 180, Board of Agriculture and Fisheries; E. Marre, *La Lutte contre la Cuscute*; A. Thaer, *Landw. Unkräuter*; Dr. A. B. Frank, *Kampfbuch gegen die Schädlinge unsere Feldfrüchte*; Dr. P. Sorauer, *Pflanzenkrankheiten*.]

¹ *Prak. Blätter für Pflanzenbau und Pflanzenschutz*, April, 1908.

² *Agric. Jour. of the Cape of Good Hope*, February, 1908.

OROBANCHACEÆ

The only weeds in this order are those of the genus *Orobanche*, known as the Broom-rapes, or robbers of Broom, from two Greek words meaning *a vetch* and *to strangle*, the vetch probably being replaced by Broom, which is commonly infested. The Broom-rapes, of which there are about one hundred species, are not so harmful as Dodder, but they may sometimes be very troublesome, especially on warm, dry, light soils.

Broom-rapes are annual, leafless, brownish root-parasites, containing no chlorophyll or green colouring matter. The stems are 6 inches to 2 feet high, generally stout and scaly, with a somewhat tuberous base, and occur singly; and the flowers, with certain exceptions, occur in lax or dense spikes. Finally, the plant is attached, by means of suckers or *haustoria*, to the roots of the clover or other plant on which it is parasitic. It subsists on the food material manufactured by the host plant, and if it be very plentiful the clover crop may be almost or quite ruined.



FIG. 73.—Broom-rape (*Orobanche minor* Sutt.), nat. size.

O. minor Sutt., or Lesser Broom-rape, is the chief trouble of the farmer, chiefly attacking clover, and occasionally doing great damage. This pest (Fig. 73) is parasitic on a number of plants, however, and is recorded by Kirchner as occurring on *Trifolium pratense*, *T. repens*, *T. hybridum*, *T. incarnatum*, *Lotus corniculatus*, and other plants. Sorauer says it is so harmful to clover in Baden that it has received the name of "clover devil" (*kleetuefel*). In Britain it occurs from the Border counties southwards; the stem is 6 inches to 2 feet in height, rather slender compared with some other species; and the flowers, appearing from June to October, are $\frac{1}{2}$ inch long, reddish, brown, violet, purplish, or yellowish-brown in colour, many being crowded in a long spike.

O. Rapum-genistæ Thuill., or Larger Broom-rape, occurs from Dumfries southwards, in Ireland, and in the Channel Islands, and is parasitic on the roots of a few shrubby leguminous plants, as Gorse and Broom. It is brownish in colour, with flowers, about 1 inch in length, of a yellow and purplish tint. The flowers, which are in dense spikes, appear between June and August.

O. ramosa L. infests hemp, and on the Continent tobacco, while it has been recorded on maize (Nobbe). It is brownish or pale yellow in colour, with light blue or white flowers.

Several other species of Broom-rape are found in Britain, but are of little agricultural importance.

The seeds of Broom-rapes are very minute, almost dust-like, and are produced in large numbers in two-valved capsules, and it has been stated that ten million seeds weigh 1 gram. Sorauer quotes Wentz as having seen 70 to 90 seed-capsules, containing on an average 1500 seeds, on a single plant! These minute, light

seeds are readily scattered by the wind, but are easily separated from clover seed samples.

The life history of Broom-rape is interesting, for the seeds only germinate on coming into contact with the roots of a host plant, and some species are parasitic on but one host, while others attack a number of plants. In the case of *O. minor* the seedling on germination is thread-like, and somewhat resembles that of Dodder. It attaches itself to the roots of its host by means of a sucker, develops a fleshy stem which "grows upwards through the soil, appearing above it like a pale, brownish-red asparagus shoot from 6 inches to 18 inches in length." The spike of flowers is then produced.

According to a Leaflet¹ issued by the Swiss Experiment Station, when the summer is warm and dry the seedlings grow rapidly in the first year, building up until autumn an onion-shaped, scaly rootstock with a large number of roots, which endeavour to attach themselves to other clover roots. No shoots come above ground in the first year, but they appear in the second year, after the clover is cut. (In this case the Broom-rape would be a biennial.) Owing to the storing up of food in the clover plants after the clover is cut, and the extra warmth of the now bare soil, growth of the Broom-rape is very rapid, and the flowers appear in a few days. In an extraordinarily short time the seeds are ripened and distributed by the wind.

As regards *prevention and remedy*, the following suggestions may be made:—

1. Although the seed of Broom-rape is so easily separated from clover seed samples, it may sometimes be found in such; and Percival quotes a case in which

¹ *Flügblatt Nr. 5, Schweizerische Samen-Untersuchungs- und Versuchsanstalt Zürich.*

he observed "the bad effects of sowing impure samples (of clover seed) purchased without guarantee." On the other hand, in the Swiss Leaflet already quoted, it is stated that, "Because foreign red clover is often badly infested with Broom-rape, one now and then hears the opinion expressed that the latter is introduced with foreign clover seed. This is not so. In the many thousand clover seed samples which have already been examined, the seeds of Broom-rape have never been found. This is easily understood. Broom-rape ripens its seeds much earlier than red clover. By the time the clover is harvested for seed the last of the parasite has distributed all its seed. And even if it did get into the clover seed, it would, on account of its small size, be completely removed by the clover-cleaning machine. *Where Broom-rape appears, its seeds were certainly already present in the soil!*"

2. When a clover crop is found to be infested the Broom-rape may easily be pulled up by hand and burnt. If it be known that clover is infested, the crop should be cut early in order to prevent the Broom-rape seeding, and the clover should then be encouraged to grow thickly and strongly, so that it may smother the weed. Ground lime and potash manures may be useful in this way if judiciously applied; and simply manuring with nitrogen, which in any other case is not advisable for clover, has been followed with good results as a preventive.¹ The better the land is prepared and manured before sowing the less will the crop be damaged by the pest. Sorauer remarks that in a case of widespread infestation the chief means of combating this pest consists in the prevention of seeding, because spreading by scions or shoots is slow, and easily preventable by uprooting the plants. The pre-

¹ Swiss Leaflet cited.

vention of seeding is doubly important, because not only are large quantities of seeds produced, and easily scattered by the wind, but they may lie in the soil for years without losing their vitality. It has been recorded by Frank that in one case the pest again attacked clover which was sown seven years after the previous crop. The later crop was so severely infested that it had to be ploughed up. On infested land, therefore, clover crops should be as widely separated in the rotation as possible.

3. The growth of heavy-yielding varieties of red clover is believed to be valuable on account of the strong, luxuriant, and rapid growth, well covering the soil. It is, indeed, known that in Switzerland home-grown, heavy-yielding red clover is hardly attacked, while foreign, less robust kinds suffer severely from Broom-rape attack. Red clover may also be replaced by lucerne or sainfoin.

4. The Swiss Leaflet recommends the sowing of Italian ryegrass with the clover, the reason being that it grows rapidly after the first cut is taken, and prevents the continuous warming of the soil and keeps the Broom-rape back. On land on which clover has previously suffered from Broom-rape pure red clover seed is therefore not sown, but is mixed with a fair percentage of Italian ryegrass, not more than about 5 lb. per acre.

5. It is recommended by Frank that badly infested fields should be deeply broken up after the first cut of clover is taken, and before the pest blooms. The land should then be used for other crops for some years. Somewhat similar advice is given by Percival, who says that, "When once established it is difficult to eradicate before doing considerable injury to the crop, and nothing short of ploughing up the clover will exterminate the pest entirely."

The Dodders and Broom-rapes above described are wholly parasitic on their host plants. The following plants are only semi-parasites. Although they possess green leaves and are able to assimilate the carbon dioxide of the air, their roots are attached by *haustoria* or "suckers" to the roots of grasses and other host plants, from which they apparently take water and the mineral food constituents necessary for their nutrition.

Where they occur on pastures and meadows an application of 4 or 5 cwt. of salt per acre checks their growth.

SCROPHULARIACEÆ

Yellow Rattle (*Rhinanthus Crista-galli* L.), also known as Rattles, Rattle-grass, Cock's-comb, or Horse-penny, is an erect-growing annual, 6 to 18 inches high, with narrow serrated leaves placed opposite one another in pairs on the stem, which is quadrangular and branched. The flowers are numerous and arranged in spikes; the corolla is yellow, with the lobes of the upper lip blue; the lower lip is shorter than the upper, and three-lobed. After the corolla has fallen the calyx is tipped with red, and resembles a Cock's-comb. The flowers appear in May, June, and July. The seed capsules are roundish, compressed, and two-valved, and the seeds are roundish, compressed, and winged, rattling in the capsule when the plant is shaken—hence several common names of the weed. The word *Rhinanthus* is from the Greek *rhinos*, the nose, and *anthos*, a flower, and therefore means *the nose flower*.

This weed (Fig. 74) is partially parasitic on the roots of grasses and other plants, and it was shown sixty years ago that it cannot be cultivated entirely by itself.¹ It is frequently very plentiful in damp meadows and pas-

¹ "Experiments by Prof. Henslow," *Gard. Chron.*, 1848.

tures, and in such cases is very harmful, useful plants being crowded out or robbed of their food supplies. Its presence in quantity also reduces the value of hay. The plant is not liked by stock, and some people believe that it imparts a bad taste to butter made from the milk of cows grazing on infested pastures. When infested grass land is broken up Yellow Rattle may appear in the first arable crop, and possibly the seeds may find their way into the granary with grain. Henslow writes¹: "If the seeds are ground up with the corn they impart a violet-brown colour to the flour. This is due to a property called *Rhinanthine*." It has been said that they similarly give an unpleasant taste to the flour.



FIG. 74.—Yellow Rattle (*Rhinanthus Crista-galli* L.), nat. size.

Yellow Rattle is usually regarded as a weed of poor

¹ Rev. Professor G. Henslow, *Poisonous Plants in Field and Garden*.

meadow land, well managed pastures being seldom infested. Mr. J. P. Sheldon wrote in 1907¹ "that an abundant growth of this weed appears to be promoted by a prevalent low temperature in the period when grass in meadow is—or ought to be—a little past the middle of its growth. In a warm and 'growing' state of weather at this period all meadows worth their salt fill up with bottom grass, and the Yellow Rattle is not seen." Another authority² says that well-drained meadows seldom suffer, but chiefly poor meadow land by streams which are fed more by stagnant water than by drainage waters; while in 1907 the Board of Agriculture received specimens from Sussex, where the weed was overrunning land on chalk under down grass.³ It is found in Britain as far north as the Shetland Isles, and in the Scottish Highlands occurs as much as 2500 feet above sea-level (Hooker).

Several preventive and remedial measures may be practised:—

(1) Early mowing before the seeds ripen; when this has been followed two years in succession, entirely satisfactory results have been obtained. Late mowing with the grass for hay is useless, for many of the seeds will have ripened and become distributed by the wind.

(2) A general improvement in the pasture should be aimed at, and depasturing with sheep in spring, followed by the application of 6 to 8 cwt. of basic slag on heavy land in November, or 5 cwt. superphosphate on lighter land in February, will be certain to reduce the weed, and if close grazing is regularly practised for a time the Yellow Rattle will probably disappear.

¹ *Agricultural Gazette*, July 8, 1907.

² A. Thaer, *Landw. Unkräuter*.

³ *Jour. Bd. Agric.*, May, 1908.

(3) Top-dressings of salt have in some instances proved effective. Grazing with sheep in April, accompanied by a dressing of 6 cwt. per acre of salt, is stated to have had good results, a field infested in 1896 producing no Yellow Rattle in 1897, the year in which treatment took place.¹

In some experiments, conducted in 1893 by the Glasgow Technical College, the weed was found to be completely destroyed by the application of 6 cwt. of salt per acre in dry sunny weather in the end of April. The salt burned the surface of the pastures very badly, but the grasses recovered when rain came, and gave an increased produce. The Yellow Rattle, however, was completely exterminated.

(4) Where infested pastures or meadows are really damp or wet, they should be drained, grazed, and manured.

Eyebright (*Euphrasia officinalis* L.) is an erect annual (Fig. 75) common in pastures and meadows on light soils.

It is a very variable plant, and some forms are met with on damp peaty ground. The stems are thin and wiry, from 1 to 6



FIG. 75.—Eyebright (*Euphrasia officinalis* L.),
 $\times \frac{1}{2}$. 1. Flower $\times 2$; 2. Fruit $\times 1\frac{1}{2}$.

¹ *North British Agriculturist*, October, 1897.

inches high, often branched, and bear small sessile, ovate, or lanceolate leaves with crenate or coarsely serrate margins.

The flowers are tubular, two-lipped, and white or lilac with purple veins, the lower lip being yellow; they grow singly in the axils of the leaves, and are open from June to August.

Red Bartsia (*Bartsia Odontites* Huds., or *Euphrasia Odontites* L.) is a frequent weed in fields and waste places, and by roadsides. It has an erect branched wiry stem, and in habit and general appearance resembles a large red Eyebright. The leaves are opposite and sessile, usually narrowly lanceolate and serrate, though they vary very much in shape. The flowers are two-lipped, pink and hairy, and appear in July and August, arranged on one side of the flowering stem.

Yellow or Viscid Bartsia (*B. viscosa* L.) is an annual plant, with stems about a foot high, ovate coarsely serrate leaves, and yellow two-lipped flowers, which are open in June to October. The whole plant has sticky hairs upon it. It sometimes grows abundantly in grass land.

Lousewort or Red Rattle (*Pedicularis sylvatica* L.) occurs on heaths and dampish meadows throughout the country. It is a perennial, with long smooth branches which spread over the ground and grow erect at the ends. The leaves are oblong-pinnatifid, the flowers two-lipped, about an inch long, and rose-pink, appearing in May.

Another species (*P. palustris* L.), which is annual, grows in marshes and bogs. It has a stout erect stem, with few or no branches, and large crimson flowers (Fig. 76).

Cow-wheat (*Melampyrum pratense* L.) is another semi-parasitic plant which grows chiefly on the sides of woods and in thickets, though it is sometimes seen

in dry pastures. The branched stem grows from 6 to 18 inches high, and bears opposite leaves, which are usually lanceolate-entire, sometimes resembling broad grass leaves. The flowers are axillary on one side of

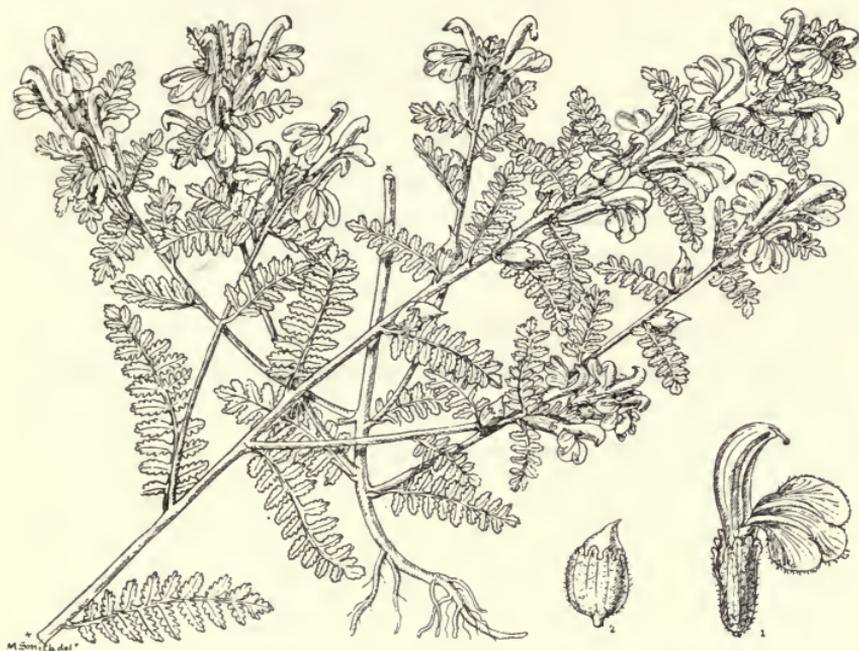


FIG. 76.—Lousewort (*Pedicularis palustris* L.), \times about $\frac{1}{2}$.
1. Flower, and 2. Fruit, both enlarged.

the stem; they have long narrow yellow corollas, tubular and two-lipped, rather like those of a snapdragon, and are seen from June to September.

Toothwort (*Lathræa squamaria* L.) is a perennial parasitic plant which lives on the roots of trees and shrubs, especially hazels. The whole plant is fleshy, with stout stems 3 to 8 inches long; the branched root-stock has thick fleshy scales crowded upon it, and its roots are attached to those of the "host," from which it draws its nourishment. The plant is pale yellow or

sometimes pinkish, and is practically devoid of chlorophyll. The flowers appear in April and May; they are dull purple in colour, and are arranged in unbranched scaly racemes, which are curved downwards at the tip when young. The corolla is two-lipped and open.

LORANTHACEÆ

Mistletoe (*Viscum album* L.) This familiar ever-green parasite is capable of attacking a great variety of trees, but is perhaps most abundant on poplars and on apple-trees in orchards, where it does a considerable amount of damage.

The stems are round, dichotomously branched or "forked," and yellowish-green, like the opposite fleshy, obovate-lanceolate leaves. The plant is dioecious, the small four-petalled male flowers being on one individual, and the female flowers on another.

The latter have inferior one-celled ovaries, which develop into round, white, semi-transparent berries, the contents of which are extremely viscid. Flowering takes place in March and April, and the berries are ripe about November and December, at which time they are distributed by thrushes and other birds; the seeds are deposited in excreta or rubbed by the beaks of the birds on branches of trees.

The seeds begin to germinate about April or May, when they send out a root which immediately curves towards and penetrates the bark, dissolving its way by means of enzymes down to the young wood. In a year or two the primary root produces green lateral roots, which grow out from it at right angles and extend along the branch mostly in the bast. From the lower side of these lateral rhizome-like rootlets short roots or "sinkers" are pushed out into the wood, from

which they probably absorb water and mineral constituents, which the plant needs for nutrition. From the upper side of these green root "runners" adventitious buds arise and burst their way out through the bark, ultimately growing into leafy branches.

Although young Mistletoe plants develop slowly at first, after a time they grow more vigorously, and seriously rob their host branches of food. The orchard trees suffer in consequence, and yield less fruit than they should do. At the same time canker sometime appears on the swollen branches attacked by the parasite, and may spread to healthy trees in the neighbourhood.

Where the pest occurs on orchard trees it is perhaps best to cut off the affected branches. Where this is not feasible the parasite may be cut out completely, roots and all, covering up the wound afterwards with Stockholm tar. The female plants especially should be destroyed, as it is from these only that the parasite is distributed.

CHAPTER VIII

POISONOUS PLANTS¹

IN addition to the weeds of arable and pasture land already described, there are a considerable number which are chiefly important on account of their poisonous or irritant properties, and their consequent harmful effects on farm live stock. In cases where such weeds occur in large quantities they may be unavoidably harvested with hay or other crops, and thus be later given to stock; or they may be eaten in the green state in the open fields and along hedgerows. There are also certain poisonous plants which, though not weeds, may usefully be included here, on account of the fact that they are occasionally eaten by farm animals, on which they have an irritant or toxic effect. Laburnum, Yew, and other noxious plants may be browsed upon by stock in fields near large gardens; others, such as Box, Rhododendron, Poison Ivy, Hellebore, and Larkspur, may be obtained in clippings and other rubbish from gardens and shrubberies.

RANUNCULACEÆ

Monkshood (*Aconitum Napellus* L.) is not commonly found otherwise than in gardens, but occurs in the wild state in shady places near streams in Wales

¹ The symptoms of poisoning by the various plants and the antidotes or remedial measures are not in general given. For information on these points reference must be made to medical or veterinary works, and to the works by Cornevin, Henslow, and Smith. (See Bibliography.)



Photo, 1909.

J. C. Varty-Smith.

FIG. 77.—Monkshood (*Aconitum Napellus* L.).

and one or two western counties. It is an upright perennial 2 feet or so in height, with deeply cut leaves, and tall spikes of dark blue flowers, about an inch in diameter, placed on upright downy stalks. The upper sepal of the blue calyx is in the form of a hood or cowl, hence the common name. The rootstock is spindle-shaped. Flowering takes place from July to September.

Although the whole plant (Fig. 77) is very poisonous, its virulence depends to some extent upon the age of the plant and the climate in which it is grown. The leaves are the least poisonous, the seeds more so, and the root the most deadly. The toxic principle is the alkaloid *Aconitine*. Drying removes a part of the poison, and boiling removes most of it, as it is soluble in boiling water (Cornevin). Medical works record many examples of human poisoning, particularly in cases where its root has been mistaken for horse-radish; this mistake should rarely occur, as the Aconite root is a conical tap-root, tapering to a point, while that of the horse-radish is cylindrical, and possesses a characteristic pungent odour. The plant is generally avoided by live stock, but poisoning of horses, cattle, sheep, and pigs have been recorded (Cornevin). Linnæus also says that it is fatal to cows and goats when they eat it fresh, but mentions that when dried it does no harm to horses.

Buttercups (*Ranunculus* sp.).—Several species of Buttercups are of a poisonous character, containing an acrid juice. All bear yellow flowers of varying sizes. The toxic principle, however, is volatile, and easily destroyed by boiling or drying; in hay, therefore, Buttercups may be considered harmless, and are readily eaten by stock, forming a nourishing food. Buttercups, however, may well be replaced in pastures by more useful plants. (See also p. 152.)

R. sceleratus L., known as Celery-leaved Buttercup, is an upright annual, about 1 to 2 feet high, with smooth leaves divided into three irregular lobes. It occurs in ditches, ponds, and wet places, flowering from May to September. The flowers are small, about one-fourth of an inch across, and the sepals reflexed, or turned sharply back towards the hollow stem. This species is especially noxious to farm stock.

R. acris L., Tall Crowfoot or Acrid Buttercup, is a hairy erect perennial with much divided leaves. It attains to a height of 3 feet; the flowers are much larger than those of *R. sceleratus*, being about three-quarters of an inch across. The sepals are spreading, and the flower stalks cylindrical. Tall Crowfoot is found in meadows and by roadsides; flowering takes place between April and September. Tall Crowfoot has been a frequent cause of cattle poisoning, and induces intense inflammation of the digestive organs. (See also p. 152.)

R. bulbosus L., or Bulbous Buttercup, is another hairy erect perennial, distinguished from other Buttercups by the stem, which has a swollen bulb-like base, generally about the size of a hazel nut. The leaves are divided, and the flowers, which open from May to June, are $\frac{1}{2}$ to 1 inch across, the sepals being reflexed to touch the flower stalk. It is similar in its poisonous qualities to *R. acris*. (See also p. 152.)

R. Flammula L., the Lesser Spearwort, is a common species of *Ranunculus* in wet places, such as water meadows and marshes. It attains a height of 1 foot, and bears long, narrow, pointed leaves, very different in form from those of the field Buttercups. The flowers are about half an inch in diameter when fully open, and appear between June and August. This species has, according to Henslow, often proved fatal to horses and cattle which have eaten it; such accidents

have occurred at the village of Gamlingay, in Cambridgeshire.

R. Ficaria L., or Lesser Celandine, has also caused poisoning among cattle. It has heart-shaped leaves, and grows quite close to the ground, only attaining 4 to 6 inches in height. The solitary flowers are about three-fourths of an inch across, with about a dozen bright yellow petals, and appear from March to May, being open much earlier than those of the other species mentioned.

R. repens L. and *R. arvensis* L., already dealt with (pp. 50 and 52), are cited by Cornevin as poisonous plants.

Wood Anemone (*Anemone nemorosa* L.), the common Anemone of woods and copses, is sometimes present in meadows. It is a very acrid perennial herb, which flowers in April and May. Although cattle have been poisoned by it, there appear to be no records of fatal results.

Larkspur (*Delphinium Ajacis* Reich.) is not common, but occurs in cornfields in Cambridgeshire, Sussex, and some other places. It is an annual, and the blue, white, or pink flowers open in June and July. They are about an inch in diameter, and one of the sepals is prolonged into a characteristic "spur," from which the plant takes its common name.

The seeds of Larkspurs are said to be especially poisonous, the toxic principle being *Delphine*, an alkaloid. One species, Stavesacre (*D. staphisagria*), is used in medicine.

Hellebore (*Helleborus fatidus* L. and *H. viridis* L.) are by no means common plants, but the former, Stinking Hellebore, so called on account of its fetid odour, occurs in thickets and on chalk pastures in some southern and eastern English counties; while

the latter species, Green Hellebore, is found, also on chalk, in woods and hedges in many localities.

The flowers, which are many in the case of *H. fatidus* and few with *H. viridis*, open early in the year (February to March and March to April respectively). They have no prominent petals; what appears to be the corolla is formed of the sepals, which are five in number, and in *H. viridis* green and spreading, but in *H. fatidus* green tipped with dull purple, erect and overlapping. The leaves are borne on long stalks, and are divided into irregular palmate lobes. Both species are perennial. The Christmas Rose (*H. niger*) is a much esteemed cultivated species of *Helleborus*.

Both species are powerful vegetable irritants, being purgative and cathartic, the toxic principle being the glucoside *Helleborin*. Fatal poisoning of human beings has been recorded. The poison is not removed by drying or boiling as in the case of Buttercups. Live stock are unlikely to touch the plant or eat it in sufficient quantity to cause serious results, yet animals have been killed by it—"cows have died from eating the trimmings of the Fetid Hellebore mixed with other herbage when thrown out from a shrubbery into the field where they were" (Henslow).

PAPAVERACEÆ

The Common Poppies (*Papaver* sp.), which are dealt with from another standpoint at p. 53, are actively toxic or narcotic, the worst species being *P. somniferum* L. (the Opium Poppy). The common red Poppy (*P. Rhæas* L.) is stated by Cornevin to be poisonous in all its parts, and sufficiently so to occasion accidents every year. The toxic principle consists of the alkaloids *Morphine* and *Rhæadine*. Poisoning of domestic

animals may occur if they are fed with clovers or sainfoin which are infested with Poppies, and also when they ingest the capsules and seeds with other waste matter from the winnowing or grading of cereals. Cattle have been occasionally injured by eating unripe Poppy-heads when the plant was mixed with clover and sainfoin (Henslow). In the open, however, farm animals are usually safe where Poppies abound, as the unpleasant odour and taste of the plants render them obnoxious.

Cornevin remarks that cattle poisoned by *P. Rhæas* exhibit at first symptoms of excitement, shown by continual movement, by pawing of the soil or litter, by increased respiration and a more rapid pulse. This is followed by stoppage of the digestive functions, and sometimes a little swelling of the eyelids. These preliminary symptoms are succeeded by a period of coma, the animal appears to sleep while standing, remaining motionless, and if forced to move walks in an unsteady manner. Soon it falls, and, if a fatal result is likely to occur (which is exceptional), the animal remains stretched out on the ground; respiration becomes slower, the temperature falls, and after a few convulsive movements death supervenes owing to arrested respiration.

It may be added that the drugs morphine, opium, and laudanum are prepared from Poppies; the red colouring matter of the petals is also extracted and utilised for certain purposes.

Greater Celandine (*Chelidonium majus* L.) is an erect branched perennial which grows in "waste places and hedgerows in the South of England, probably naturalised, elsewhere an escape" (Hooker). It attains to a height of 2 feet. The leaves are abundant, very thin and much divided, with toothed and lobed segments.

The yellow flowers open between May and August, are nearly 1 inch in diameter, and occur "in loose few-flowered umbels" on slender stalks; the petals are four in number. The seed capsules are about $1\frac{1}{2}$ inch long. The plant exhales an unpleasant odour, and contains a yellowish acrid juice.

C. majus is a vegetable irritant, producing nausea and dysentery, and is a drastic purgative. The toxic principle is *Chelidonine*, an alkaloid, and neither drying nor boiling eliminates the poisonous property. It has been used by country people as an emetic and purgative, but should be avoided owing to its harmful nature. Animals refuse the plant.

CRUCIFERÆ

Charlock (*Sinapis arvensis*), which is more fully dealt with at p. 58, must also be included among poisonous plants, since the whole plant is an irritant when in bloom, and the seeds are of a dangerous character, causing inflammation of the intestine. Cornevin states that when used in admixture in the manufacture of a poor quality oil-cake and fed to cattle the cake caused intestinal inflammation, severe diarrhœa, and great thirst. The effects are probably due to Oil of Mustard.

CARYOPHYLLACEÆ

Corn Cockle (*Agrostemma Githago* L.) is a common plant of cornfields, covered with white hairs, and attaining 3 or 4 feet in height. It is tall and erect, with straight, narrow lanceolate leaves up to 5 inches long placed opposite one another on the stem in pairs. The flowers (Fig. 78) are borne singly on long stalks which spring from the axils of the leaves. They are

1½ to 2 inches in diameter, with five pale purple or violet-red petals, and appear in June, July, and August. The five green sepals are much longer and narrower than the petals. The seed capsule is large, and contains twenty or thirty rough black seeds, which are nearly the size of grains of wheat, and for this reason



FIG. 78.—Corn Cockle (*Agrostemma Githago* L.), × about ½.
1. Fruit enlarged.

are separated from the cereal with difficulty. They are bitter to the taste.

The plant is harmful in three ways. In the first place, it is a weed in the usual sense—it grows where it is not required and crowds the cultivated crop. Secondly, the seeds may be ground up with wheat, discolouring the flour, and imparting even to bread when baked a greyish tint and disagreeable odour. Thirdly, the seeds are of a poisonous character, the

toxic principle not being destroyed by heat of an ordinary oven in baking. Bread containing Corn Cockle has proved fatal. Although farm live stock are unlikely to touch the plant when growing, the seed may be ground up and mixed with feeding stuffs, and Cornevin states that poisoning has occurred in the case of man and all domestic animals. In 1874, evidence in a case at Lyons showed that there were then merchants sufficiently unscrupulous to add 45 per cent of Corn Cockle flour to meals intended for the feeding of stock. Cornevin was unable to state the amount of the flour necessary to cause death for animals other than calves, pigs, dogs, and poultry, and for these the amounts are—

Calf25 lb.	} per 100 lb. live weight.
Pig	.	.	.	.10 "
Dog	.	.	.	.9 "
Fowl	.	.	.	.25 "

Since that date numerous experiments have been made with Corn Cockle, and a variety of conclusions have been recorded. We summarise from *The United States Experiment Station Record* various notes which have appeared for many years past, the experiments referred to being conducted in Germany. In experiments at the Vienna Experiment Station¹ bread containing 40 per cent of Cockle seed meal was eaten by both adults and children, and gave negative results. In 1892 Kornauth and Arche found² by feeding trials that Corn Cockle was not poisonous to pigs, a conclusion which is contrary to general belief. They found that albuminoid metabolism was diminished, but fat production increased; with 70 per cent of Corn Cockle in the food the growth of the animals was diminished, but the

¹ *Exp. Sta. Rec.*, vol. iv. p. 91.

² *Ibid.*, vol. iv. p. 90; vol. v. p. 228.

action did not appear to be poisonous. The authors even concluded that Corn Cockle may be regarded as a harmless and valuable food for growing pigs, and refuse containing it is extensively used in Hungary for fattening pigs.

In 1893 a number of pigs died in Germany when fed on coarsely ground rye tailings containing 6 per cent of Cockle, symptoms of acute poisoning being observed. Forty work-horses, however, were uninjured when given $3\frac{1}{4}$ lb. of similar tailings.¹ In another case five cows were supposed to have been poisoned by Cockle;² and in still another to exert a poisonous action on pigs (1904-5).³ Experiments conducted in 1903-4 showed that Corn Cockle exerted a more favourable than unfavourable influence on the total yield of milk of cows, but a very unfavourable influence on the quality of butter.⁴ About the same time⁴ experiments with cows, sheep, pigs, and goats indicated that in the amounts usually found in feeding stuffs, Corn Cockle has no poisonous influence on domestic animals.

About 1892 Nevinny concluded⁵ that 6 grams of Cockle seed consumed in 1200 grams of bread were beyond doubt poisonous in effect, and that the sale of grain or flour containing it should be forbidden. Kobert also thought that the sale of feeding stuffs containing the seeds of Corn Cockle should be prohibited by law.⁶ Pesch, who made an extensive study of the question, concluded⁷ as follows: "Under certain conditions Corn Cockle is injurious to domestic animals. The amount of the poisonous substance in the seed is variable, depending probably upon the season and

¹ *Exp. Sta. Rec.*, vol. v. p. 813.

³ *Ibid.*, vol. xvi. p. 103.

⁵ *Ibid.*, vol. iv. p. 90.

² *Ibid.*, vol. xii. p. 394.

⁴ *Ibid.*, vol. xv. p. 1001.

⁶ *Ibid.*, vol. iv. p. 92.

⁷ *Ibid.*, vol. iv. p. 310.

the soil. Animals become accustomed to it, so that amounts of seed which at first cause sickness, later have no injurious effect. The susceptibility of animals to the poison varies both with the species and the individual. Young animals are more readily affected than older ones. It is believed that rodents and sheep are not susceptible, and, as far as is known, grown cattle are only slightly or not at all affected by the poison. Calves, swine, horses, and especially dogs, are more or less susceptible. Concerning birds and fowls, there is some doubt."

Corn Cockle is included by A. B. Smith¹ as a simple irritant poison.

The toxic principle is variously stated to be *Sapotoxin*, a glucoside, *Smilacin*, *Saponin*, or *Githagin*. Pesch says² that the seeds contain a poisonous substance called Saponin or Githagin, a bitter property which may cause nervous debility and dysentery. "The poisonous constituent is very freely soluble in water, and possesses a sharp burning taste. It has no odour, but when inhaled in the smallest quantity it produces violent sneezing. When briskly shaken with water it froths like soap. The poison is found in nearly all parts of the plant, but mainly in the kernel of the seed."³ The starch grains of Corn Cockle are only about one-fifteenth the size of those of wheat, and are easily distinguishable with the microscope, and by a chemical test with iodine.

The evidence given above is sufficiently conclusive to show that the ingestion of the seeds of Corn Cockle should always be avoided, and great care should be taken that the seeds are completely removed from cereals before the latter are used for food.

¹ *Poisonous Plants of all Countries*, 1905.

² *Die Füttermittel des Handels*, 1906.

³ *Farmers' Bull.*, No. 86, U.S. Dept. Agric.

When Corn Cockle occurs in cornfields it should be eradicated, and strenuous attempts made to prevent it reaching the seeding stage. Pure seed corn should always be used.

CELASTRACEÆ

The Spindle Tree (*Euonymus europæus* L.), the generic name of which is taken from Euonyme, "Mother of the Furies," occurs in copses and hedges, often on chalk, from Roxburgh southwards. It is stated by Hooker to be rare in Scotland and local in Ireland. It grows from 5 to 20 feet in height, and is a smooth and fetid shrub or tree. The leaves are ovate-lanceolate in shape, 2 to 4 inches long, smooth, in opposite pairs, with short stalks. The flowers, which open in May and June, are one-third to one-half an inch in diameter, and occur in clusters of five to ten on stalks of an inch or more in length; they are greenish-white in colour. The bark is at first bright green and smooth. The common name is derived from the fact that the wood was formerly made into spindles.

This plant is poisonous in all its parts, but the berries are especially so. Children have suffered from eating the fruits, which are strongly purgative; and Cornevin states that sheep and goats have been injured by eating the leaves. The poisonous principle is the glucoside *Euonymin*.

RHAMNEÆ

Common Buckthorn (*Rhamnus catharticus* L.) is a shrub of 5 to 10 feet high, much branched, the branches being opposite and spinous at the ends; the leaves are ovate and serrate; the yellowish-green flowers, under $\frac{1}{4}$ inch in diameter, may be solitary or

in crowded cymose clusters on short stalks in the axils of the leaves ; and the fruits, containing four stones, are round, black, and strongly cathartic and purgative in character. The flowers appear from May to July, and, according to Hooker, the Buckthorn occurs from Westmorland southwards, chiefly on chalk, and is perhaps not wild south of Durham, while it is rare in Ireland. The fruits should not be eaten, as they may produce dangerous effects: they yield a green dye.

LEGUMINOSÆ

Indian Tares.—Various species of *Lathyrus* met with in Spain, Italy, Africa, and other parts of the world are poisonous, and not unfrequently lead to fatal results when consumed by animals. In 1894 several horses belonging to the Bristol Tramways Company were poisoned by eating so-called Indian Peas (the seeds of *Lathyrus sativus*), and other injurious effects upon farm stock are recorded after eating cakes and meals containing these seeds. The British species, *L. Aphaca* L. (Yellow Vetchling), has caused violent headaches and vomiting in the case of persons who have eaten the seeds. This plant occurs in corn-fields from the Midland counties southwards, and flowers in June and July. It grows to a height of 1 to 3 feet, and bears large leaf-like stipules and long tendrils. The pale yellow flowers are produced singly at the nodes. [See also "Lathyrus Poisoning," *Veterinary Journal*, 1885 and 1886; "Leguminous Plant Poisoning," *Jour. Bot. Soc. Edin.*, Dec., 1894, by Dr. R. S. MacDougall.]

Lupins (*Lupinus* sp.) are not much cultivated in this country on the farm, but various kinds are well known in garden cultivation, where they are highly valued for

ornamental purposes. Some species are valuable forage crops, and useful for reclaiming sandy soils, being usually ploughed in or folded with sheep. Of these the Yellow Lupin (*L. luteus* L.) and Blue Lupin (*L. angustifolius* L.) are grown most extensively. The Yellow Lupin has caused much trouble on the Continent, especially in Germany. Cornevin states that in 1880 no less than 14,138 out of 240,000 sheep fed upon it, or 5.89 per cent, died after suffering from a complaint termed "Lupinose." Sheep were chiefly affected, because it was to this class of stock that the crop was principally given, but cattle, goats, and horses did not escape. Percival states that Lupins "contain a variable proportion of a bitter alkaloid which makes them unpalatable to horses and cattle, and sheep at first appear to dislike the crop. In addition to the bitter alkaloid, Lupins under certain indefinite conditions of soil, manuring, and storage sometimes contain a poisonous compound named *Lupinotoxine*, which rapidly produces fatal results in sheep when the latter are fed with even moderate amounts of the cut green fodder or hay. Of the various methods to render the Lupin crop perfectly innocuous, heating with steam under pressure of one or two atmospheres has proved the most certain."

"**Java**" Beans (*Phaseolus lunatus*) are the seeds of a foreign bean which have been occasionally imported into this country from the East for feeding purposes, and owing no doubt to their general similarity to white haricots and butter beans have found favour with farmers and others. In the past five years there have been a number of cases of poisoning by so-called "Java" Beans (Fig. 79a). In March 1906 the Board of Agriculture and Fisheries published a report of the poisoning of farm animals at eight centres. At two of

them the number of animals were not stated, but at the other six 133 head of cattle were involved, and of these no fewer than 43 died. The meal on which the animals were fed was prepared from the beans of *P. lunatus*, of which several types occur in cultivation and in the wild state. These types exhibit considerable differences in colour, some



FIG. 79a*.—Java Beans, nat. size.

of them being creamy-white, reddish-brown, brownish with purple spots and blotches (Fig. 79b), purplish-black, or black with white stripes.

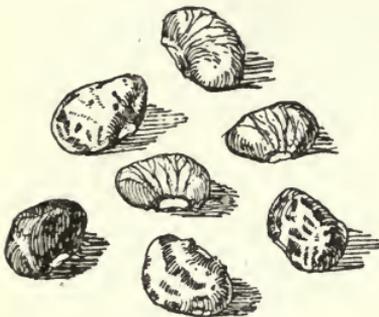


FIG. 79b*.—Red Rangoon Beans, nat. size.

The toxic principle is *Phaseolunatin*, a glucoside which, under certain conditions, gives rise to prussic acid. The largest proportion of the poisonous principle appears to be contained in the coloured

seed beans ; the white forms (Fig. 79c) contain much less, or none at all, and are in general safe for feeding to stock. Before any doubtful kinds of beans are used for feeding purposes their identity should be ascertained, and they should be purchased under guarantee. (See the *Journal of the Board of Agriculture* for March and April 1906, and March

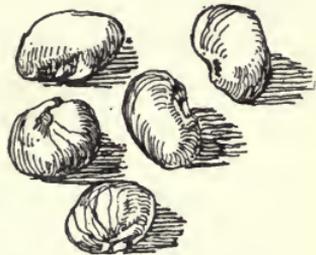


FIG. 79c*.—White Beans, nat. size.

1908 ; the *Transactions of the Highland and Agricultural Society*, 1907 ; the *Bulletin of the Imperial Institute*, 1903 ; and the *Proceedings of the Royal Society*, 1903.)

Laburnum (*Cytisus Laburnum* L.) is a decorative tree, well known throughout the country, the drooping racemes of yellow flowers appearing in May and June. It is stated by Henslow to be "certainly one of the most poisonous of all trees cultivated in gardens"; and Cornevin remarks that numerous experimental researches have proved that the wood, bark, leaves, flowers, seeds, and roots are poisonous, the seeds especially so. Smith includes the Laburnum among vegetable irritants, producing nervous symptoms, abdominal pain, vomiting, purging, and tetanic spasms. The toxic principle is *Cytisin*. A case was recorded¹ by the Board of Agriculture in 1908, in which two horses were alleged to have been poisoned in North Wales by eating Laburnum seeds, which were found in their stomachs on post-mortem examination, although in very small quantity. The symptoms attendant on Laburnum poisoning in cattle are stated to be trembling, disinclination to move, partial paralysis of the limbs, tympany, and salivation.

ROSACEÆ

The Cherry Laurel (*Prunus laurocerasus* L.), so common in shrubberies, has caused numerous accidents both to man and the domestic animals on the Continent, and Gerlach (*vide* Cornevin) cited a case of the poisoning of twenty-five sheep. The crushed leaves are used by entomologists for killing insects. Its toxicity probably depends to some extent on locality. Henslow remarks that in England it appears to be much less, if at all, harmful, and states that his own cows completely

¹ *Jour. Bd. Agric.*, March 1908, p. 695.

ruined a long laurel hedge, the abnormal food doing no damage either to the cows or to the milk they produced.

CUCURBITACEÆ

Bryony (*Bryonia dioica* L.) is a well-known climbing plant of hedges and thickets in England, not being



Photo, 1909.

H. C. Long.

FIG. 80.--Spray of Bryony (*Bryonia dioica* L.).

found in Scotland and Ireland (Hooker). The leaves are five-lobed, light green in colour, and the plant climbs by means of long thread-like tendrils, which twine round other plants for support (Fig. 80). The rootstock consists of large fleshy tubers, "sometimes nearly two feet long, thick as a man's arm, white, succulent, and fleshy, with an acrid, bitter, and disagreeable taste" (Henslow). The flowers are quite small and greenish-white, appearing between May and October; they give rise to red berries. Bryony has an unpleasant odour, and contains a milky, nauseous juice. It is a highly irritant plant, and the tuberous roots have been the cause of the poisoning of whole families who have eaten them instead of parsnips and turnips. It has been estimated that forty berries would cause the death of a man, and that fifteen would similarly suffice in the case of children (Cornevin). The toxic principle is a glucoside called *Bryonin*.

UMBELLIFERÆ

Several members of this order may be exceedingly harmful either to man or to domestic animals.

Hemlock (*Conium maculatum* L.), illustrated in Fig. 81, a plant which may attain to 5 feet or more. It has a hollow, smooth stem, somewhat glaucous, and more or less thickly dotted with purplish spots. The leaves are large and compound, and the segments are deeply cut, as in most plants of the order. Hemlock grows on banks, near hedges, and by roadsides and streams, and in Yorkshire is found at an altitude of 1000 feet. It is a biennial, and flowers in June to July, the flowers being white and in "umbels." The poisonous principle is at first chiefly contained in the foliage, but later in the fruit, and, as in certain other plants, is largely dissipated when the plant is dried, as in hay. Owing perhaps to

the fact that the whole plant possesses a fetid, disagreeable odour it appears rarely to be touched by stock when in the growing state, although it is stated that in the United States, where it has become naturalised, many domestic animals have been killed by it. Cases of poisoning have arisen from eating the seeds for those of anise, and through using the leaves for parsley; the roots have also been mistaken for parsnips with deleterious results.¹ The plant has been known from ancient times to be poisonous, and it was probably the poison of the Hemlock which was administered to the philosopher Socrates by the Greeks.

The poisonous principle consists of several alkaloids, the chief of which is *Conine*. The symptoms of poisoning in cows are described as "loss of appetite, salivation, bloating, much body

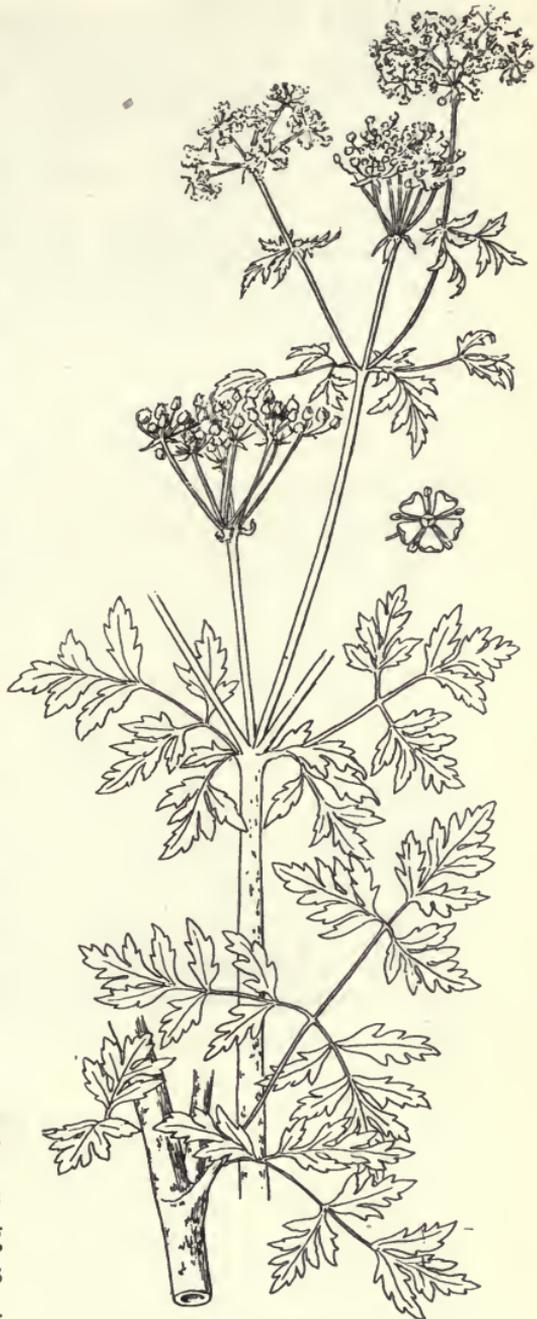


FIG. 81.—Hemlock (*Conium maculatum* L.),
× about $\frac{3}{4}$, with flower enlarged.

¹ *Farmers' Bulletin*, No. 86, U.S. Dept. of Agric.

pain, loss of muscular power, and rapid, feeble pulse." The plant should be avoided as food in any form by man or animals, and where there is danger of its being taken in this way it should be eradicated by hand pulling as fast as it appears, and by digging up the roots.

Cowbane or Water Hemlock (*Cicuta virosa* L.) is a weed which grows in damp, watery places, as by the edges of ponds, ditches, rivers, &c., from the southern counties as far north as Dumbarton and Forfar, and in Mid and North Ireland. It is a perennial plant of 2 to 4 feet in height, with large compound leaves, the serrated segments of which are long and narrow; the white flowers are produced in July to August, and occur in umbels 3 to 5 inches in diameter. The stem is stout and furrowed, and the rootstock short, fleshy, and hollow. It has been mistaken by man for celery or parsnip with fatal results. Animals appear very seldom to touch this plant, and sheep and goats are said to be but little inconvenienced by it. Henslow remarks that "It is regarded as being the most poisonous of the Umbellifers." The fleshy rootstock is the most toxic part of the plant, the poisonous principle probably being the same as in Hemlock.

Water Dropwort (*Ænanthe crocata* L.), also sometimes termed Water Hemlock, is a poisonous plant which is much more frequently the cause of harm to live stock than *C. virosa*. It is a weed of 2 to 5 feet high, which occurs in marshes, ditches, and other wet places from Argyll and Elgin southwards. The leaves are large and compound, with much divided leaflets. The flowers are white, and appear about July. The stem is grooved, hollow, and branched, while the root fibres are fleshy and spindle-shaped. This plant, illustrated in Fig. 82, is a perennial. All parts are

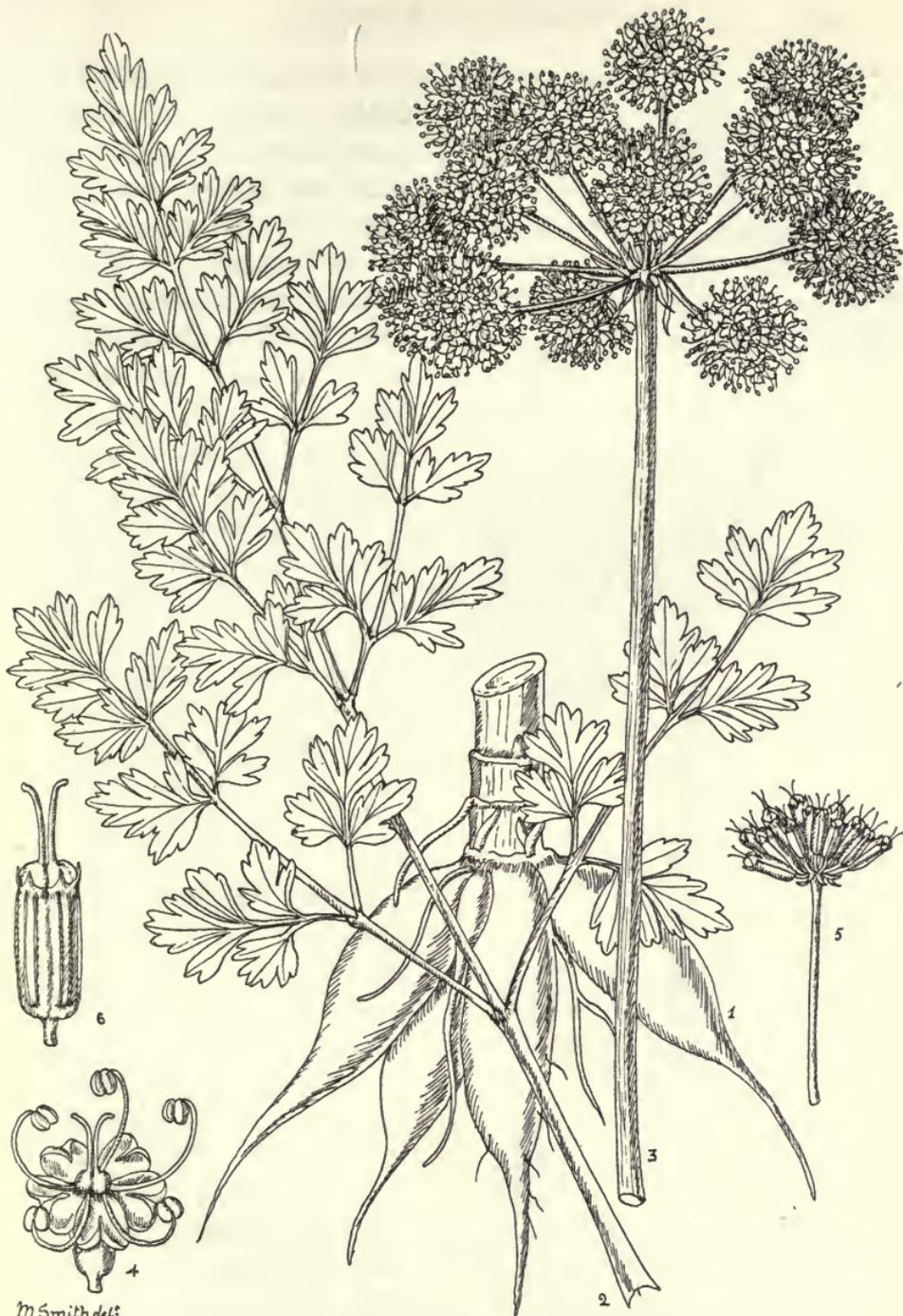


FIG. 82.—Water Dropwort (*Enanthe crocata* L.). 1. Root, reduced; 2. Leaf, $\times \frac{2}{3}$; 3. Inflorescence, $\times \frac{2}{3}$; 4. Flower, \times about 3; 5. Fruit, $\times \frac{2}{3}$; 6. Single fruit, \times about 3.

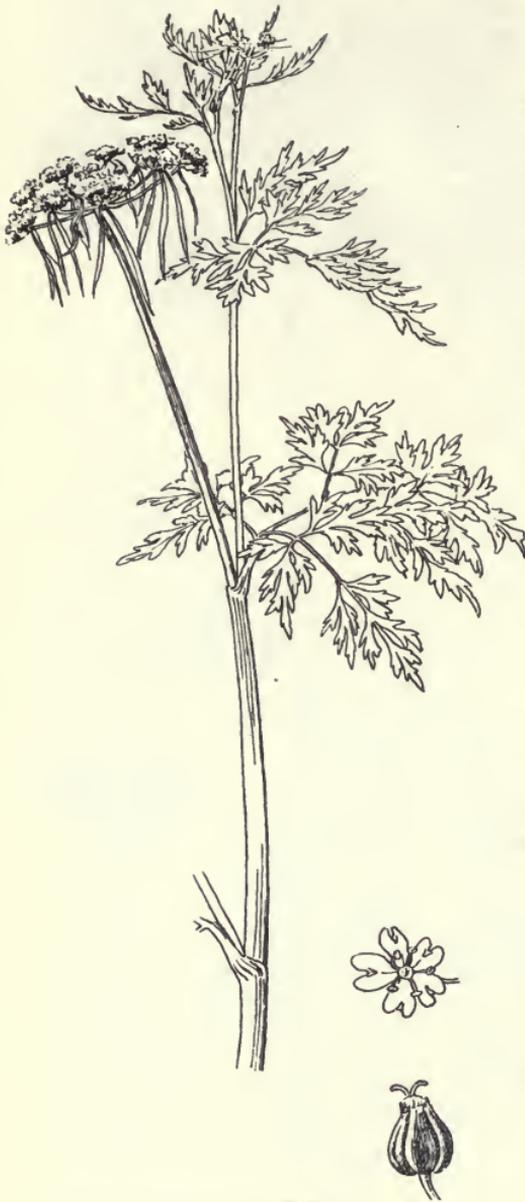


FIG. 83.—Fool's Parsley (*Aethusa Cynapium* L.),
 × about $\frac{2}{3}$, with enlarged flower and fruit.

poisonous, especially the fleshy roots; the leaves have been mistaken by man for celery, and the roots for parsnips, with fatal results. When ditches are cleaned this plant is often thrown out on the banks, and cattle are not infrequently poisoned by eating these clearings. In 1898 cattle and sheep died on a farm near Bristol (*Journal Royal Agric. Soc.*, 1898) through eating Water Dropwort. The poisonous principle is *Cœnanthin*. Other poisonous species of *Cœnanthe* are met with in Great Britain in damp situations.

Fool's Parsley (*Aethusa Cynapium* L.) is a small annual weed of gardens and cultivated fields, attaining to a height of 2 feet (Fig. 83). It occurs from Elgin southward, and also in Ireland. The foliage is compound, and resembles parsley, but is very dark green in colour. The flowers are white, those of true parsley being yellow; they appear in

July to August, and bear long drooping bracts. The roots are spindle-shaped, resembling radishes. The plant emits a nauseous odour when bruised, and is a virulent poison, all parts being toxic. The foliage and root have been the cause of death owing to their resemblance respectively to parsley and radishes. Animals appear to refuse it owing to its fetid odour. The toxic principle is an alkaloid called *Cynapine*. (See also p. 83.)

ERICACEÆ

Rhododendrons and Azaleas are both poisonous in character, some kinds especially so. Cornevin says that all species of *Rhododendron* are suspected, but mentions in particular *R. ferrugineum* L., *R. hirsutum* L., *R. Chrysanthemum* L., and *R. ponticum* L. Both English and Belgian veterinary surgeons have published records of poisoning of sheep and goats due to *R. ponticum*, and Cornevin remarks that farmers will be well advised to ensure that this plant be always kept out of the reach of ruminants.

Of the Azaleas, Cornevin takes as a type *A. pontica*, which he says is a very poisonous plant.

BORAGINEÆ

Hound's Tongue (*Cynoglossum officinale* L.) is the only member of the order Boragineæ which need be mentioned here. It is found in fields and waste places in parts of Scotland and Ireland, and throughout England and Wales, but it is not common. Hound's Tongue grows to a height of 2 feet, and has broad, downy, lanceolate leaves, and funnel-shaped reddish-purple or magenta flowers half an inch in diameter, borne in long forked clusters or cymes. Flowering takes place in June and July. The root is tapering and fleshy. The

plant is narcotic and astringent, and "smells like mice" (Hooker). It is a simple vegetable irritant, causing nausea and purging (Smith), and should be avoided.

SOLANACEÆ

Deadly Nightshade or Dwale (*Atropa Belladonna* L.) is not so widely known as is sometimes believed, many persons confusing it with *Solanum Dulcamara* L. (p. 302). It is found in waste places, thickets, and banks, "especially in chalk and limestone soils, oftenest near ruins," according to Hooker, who says that it occurs "from Westmorland southwards; also rare and near houses in Forfar, Argyle, and Ireland." The author has found it on the coast of Fife. It is a perennial branched herbaceous plant, which grows from 2 to 5 feet high. The leaves are large, oval, and pointed, up to 8 inches long, downy, and "usually in unequal pairs." The flowers, which appear between June and August, are bell-shaped or "tubular," and about 1 inch in length, purple in colour, sometimes with a greenish tinge. When ripe the berries are black, two-celled, and contain many seeds. The fleshy rootstock is stout and creeping (Fig. 84).

Animals and man suffer in varying degrees from the effects of Dwale poisoning, but animals are quite unlikely ever to touch the plant. The root is the most poisonous part, followed by the leaves, flowers, and stem, while the berries are least poisonous. The last are, however, the most likely to be eaten by children, and care should always be exercised where this plant is known to occur. Drying the plant does not result in getting rid of the poison. The toxic principle is the alkaloid *Atropine*, and the drug prepared from the plant is well known and widely used in medicine.



M. Smil'ndel.

FIG. 84.—Deadly Nightshade (*Atropa Belladonna* L.), $\times \frac{2}{3}$.
1. Calyx and pistil enlarged.

Henbane (*Hyoscyamus niger* L.) is found in parts of Scotland, in England, and in Wales, and is common in Ireland. It occurs chiefly in waste, sandy places, frequently near old buildings, and we have found it, almost side by side with *Atropa Belladonna*, on the Fife coast of the Firth of Forth. It is a hairy, sticky plant, annual or biennial, with a strong unpleasant odour. It grows to a height of 2 feet; the leaves are large, somewhat toothed and oblong. The flowers are funnel-shaped, upwards of an inch across, yellow in colour, with violet or purple veins. They appear between June and August. The seed capsule opens by means of a lid, and contains many seeds. The root is large and thick, and has been eaten instead of parsnips and chicory with dangerous results. The leaves and young shoots have been used as a vegetable, and children have eaten the seeds with serious effects.

All parts of Henbane are very poisonous, and the toxic principle, the alkaloid *Hyoscyamine*, is not destroyed either by drying or boiling. In general animals will not eat the plant, but Cornevin records the fact that it has been given to cows mixed with other fodder. Owing to the general habitat of the plant, however, this occurrence must be rare. Nevertheless care should be taken to avoid the ingestion of any part of Henbane, either by stock or by man.

Bitter-sweet or Woody Nightshade (*Solanum Dulcamara* L.) is a common plant of woods and hedges, and, although quite different in appearance, is frequently wrongly termed Deadly Nightshade. It is generally well known as a trailing plant, which climbs freely over hedges. The leaves are oval and single or trifoliate, and clusters of small purple flowers on slender stalks spring from the stem above a leaf. The flowers at once remind one of a small potato blossom, and, like

those of the potato, appear from June to August. The rootstock is extensively creeping, and the plant is a perennial. The berries are oval, and red or scarlet in



FIG. 85.—Woody Nightshade (*Solanum Dulcamara* L.), $\times \frac{1}{2}$.

colour (Fig. 85). To the taste the stem of the plant is at first bitter and then sweetish, hence one of the common names.

The toxic principle is the alkaloid *Solanine*, which occurs in the stem, leaves, and berries, and there is

no doubt that it is poisonous both to man and to farm live stock. Although stock rarely touch the plant it is occasionally taken, and may prove harmful. A case is quoted in the *Journal of the Royal Agricultural Society* (1905), in which it was eaten by a cow along with Meadow Saffron with fatal results.

Black Nightshade (*Solanum nigrum* L.) is a small branched annual of 6 inches to 2 feet in height, with oval leaves and lateral clusters of small white flowers, which give rise to black or reddish-black berries resembling black currants. The



FIG. 86.—Garden or Black Nightshade (*Solanum nigrum* L.), $\times \frac{1}{2}$.

plant (Fig. 86) has a disagreeable odour. It is frequently a troublesome weed in gardens, especially when these are not well cared for. The alkaloid *Solanine*

occurs chiefly in the berries, and to some extent in the stem and leaves. Gohier, according to Cornevin, gave 6½ lb. (3 kilos.) in the green state to a horse, and found it had no serious effects. Children, however, have been poisoned by the berries, and suffered from vertigo, dilated pupils, nausea, colic, stertorous breathing, and convulsions (Henslow).

Mention may be made here of the plant termed the "Wonderberry," stated to be a hybrid between *Solanum guineense* and *S. villosum*, which are probably varieties of *S. nigrum*. As grown in this country, the "Wonderberry" cannot be distinguished from some forms of *Solanum nigrum* L., the cosmopolitan weed just referred to, whose fruits are said to be edible in some countries and poisonous in others. Fruits of the "Wonderberry" were found by Dr. Greshoff, of Haarlem, to contain more *Solanine* than the wild English *S. nigrum* or the Canadian form known as "Huckleberry." The fruits should certainly not be eaten. See also *Gard. Chron.*, 1909, pp. 172, 204, 393, and 291 (October 30).

Thorn Apple (*Datura Stramonium* L.), a casual weed, is another poisonous plant of this order. It is an escape from cultivation, being a North American annual plant. The illustration (Fig. 87) is from plants raised in 1909 from seed saved from a specimen discovered in the author's garden in 1908. The Thorn Apple, known in America as Jimson Weed, is a smooth, coarsely growing bushy plant about 2 feet or more high, with a strong smell, and large, broad, wavy leaves with toothed margin. The flowers are white, large and funnel-shaped, on an average about 3 inches long, and open in June and July. The seed capsules are large, like a prickly horse-chestnut, and contain many rough black seeds which are somewhat kidney-

shaped, and very resistant to the usual agents of destruction.

All parts of the plant are very poisonous, but especially the seeds, the toxic principle being stated to be a mixture of the alkaloids *Atropine* and *Hyoscyamine*; its



Photo, 1909.

H. C. Long.

FIG. 87.—Thorn Apple (*Datura Stramonium* L.), showing tubular flower, thorny capsule (centre), and root (cut off and crossed behind the stem). The holes in some of the leaves are due to grubs.

harmful properties are not destroyed either by drying or boiling. Owing to its disagreeable odour and taste the Thorn Apple is not likely to be eaten by live stock even if found, and the accidents which have occurred have been chiefly among children, who have eaten the

half-ripe sweetish seeds; several cases were reported to the United States Department of Agriculture in the autumn of 1897. In the United States also one or two cases are recorded in which cattle were poisoned by eating the leaves of young plants present in hay.

The Potato (*Solanum tuberosum* L.) is a member of the same order, and contains the alkaloid *Solanine* in variable proportions in the green parts, and to some extent in "greened" tubers. In general, however, the tubers may be eaten with impunity, and we believe there is no record of injury to man from the potato plant. Henslow says that accidents with animals are not at all uncommon, and cattle have suffered most. Sir John Macfadyean (Principal, Roy. Vet. College, London) has shown that old sprouted potatoes, even after boiling, are a deadly poison to horses. In 1896 eleven horses died from eating in most instances small quantities of sprouted "chat" potatoes, and two test-horses fed on the potatoes died. "An affected animal seems dull, and dies within twelve hours after being first observed, without evincing any sign of pain."¹ We know, on the other hand, of pigs eating considerable quantities of potato haulm without any apparent ill-effect. It is advisable, however, not to feed the haulm to stock, but to plough or dig it into the soil, except when diseased, in which case it should be burned.

SCROPHULARIACEÆ

The Foxglove (*Digitalis purpurea* L.) is such a well-known denizen of our copses, woods, banks, and roadsides, that a description is almost unnecessary. It grows from 2 to 4 feet high, and is erect and rugged in appearance. The leaves are sometimes a foot or

¹ Prof. R. Wallace, *Farm Live Stock of Great Britain*, 1907, p. 505.

more in length, and the large purple, spotted, pendulous flowers, which open between July and September, occur in dense racemes. All parts of the plant are poisonous, but especially the seeds; the leaves are less active after the flowering period. A well-known drug, namely, the glucoside *Digitalin*, is prepared from the Foxglove. The toxic principle is not destroyed by drying the plant. As animals are not known to touch this plant in the open, it is chiefly of human interest. It should never be employed as a medicinal herb except under expert advice, and it should never be included in grass made into hay or silage.

POLYGONACEÆ

Sheep's Sorrel (*Rumex Acetosella* L.), dealt with at pp. 119, 204, has also been said to possess poisonous properties due to acid oxalates (binoxalate of potash, sold as salts of lemon), and Cornevin states that veterinary surgeons charge it with poisoning both horses and sheep.

THYMELACEÆ

The Spurge Laurel (*Daphne Laureola* L.) is an ever-green shrub, found in copses and banks in stiff soil from York and Durham southwards. It bears black berry-like fruits, which are very acrid and poisonous, and children have been injured by eating them. On account of its intense bitter flavour the plant is very rarely touched by animals. Another shrubby species with pink flowers, which appear in early spring before the leaves, is **Mezereon** (*D. Mezereum* L.). It is found in copses and woods, and is similarly poisonous.

EUPHORBIACEÆ

This order contains a number of very poisonous plants ; of these five may be noticed here.

Dog's Mercury (*Mercurialis perennis* L.) is a weed of woods, hedges, and shady places, and is found as far north as the Highlands. It is a hairy plant 6 inches to 18 inches high, with the upper ovate-lanceolate leaves 2 or 3 inches long ; the lower ones are smaller. The flowers are minute and unisexual: the males and females occur on separate plants (Fig. 88), and appear in March and April. The stem is erect and solitary, and the rootstock slender and creeping. The plant is a perennial.

The juice of Dog's Mercury is stated to be emetic and the seeds dangerously purgative, but heat usually destroys the poisonous property (*Mercurialine, Oil of Euphorbia*). Owing to this weed having a disagreeable smell it is rarely touched by animals, but it has proved fatal to sheep, and to horses fed on herbage containing it cut from a hedge.

Annual Mercury (*Mercurialis annua* L.) is somewhat similar in appearance to the foregoing species, but annual only. It is a weed found in fields, gardens, and on waste land in England, and is met with as a casual weed in Scotland, and occasionally in Ireland. It resembles *M. perennis* in its poisonous properties, but, according to Cornevin, it has been used as a pot herb in Germany. Both plants should be altogether avoided, however, for any edible purpose.

Caper Spurge (*Euphorbia Lathyris* L.) is a common weed of woods and copses in Great Britain. It is a biennial herbaceous plant, being short and leafy in the first year, and 3 feet or more in height in its second year. The leaves are 2 to 8 inches long, and placed



FIG. 88.—Dog's Mercury (*Mercurialis perennis* L.). 1. Root, $\times \frac{2}{3}$; 2. Male plant, $\times \frac{2}{3}$; 3. Male flower, $\times 2$; 4. Female plant, $\times \frac{2}{3}$; 5. Female flower, $\times 2$; 6. Fruit, \times about 3.

opposite one another on the stem in pairs. Several male flowers are associated with one female flower in such a way that they may be mistaken for a single tiny greenish flower. Flowering takes place in June and July. The juice of this plant is very acrid, and the seeds yield a violently purgative oil; country folk indeed have employed the seeds as a purge, and have been victims of their imprudence. When the seed is taken in overdose it will "inflamm the mouth and stomach, and cause intense diarrhoea and vomiting. If the dose is sufficient, there will be nervous disorders, unconsciousness, general collapse, and death."¹ In the United States cattle are said to be "quite resistant to its influence, but they are sometimes overcome." It appears only to be taken by young animals, and cases of poisoning have been reported. The toxic principle is *Euphorbin* and *Oil of Euphorbia*.

Box (*Buxus sempervirens* L.) is a well-known ever-green shrub or small tree found on the chalk hills of Kent and Surrey, and much employed in garden decoration. It flowers in April and May, and may grow from 3 to 15 feet high. All parts are bitter, and poisonous both to animals and man. Farm stock may occasionally browse upon it, but only rarely, and all clippings should be disposed of in such a way that they cannot be reached by stock. The disagreeable odour and bitter taste will usually tend to the safety of animals. The alkaloids *Buxin* and *Oil of Euphorbia* form the toxic principles in it.

The Castor Oil Plant (*Ricinus communis* L.) is a foreign plant, sometimes cultivated in Britain as an ornamental plant. The seeds are poisonous, and injure fowls, pigs and sheep, and man. Eighty sheep are stated by Cornevin to have been killed through eating

¹ U.S. Farmers' Bull., No. 86.

the refuse from the crushing of the seeds for oil. The same authority says that the residue has more pronounced properties than the oil itself. It has been found as an impurity in linseed cake and maize meal (*Jour. Roy. Agric. Soc.*, 1892).

CONIFERÆ

The Yew (*Taxus baccata* L.) is one of our most poisonous plants, but although the wood, bark, leaves, and seeds are all injurious, the scarlet mucilaginous cup enveloping the ripe seed may be eaten with impunity. The old leaves and shoots are the most poisonous parts, and as they have no noxious flavour, cattle and horses readily eat them. Trimmings which have been carelessly thrown down have also poisoned animals which have eaten them. Stock are perhaps more easily tempted to browse on the dark green foliage in winter, when they get more dry food than usual.

Many cases of fatal human poisoning by Yew have occurred. In the *Journal of the Royal Agricultural Society* several cases of poisoning of farm stock are mentioned (a horse in 1885, deer and horses in 1893, shorthorns in 1893). Many instances, however, have been recorded in which no fatal result has followed from eating the leaves, and it appears that the lower branches of Yew trees in parks and grounds are constantly cropped by cattle without any ill-effects (*Trans. Chem. Soc.*, 1902 ; *Jour. Board Agric.*, 1903). Some uncertainty exists as to the nature of the toxic principle, but the numerous recorded cases of fatal effects from eating the leaves of the Yew afford sufficient evidence that, under some circumstances, the tree contains an active poisonous principle, which is believed by some authorities to be an alkaloid named *Taxine*.

Cornevin found by experiment with leaves in autumn and winter that to cause death it would be necessary to ingest the following weight of leaves:—

Horse	0.2	lb. per 100 lb. live weight.
Ass and Mule	0.16	” ” ”
Cow	1.0	” ” ”
Sheep	1.0	” ” ”
Goat	1.2	” ” ”
Pig	0.3	” ” ”
Rabbit	2.0	” ” ”

Clippings from Yew trees should never be thrown down where they can be eaten by stock, and where Yew trees overhang hedges near pastures it is advisable to have them lopped back to a distance out of reach of grazing stock.

Cupressus poisoning has also been recorded, two instances coming to the notice of the Board of Agriculture and Fisheries in 1905; the death of cattle was attributed to the poisonous effects of *C. macrocarpa* and *C. nootkatensis*. In one instance four bullocks died, and in another three heifers were stated to have suffered from irritant poison, one of them having died. The Board had then no information as to the poisonous properties of the two species of *Cupressus* referred to, and stated that no record could be found of any similar case which would tend to confirm the suspicion that these trees are poisonous to cattle.

AMENTACEÆ

The Oak (*Quercus* sp.).—The ingestion of acorns has frequently caused serious losses among young cattle up to two years old, as in 1808, 1870, 1884, and 1900. Cattle over three years old were seldom affected, while

sheep and pigs did not appear to be susceptible to the poisonous property of the acorns. Acorn poisoning is not properly understood, but it is quite distinct from indigestion due to eating an excessive quantity of acorns. As the acorns are most likely to be eaten in long, dry, and hot summers, when herbage on the pastures is scarce, efforts should in such cases be made to keep cattle off areas where acorns are abundant. Sheep and pigs appear to be almost immune to the poisonous action of acorns. No remedy is known (see Board of Agriculture *Leaflet*, No. 13, and *Jour. Royal Agric. Soc.*, 1871).

LILIACEÆ

Meadow Saffron (*Colchicum autumnale* L.) is a perennial plant with whitish or pale purple flowers, closely resembling crocuses (Fig. 89). The long, broad, lanceolate, dark green leaves are produced in spring, while the flowers, two or three from a corm, bloom in succession from August to October, soon dying down. Curiously enough the seed-vessel remains beneath the surface until the next spring, when it appears above ground with the leaves. The bulb-like fleshy underground stems (corms) are about the size of small tulip bulbs, and lie from 6 to 10 inches deep in the soil. This plant occurs in meadows from the far north of England to the south coast, and has been reported to the author as especially plentiful in Herefordshire and parts of South Wales. It appears to occur especially on limestone soils.

C. autumnale has received many names more or less characteristic of its growth, e.g. Autumn Crocus, Meadow Crocus, Naked Ladies. It is poisonous in all its parts, and many cases of poisoning of horses, cattle, and sheep



FIG. 89.—Meadow Saffron (*Colchicum autumnale* L.). 1. Flowering corm (late summer and autumn); 2. Leaves and seed-vessel (spring); 3. Cross section of seed-vessel. All $\times \frac{2}{3}$.

have been recorded. Poisoning may occur in spring owing to the leaves and seed-vessels being eaten in the open, or when dried in hay, or to the cropping of the blooms in late summer and autumn. "As the plant is most injurious to animals and man, it should be destroyed in fields, for cattle will sometimes crop the leaves in the spring."¹ Cornevin found by experiment that the ingestion of 8 to 10 grams of green leaves per kilogram of live weight, say 3 to 5 lb. for an average cow, was sufficient to cause death to ruminants. It would appear also that if a small quantity be eaten each day with other food, the effects may accumulate and lead to fatal results. Further, the poisonous principle, *Colchicine*, is not volatile, and not removed by drying the plants, hence hay containing the dried leaves may cause trouble. "It is an irritant poison, causing violent purging. This plant was the probable cause of the cows dropping their calves, the farmer having lost between eighty and ninety calves."²

It has been stated by Stebler and Schroeter³ that Meadow Saffron abounds in meadows in Switzerland, and is poisonous both in hay and in the field. Cases of poisoning of animals and human beings are of yearly occurrence. In general, cattle avoid the plant both in the meadows and in the stalls, but young animals are often poisoned, and in early spring, when cattle stall-fed in winter are turned out to grass, poisoning frequently occurs. Sheep and goats appear to be more or less immune and eat the leaves, but pigs are very sensitive.

Since this plant is so poisonous it should be eradicated wherever found. As the corms are deep-seated they can only be dug out by hand on small areas, but

¹ *English Botany*, vol. ix. p. 225.

² *Jour. R.A.S.E.*, 1905.

³ *Matten und Weiden der Schweiz*, vol. ix. p. 209.

where the patches are large in extent the best plan appears to be to pull off the leaves as fast as they appear in spring, while when flowers appear they can be cut down or similarly pulled off. All parts removed should be burned. If the leaves be hand pulled for one or two seasons, says Percival, there is no necessity to dig up the corms, the plant being readily exterminated.

Herb Paris (*Paris quadrifolia* L.) is found in damp woods, especially on chalk soils, from Renfrew and Moray southwards. It grows 6 to 12 inches high, on a stem which usually bears four somewhat oval leaves arranged in a whorl. From the centre of the whorl a single upright flower stalk arises bearing a solitary green flower, which later produces a black berry. The rootstock is white and creeping, and the plant perennial.

All parts of Herb Paris are poisonous, it being an emetic and narcotic; the rootstock is purgative. The toxic principle is the glucoside *Paradin*. Stock are unlikely to meet with this plant except in fields bordering open woods or plantations.

Lily-of-the-Valley (*Convallaria majalis* L.) is uncommon in the wild state, but occurs in certain woods from Moray to the southern countries, and is abundant in some districts. Flowering occurs in May and June. No description is necessary, the plant being well known. All parts are poisonous, but the flowers are the most dangerous. Farm stock are hardly likely to touch this plant owing to its habitat, but its poisonous character should be borne in mind in districts where it occurs wild.

AROIDEÆ

Lords and Ladies, or Cuckoo Pint (*Arum maculatum* L.), is one of the best known plants of the countryside,

being commonly present in woods, hedge banks, and along the sides of ditches. It is a great favourite of children, and is easily recognised by the long-stalked leaves, shaped like an arrow-head and often spotted with black, and by its large yellowish-green spathe or leaf-like bract which encloses the pale purple spadix, at the base of which appear the crowded scarlet berries after the flowering period. This plant is of no agricultural importance as a weed in the usual sense of the word, though it occurs occasionally in meadows ; it must, however, be mentioned on account of its poisonous properties. All parts of the plant are deleterious, and children who have eaten the tempting berries have been fatally poisoned. The bruised leaves emit a disagreeable odour, and the plant is not spontaneously eaten by farm live stock, although pigs have eaten the tuber-like corms (which are renewed annually at the base of the stem) and suffered in consequence, though we believe that no fatal results are recorded.

The poisonous property is destroyed by drying, and corms have been used for human food for the starch which they contain ; when ground to a pulp, and baked and powdered, the material is sometimes known as Portland arrowroot. Owing also to the fact that it was used in the reign of Queen Elizabeth for stiffening ruffs and frills it has been called Starch-wort, and the following quotation from Gerarde's *Herball* is interesting : "The most pure and white starch is made of the rootes of the Cuckow-pint ; but most hurtfull for the hands of the laundresse that hath the handling of it ; for it choppeth, blistereth, and maketh the hands rough and rugged, and withall smarting." In his *Natural History of Selborne* Gilbert White states that he observed the root of the Cuckoo-pint to be "frequently scratched out of the dry banks of hedges, and eaten in severe snowy

weather" by thrushes; he also noticed that pheasants frequently eat the berries.

GRAMINEÆ

Darnel (*Lolium temulentum* L.) was formerly a fairly common plant in cornfields. It is an annual much resembling *L. perenne* (Ryegrass), but without stolons, and the spikelets are similarly placed edgewise on the flowering stem, in this respect differing from *Triticum repens* (Couch Grass). The empty outer glume generally exceeds the spikelet in length, this point effectively distinguishing it from *L. perenne*. It attains to 2 feet in height, and flowers from June to August (Fig. 90). The whole plant is quite suitable as food for stock before the seeding stage is reached, only the grain being poisonous, and this not invariably so. It is harmful both to men and animals, though it has been eaten in the form of bread with impunity, and Henslow says that "Though poisonings have been frequent, deaths have been rare." The poisonous properties are due to the presence of a small fungus in the seed; it is said that the dangerous properties are most conspicuous in wet seasons. Great care should be taken that the seeds of Darnel are not ground up with wheat into flour, while equal care should be observed that none are sown with seed corn.

FUNGI—ASCOMYCETES

Ergot (*Claviceps purpurea* Tul.) is a fungus which is parasitic on rye and various grasses. It has frequently been accused of causing abortion among cows, which have ingested it with the plants which it attacks. Some



M. Smith del.

FIG. 90.—Darnel (*Lolium temulentum* L.), $\times \frac{2}{3}$, with spikelet enlarged.

authorities consider that there is little ground for such a belief ; but its poisonous qualities are undoubted, and "serious poisoning effects, resulting in numbness, paralysis, and gangrene of the extremities, are rapidly produced when animals are fed with considerable quantities of ergoted hay " (Percival).

"Want ye corn for bread?
'Twas full of darnel : Do you like the taste?"
—SHAKESPEARE, I *Henry VI.*, Act iii. sc. 2.

CHAPTER IX

WEEDS OF PONDS, RIVERS, AND DITCHES

MANY plants are specially adapted to live in water, either (1) floating free and unattached to the soil, in which case they derive their nourishment entirely from substances dissolved in the water ; or (2) with their roots in the mud or soil forming the bed of the river or pond ; in the latter case the materials necessary for growth are taken by the roots from the soil, and also in part from the water by means of the leaves of the plants.

When allowed to grow without interference water plants become troublesome in rivers, ponds, lakes, and ditches, and much expense must be incurred in keeping them down. Some of them choke the small streams and ditches in which they grow, and prevent the free drainage of water from adjoining land. Flooding of low-lying areas may arise through the blocking of water-courses by this class of weeds, and pasture and arable land may thus be made less valuable for grazing purposes or the cultivation of cereals and other farm crops. Canals and navigable rivers are frequently made almost impassable for traffic by the growth of water plants. Boating and bathing in lakes, ponds, and rivers may be rendered difficult and dangerous by them, and their presence in abundance may ruin the water for angling purposes. Skating may also be spoilt by floating weeds. Many plants found by the sides of streams and ditches

are poisonous and dangerous to stock which have access to them, and others entail much expense and annoyance by invading cultivated watercress beds.

Water plants exhibit very striking adaptations to their environment. Some of them, such as Water Lilies and certain kinds of *Potamogeton* and *Chara*, are only met with in fairly deep water, while others, such as Rushes, Reed Grass, Yellow Iris, and Marsh Marigold, are chiefly found in shallow water by the margins of ponds and streams. Brooklime and some forms of Water Crow-foot inhabit running streams; other plants are adapted to the stagnant or slow-moving water of ponds and canals.

A fairly marked succession of zones of vegetation is frequently observable at the sides of ponds, lakes, and slow-moving rivers. At the extreme edge, where the water joins the dry land, the ordinary herbage of the field is intermingled with plants such as *Caltha palustris*, *Ranunculus Flammula*, *Pedicularis palustris*, and various kinds of *Juncus* and *Carex*, which can grow freely in water-logged soil. In somewhat deeper water other species of *Carex*, Yellow Iris, Water Mint, and *Phragmites communis* often predominate. Further in are seen the Bulrushes (*Scirpus lacustris* and *S. Tabernæmontani*) and *Equisetum limosum*; the yellow and white Water Lilies appear usually in from 6 to 12 feet of water, while many of the Potamogetons are found only where the water is 12 to 24 feet deep.

Fresh water Algæ and species of *Chara* and *Nitella* frequently cover the bed of the pond or lake in the deepest parts.

In the surface water all over the pond, down to a depth of 8 or 9 feet, there are often present a vast number of Diatoms, Desmids, and other very minute Algæ, forming the *plankton* or free floating vegetation.

The following are some of the more important weeds of ditches, ponds, and streams :—

RANUNCULACEÆ

Water Crowfoot.—Under this name may be grouped a number of aquatic *Ranunculi*, which from a botanical point of view are closely related and difficult to dis-

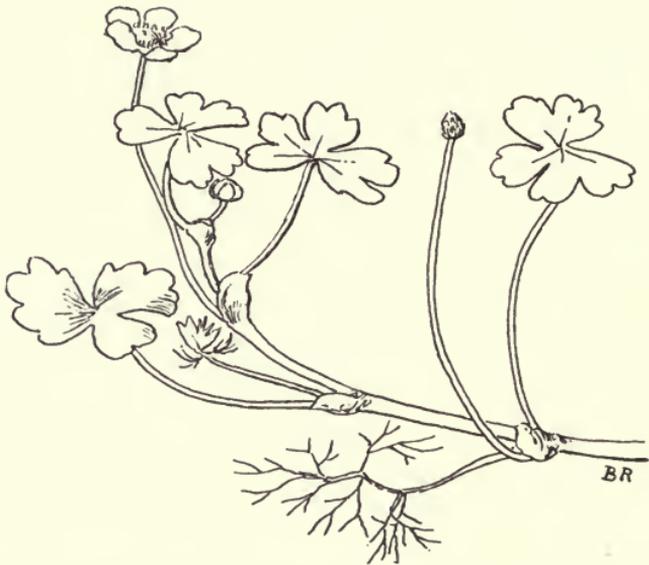


FIG. 91.—Water Crowfoot (*Ranunculus peltatus* Fries.), nat. size.

tinguish from each other. They have white flowers with a yellow centre ; most of them have stems many feet long ; in some species only submerged, finely divided leaves are present, while others have in addition leaves with flat-lobed segments which float on the surface of the water.

The following may be noted :—

R. heterophyllus Fries.—Floating leaves, three- to five-lobed, nearly circular in outline ; submerged leaves,

composed of long, thin, branch-like segments which are weak and collapse into the form of a paint brush when lifted out of the water.

R. peltatus Fries. resembles this, but the segments of the submerged leaves are more rigid, and do not close up when they are taken from the water (Fig. 91).

R. trichophyllus Chaix., found chiefly in stagnant water, has black, rigid, submerged leaves, with short flower stalks and few or no floating leaves.

R. fluitans Lamk. has long peduncles to the flowers; leaves like the preceding. The plant is found usually in running water.

Lesser Spearwort (*R. Flammula* L.).—See pp. 155, 279.

Greater Spearwort (*R. Lingua* L.) is a somewhat rare species, with flowers like a large yellow buttercup, $1\frac{1}{2}$ to 2 inches in diameter; it is found in marshes and ditches. The leaves are long and undivided, lanceolate, with their base partly clasping the hollow, smooth stem.

Celery-leaved Crowfoot (*R. sceleratus* L.).—See pp. 155, 279.

Marsh Marigold (*Caltha palustris* L.) is a well-known inhabitant of marshy places and ditches. The leaves are roundish or kidney-shaped, and the flowers golden-yellow, 1 to 2 inches in diameter.

NYMPHÆACEÆ

Yellow Water-lily (*Nuphar luteum* L.) is common in lakes and ditches which are from 6 to 12 or 15 feet deep. It possesses a strong creeping rootstock, which is buried in the mud below. The leaves are leathery, circular, and deeply divided at the base; some of them are submerged, others float on the surface of the water. The yellow flowers, over 2 inches across, have eighteen to twenty petals, and smell like brandy. The

plant is spread by means of its rootstock and by small seeds, which ripen into a berry above water.

The **White Water-lily** (*Nymphaea alba* L.) is also found in slow-moving streams and in ponds of clear water. The leaves have very long stalks and floating leaf-blades, which are circular, with cordate base. It is propagated by its strong fleshy rootstock, and by the seeds which are produced in a capsule ripening under water.

HALORAGEÆ

Mare's Tail (*Hippuris vulgaris* L.) is a common aquatic perennial at the edges of ponds and slow-moving streams. It has a stout creeping rootstock, and erect round stems about $\frac{1}{8}$ to $\frac{1}{4}$ of an inch in diameter (Fig. 92). The leaves are very narrow, about an inch long, and arranged in whorls six to twelve together at each of the many joints.

The flowers are green, very small, with no petals, and only one stamen.

Water Starwort (*Callitriche verna* L.) is a very variable species, abundantly distributed in the water of ponds, ditches, and slow streams throughout the



FIG. 92.—Left: Water Starwort (*Callitriche verna* L.), $\times \frac{1}{2}$. Right: Mare's Tail (*Hippuris vulgaris* L.), $\times \frac{1}{2}$, with fruit enlarged.

country, and often found growing on mud by the side of ponds. Watercress growers frequently complain of

it as a pest. The typical form (Fig. 92) has delicate submerged round stems; the leaves are opposite; those under water are narrow and linear, others, which float on the surface, being broader, generally spatulate, and arranged in the form of a characteristic rosette. The flowers are very small, unisexual, the males with a single stamen, the females with two whitish bracts and a four-celled ovary.

C. autumnalis L. is a species with dark green submerged leaves only.

Water Milfoil (*Myriophyllum alterniflorum* DC.) is a frequent pest in lakes, ponds, and ditches, especially in hilly districts. It has a creeping rootstock, and long, thin floating submerged stems which bear whorls of very finely divided leaves.

The sexual organs are usually separated in different small, axillary white flowers.

In speaking of the damage by water-weeds to boating and angling in the Scotch lakes, Sir Herbert Maxwell says¹ he would prefer to contend with the troublesome pest *Elodea* (see p. 332) than with *Myriophyllum*. The latter is "rampant every year" after mid-summer; *Elodea* only once in six or seven seasons.

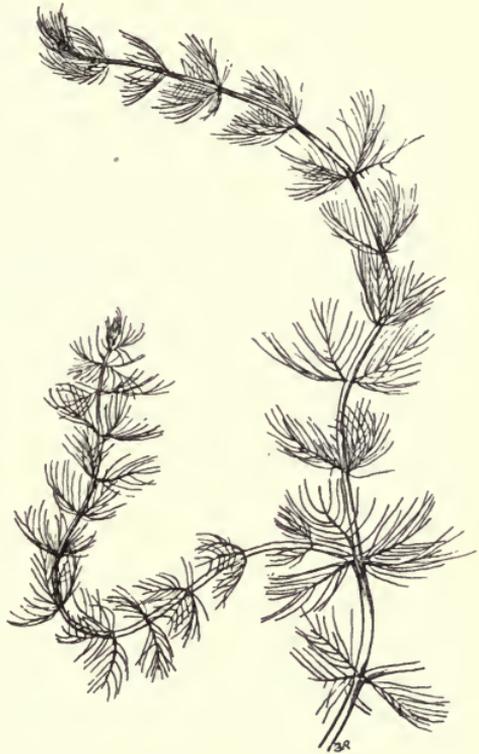


FIG. 93.—Water Milfoil (*Myriophyllum verticillatum* L.), $\times \frac{2}{3}$.

¹ *Scotsman*, Oct. 7, 1897.

Myriophyllum verticillatum L. (Fig. 93) is another common species of Water Milfoil very closely resembling the one already mentioned, but with stronger stems and more leaves in a whorl. The flowering spike is erect when in bud, that of *M. alterniflorum* being curved at the tip.

UMBELLIFERÆ

Many umbelliferous plants are inhabitants of wet places, or grow in water at the sides of rivers and ponds and in ditches. The following are often troublesome weeds in such situations:—

Marshwort (*Apium nodiflorum* Reich.) is a pest with the habit of watercress, and sometimes found in watercress beds. The stem is procumbent, 1 to 3 feet, with roots at the joints. The leaves are pinnate or trifoliate, the leaflets being usually ovate with blunt irregular serrations. The flowers are white, in umbels placed opposite to the leaves, and open from July to August.

Apium inundatum R. is an allied plant, which grows generally in deeper water. It has creeping or floating stems, and most of the leaves are submerged, with fine linear segments. The leaves at the surface of the water have pinnate, wedge-shaped leaflets. The flowers and umbels are very small, appearing from June to July.

Water Parsnip (*Sium angustifolium* L.) is a common ditch plant, with creeping rootstock and erect round stem, 1 to 3 feet high. The leaves are 4 to 8 inches long, pinnate, the leaflets ovate and irregularly lobed. The umbels of white flowers are lateral, opposite the leaves, flowering taking place in August.

VALERIANACEÆ

Valerian or All-heal (*Valeriana officinalis* L.) is a frequent inhabitant of ditches and marshy places by ponds and rivers. It is a tall plant, 2 to 4 feet high, with pinnate leaves, having four to ten pairs of lanceolate and usually serrate leaflets and one terminal leaflet. The flowers have five-lobed pale pink corollas, and are arranged in terminal corymbose clusters, opening in June to July.

COMPOSITÆ

Hemp-Agrimony (*Eupatorium cannabinum* L.) is a widely distributed plant, found on the banks of streams and in wet ditches. The stems are usually 2 to 4 feet high, round and woolly; the leaves consist of three to five lanceolate-serrated segments. The flowers are pale reddish-purple in colour, and arranged in dense terminal corymbs; they appear from July to September.

SCROPHULARIACEÆ

Marsh Figwort (*Scrophularia aquatica* L.) is often abundant on the edges of ponds, rivers, and ditches, where it impedes the flow of water and interferes with angling.

It has a well developed creeping rootstock and erect, square, winged stems, smooth below, 2 to 4 feet high. The leaves are opposite, oblong-lanceolate, with cordate base and crenate-serrate margins. The flower is two-lipped, green below and dark purple in its upper portion, the corolla tube bulging.

Knotted Figwort (*S. nodosa* L.) grows in somewhat drier situations. It has a tuberous knotted rootstock, and leaves with doubly serrate margins, the serrations

at the base being much larger than those on the upper part of the leaves.

Speedwells.—Belonging also to this order are Water Speedwell (*Veronica Anagallis* L.) and Brooklime (var. *Beccabunga* L.), two weeds frequently found in ditches and watery places. The former has stout, erect, smooth stems, which are succulent and hollow, and 1 to 2 feet high; below are creeping stolons. The leaves are lanceolate-serrate, sessile, and partly clasping the stem. The flowers have a pale lilac corolla, and are in long racemes.

Brooklime has procumbent stems, which take root at the joints, and stalked ovate leaves. The flowers are smaller than those of the previous species, and are sometimes bright blue or pink.

LABIATÆ

Belonging to this order are the Mints, several species of which are abundant in wet places by rivers and ponds. They have subterranean creeping rhizomes, and spread very rapidly, often tending to block up ditches and prevent free movement of water.

Capitate Mint (*Mentha aquatica* L.) is perhaps the commonest of such species. It has stems 12 to 18 inches high, with stalked ovate or cordate woolly leaves, and somewhat dense spikes of lilac labiate flowers.

Skull-cap (*Scutellaria galericulata* L.) is another Labiate common on the banks of streams and in ditches. It grows from 6 to 12 inches high, has oblong-lanceolate leaves with serrated or crenated margins, and blue labiate flowers two-thirds of an inch long, placed singly in the axils of the leaves on opposite sides of the stems.

Marsh Woundwort (*Stachys palustris* L.) is very common in similar situations to the last species. It

has spikes of dull purple labiate flowers. The root-stock creeps extensively, and from it grow upright stems $1\frac{1}{2}$ to 2 feet high, with somewhat narrow ovate-lanceolate and almost sessile leaves.

POLYGONACEÆ

Great Water-dock (*Rumex Hydrolapathum* Huds.) is a widely distributed and characteristic river-side plant, and the largest of the British Docks. The stems are stout, branched, and 3 to 5 feet high, with oblong-lanceolate leaves, which are cordate at the base, and sometimes more than a foot long. The flowering panicle is leafless, with crowded whorls of flowers.

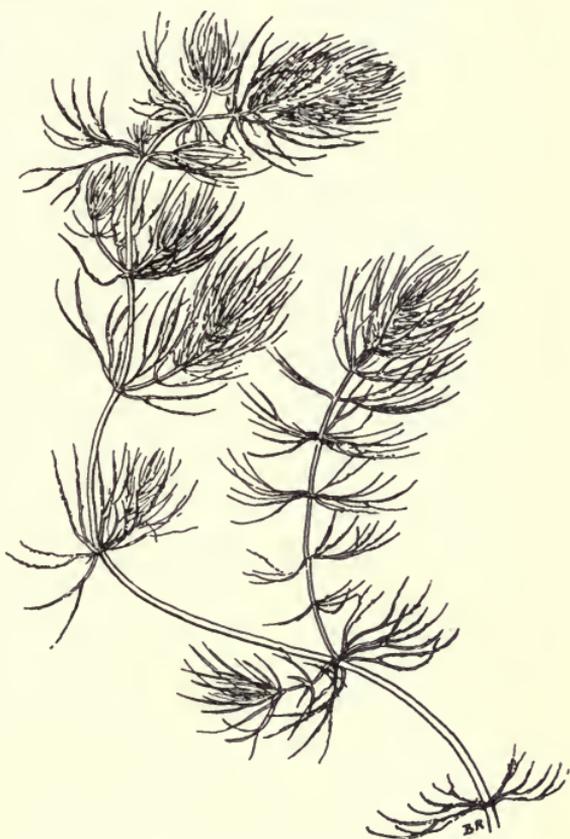


FIG. 94.—Hornwort (*Ceratophyllum demersum* L.), $\times \frac{2}{3}$.

CERATOPHYLLACEÆ

Hornwort (*Ceratophyllum demersum* L.) is a locally distributed aquatic plant, completely submerged in the water of ponds and ditches. It possesses long slender stems and leaves in whorls (Fig. 94). The leaves are usually dark green, much divided into narrow, toothed segments, and about an inch long. The flowers are

small and monoëcious, with many stamens, and one-celled ovary.

HYDROCHARIDACEÆ

Water-thyme: Canadian Pondweed (*Elodea canadensis* Michx. = *Anacharis Alsinastrum* Bab.) is an introduced aquatic weed, native of North America. The plant (Fig. 95) is a fresh green colour, is semi-transparent, and has completely submerged, slender branched stems, which bear whorls of three or four lanceolate-serrated leaves at short intervals. The stems are brittle, and often 3 or 4 feet long; when broken in pieces each piece is capable of developing roots at the joints, so enabling it to attach itself to the mud at the bottom of the pond or stream, where it grows very rapidly into a new branching plant. In its native country Water-thyme is dioëcious, and produces small, one-seeded capsules. In Britain only male plants have been found, and these only in one or two localities. It spreads vegetatively, at an exceedingly rapid rate, by means of broken pieces of stem when introduced into ponds and slow-moving streams.



FIG. 95. — Canadian Pondweed (*Elodea canadensis* Michx.), $\times \frac{2}{3}$.

It appears to have been introduced into the North of Ireland about 1836, and into England about five years later. From that time to the present it has made its way into all parts of the country, and has become a constant source of trouble

by blocking up canals and streams. River and canal navigation is impeded by its presence, and it seriously interferes with angling in lakes and slow-moving rivers.

In certain seasons it becomes rampant, spreading its long tangled stems through the water in all directions. For a period of three or four years afterwards it frequently dies down, probably owing to exhaustion of the nutritive materials of the mud and water, and then is only seen as a green carpet on the bed of the lake or stream. (See also p. 327.)

It is a nutritious green food for horses and cattle when fresh.

IRIDACEÆ

Flag or Yellow Iris (*Iris Pseud-acorus* L.).—This well-known, handsome plant, with its large yellow flowers, is common in wet ditches and by the margins of streams and lakes where the water is not more than 12 to 18 inches deep. It has stout, creeping rootstocks on the mud below, and from them are sent up round stems and sword-shaped leaves. The flowers appear usually from June to August. The plant is propagated by means of its rootstock and its flat seeds, which are produced in numbers in large three-celled capsules.

TYPHACEÆ

Bur-reed (*Sparganium ramosum* Huds.) is a frequent inhabitant of ditches and the banks of ponds and rivers. The erect stems rise to a height of about 2 feet, and bear long, narrow leaves (2 to 3 feet long and about $\frac{1}{2}$ to 1 inch broad) three-angled at their base. The flowering stem is branched, and the unisexual flowers are arranged in round heads, or "burs," about an inch in diameter.

S. simplex is another fairly common species resembling the above, but with simple instead of branched flowering stems, and often having narrow floating leaves.

Club-rush: "Bulrush," Reed-mace (*Typha latifolia* L.), is a common water plant, with dark, rich brown spikes, in shape somewhat like a lamp brush. The plant, with its tall stems, is common in ponds and ditches, and on the margins of lakes and rivers: it needs no further description.

LEMNACEÆ

Duckweed (*Lemna minor* L.).—This is a familiar palish green minute plant which is often seen completely



FIG. 96.—Lesser Duckweed (*Lemna minor* L.),
nat size.

covering the surface of small ponds. It is abundant in ditches and backwaters of many rivers and streams, and is troublesome in watercress beds. Each plant floats on the water, and consists of one

or two flattened scale-like "fronds" an eighth of an inch or so in diameter (Fig. 96). From the under part a delicate root about $\frac{1}{2}$ to 1 inch long dips into the water. Very minute unisexual flowers arise on the "fronds," and these produce seeds which propagate the plant. Multiplication, however, goes on most rapidly by vegetative budding off of young fronds, which become disconnected from the parent and then carry on an independent life, the process being repeated.

Another larger species (*L. trisulca* L.), with fronds $\frac{1}{2}$ to $\frac{3}{4}$ of an inch across, the young ones of which grow out at right angles to the older ones, is common also in many places on stagnant water.

A less frequent species is *L. polyrhiza* L., with several roots to each plant, instead of one.

ALISMACEÆ

Water Plantain (*Alisma Plantago* L.) is a common inhabitant of ditches and the edges of streams. The stems are fleshy, with a swollen base from which spring up long-stalked erect leaves (Fig. 97). The submerged floating leaves are linear, those which come above the water having long lanceolate blades (6 to 8 inches long) with a cordate base. The flowers, which are seen from June to August, are pale pink, with six perianth segments, and are arranged in an erect panicle.



FIG. 97.—Water Plantain (*Alisma Plantago* L.), $\times \frac{2}{3}$, with flower enlarged.

Arrow-head (*Sagittaria sagittifolia* L.) is another species of this order less common than Water Plantain, but met with in similar positions in water. It has peculiar creeping stoloniferous stems, the branches of which end in small tubers about half an inch in diameter. The sub-aerial leaves are characteristically arrow-shaped, hence the popular name of the plant. The leaves in the water consist of narrow petioles without leaf-blades.

The unisexual flowers have white petals, and are arranged in whorls; the upper are male, and the lower female.

NAIADACEÆ

Pondweed.—The term “pondweed” is applied in a restricted sense to representatives of the genus *Potamogeton*. A large number of species are known, some of them with floating leaves, others with submerged leaves only. The majority are inhabitants of water from 12 to 24 feet deep.

The flowers are arranged in terminal or axillary spikes; they are small, with four greenish perianth segments, four stamens, and an ovary of four carpels, which ripen into small drupes, each containing a single seed.

The species perhaps most frequently met with are:—

Potamogeton natans L. (Fig. 98), with floating, leathery, elliptic or ovate leaf-blades and long alternate petioles, some of which remain under water and develop no blade.

P. polygonifolius Pourr. somewhat resembles *P. natans*, but has narrower floating leaf-blades, and lanceolate submerged blades also.

P. heterophyllus Schreb. has flowering stems with



FIG. 98.—Left: Floating Pondweed (*Potamogeton natans* L.). Right: Curly Pondweed (*P. crispus* L.). Both $\times \frac{2}{3}$.

many barren branches, elliptical floating leaves and narrow lanceolate submerged leaves. The stem of the flower spike is thicker in the upper part than in the lower. The following species have submerged leaves only :—

P. lucens L. is common in deeper ponds, lakes, and canals. The leaves are 4 to 10 inches long, ovate or lanceolate, and translucent.

P. perfoliatus L. is a smaller species, with round stems and translucent ovate leaves 1 to 3 inches long, which clasp round the stems.

P. crispus L. (Fig. 98) has long flattened stems, on which are arranged, usually in two opposite rows, somewhat narrow oblong leaves 1 to 3 inches long, the margins of which are crisped or wavy.

P. densus L. has opposite elliptic-lanceolate short leaves, $\frac{1}{2}$ to 1 inch long, arranged very closely together in two rows on the brittle stems. It is sometimes a nuisance to growers of watercress.

P. pusillus L. is a smaller submerged species, with thin stems, and very narrow acute leaves.

CYPERACEÆ

This order includes a large number of species of plants, many of which are common inhabitants of river-banks, lakes, ditches, and marshy places, and usually spoken of as Rushes and Sedges. One or two only need be mentioned here.

Bulrush, Club-rush (*Scirpus lacustris* L.) is often met with in shallow water on the edges of ponds and slow-moving streams. It has an extensive creeping root-stock, tall green stems, usually leafless, 4 to 6 feet high, and $\frac{1}{2}$ to $\frac{3}{4}$ of an inch thick, with a spongy interior. Occasionally in running water flat floating leaves are

present. The inflorescences are terminal, reddish-brown clusters or cymes.

S. Tabernæmontani Gmel. is a sub-species of the above, with glaucous stems.

Sedges.—Many of these plants are found in marshes and ditches and on the margins of ponds and rivers. They much resemble grasses in general appearance, but the stems are usually triangular in section, and the leaf-sheaths are entire, not split, as in most grasses. The flowers are unisexual and in spikes; the male flowers have three stamens and no perianth; the female flowers have a peculiar bottle-shaped perianth, in which is the ovary, with its two or three projecting stigmas. The fruit is a small, three-angled nut.

Common species which may be described as weeds of the margins of ponds, river-banks, and ditches are *Carex ampullacea* Good., *C. vesicaria* L., *C. paludosa* Good., and *C. riparia* Curt. These grow from 1 to 3 feet high, with broad, grass-like leaves, and have creeping or tufted rootstocks.

GRAMINEÆ

The Reed (*Phragmites communis* Trin.) is a grass which occurs in shallow water at the edges of lakes and streams and in ditches throughout the country. It is useful for bedding of animals and for thatching. The rootstock is much branched, often forming a dense, mat-like growth under water, some of the rhizomes extending 20 or 30 feet. The erect stems are round, 6 to 10 feet high, with broad flat leaves usually about an inch wide, and of ashy-green colour beneath. The panicle is diffuse, 6 to 12 inches long, with purple, shining, three- to six-flowered spikelets.

EQUISETACEÆ

Horse-tails.—All the representatives of this order are adapted for life in wet places.

One species, *Equisetum limosum* L., is commonly met with in about 2 or 3 feet of water along the edges of lakes and in ditches. The smooth stems grow from 1 to 3 feet high, sometimes with short, simple branches in whorls. The terminal spore-bearing spike or cone is short and blunt.



FIG. 99.—Stonewort (*Chara vulgaris* L.), nat. size, with reproductive organs magnified.

CHARACEÆ

Various species of Stoneworts (*Chara* and *Nitella*) are lowly botanical forms with a complicated floral structure. They may have simple or branched stems up to 1 foot long, according to species. Cylindrical branches in whorls are produced at the nodes

(Fig. 99). The Stoneworts grow in brackish or fresh water, and are attached to the mud at the bottom, frequently covering large areas with vegetation. They are not usually troublesome.

DESTRUCTION OF WATER WEEDS

1. The opportunities for the destruction of water weeds, and the methods which can be employed for diminishing them, are few compared with those available in the case of weeds of gardens and fields. When abundant in ditches they should be cut with the scythe or hook or pulled up by hand, and their removal should be arranged and repeated so that at all times of the year the water has a free passage, and is not forced back or kept in a stagnant state to the detriment of adjoining cultivated land or pasture.

Along the margins of ponds, lakes, and rivers also they are best cut down with the scythe when the water is low, or from a boat when wading is not feasible.

In dealing with the question of cutting weeds in rivers and lakes kept for fishing, or for the attraction of water-fowl, it must be remembered that if weeds are cleared away completely the natural cover, and to some extent the spawning beds of fish, are destroyed or damaged. Water plants provide food and shelter for thousands of insects and their larvæ upon which fish and water-fowl largely feed, and their reduction involves much detriment to the sporting value of the water. Cutting should therefore be carried out with judgment, patches being left untouched for a time, and cut later when areas previously mown have somewhat recovered.

The operation of cutting weeds in ponds and streams is managed in various ways. A hand-power machine for use with a boat or punt is illustrated in Fig. 100, the weed-cutter consisting of V-shaped scolloped saws dragged along the bottom at the end of an oscillating and hinged arm. The same kind of cutter may be used with motive power in a punt or boat, which may

be of a considerable size and cost a large sum of money. A motor punt weed-cutter is illustrated in Fig. 101.

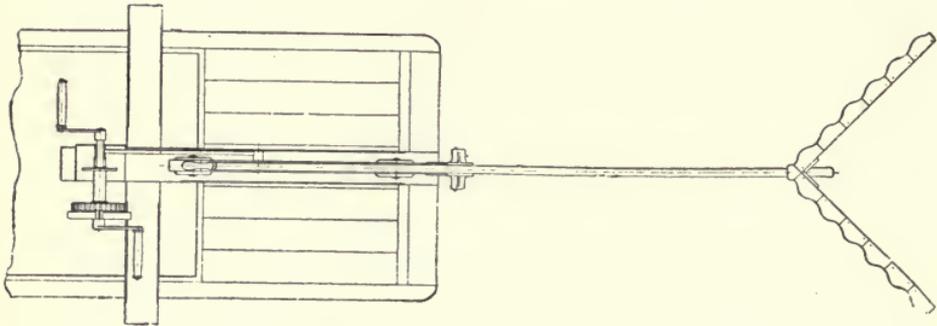


FIG. 100.—Hand-power Machine for fixing to Boats or Punts, which may be rowed by oars or towed from the bank by ropes. The cutting is performed by the V-shaped scolloped saws suspended from an oscillating hinged arm. A similar V-shaped weed-cutter on a long handle is useful for hand work from the bank, boat or punt. (Saunderson, Bedford.)

Scythe blades may be attached to ropes which can be dragged through the weeds from a boat, or from



FIG. 101.—Motor Punt Weed-cutter. (Saunderson, Bedford.)

opposite banks of the river or stream when not too wide.

An excellent weed-cutting saw is illustrated in Fig.

102. This is a long flexible blade with saw-like teeth, which quickly severs the stems of water weeds.

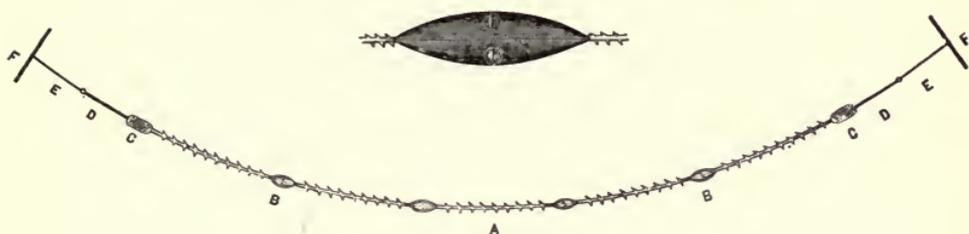


FIG. 102.—Ziemsen's Weed-cutting Saw: A, the saw-like teeth; B, torpedo-shaped sinkers; C, clamp; D, wire; E, rope; F, handle.

In shallow and wide streams weeds are often cut by men who wade in the water and use hand scythes.

As far as possible the cut weeds should be removed from the river, and not sent down stream to be a trouble and annoyance to neighbours below.

2. In addition to cutting weeds by means of different tools, some of them may be kept down to a certain extent by swans. These birds nip off the young tops among water plants, and check their rampant growth, as in the case of *Elodea canadensis* (p. 332).

3. For the destruction of floating slimy "scum," particularly in fresh-water lakes, copper sulphate has been used with success. This substance in exceedingly minute amounts kills Desmids and many microscopic green and brown slimy algæ composing the "scum." (One part in a million is sufficient to destroy the growth, and does not harm fish nor prevent the water from being used for drinking purposes.)

One and a half ounces of copper sulphate dissolved in two gallons of water and applied as a spray to the "slime" on the surface of water has been found to destroy it. A second spraying a week later makes success more certain.

Ponds and lakes have been cleared of slimy algæ also by placing copper sulphate in a sack and towing it up and down in the water from the end of a boat. About 1 lb. of the chemical per 125,000 gallons of water in the pond has been found suitable for the work. The amount of water in the pond can be calculated with sufficient accuracy by multiplying the average length, breadth, and depth in feet together, and multiplying this product by $6\frac{1}{4}$ (the approximate number of gallons in a cubic foot).

4. The weeds of watercress beds must be dug out or constantly pulled up by hand.

“The seeds of most sorts of weeds are so hardy, as to lie sound and uncorrupt for many years, or perhaps ages, in the earth; and are not killed until they begin to grow or sprout, which very few of them do unless the land be ploughed, and then enough of them will ripen amongst the sown crop to propagate and continue their species, by shedding their offspring in the ground (for it is observed they are generally ripe before the corn), and the seeds of these do the same in the next sown crop; and thus perpetuate their savage, wicked brood, from generation to generation.”

—JETHRO TULL, *The Horse Hoeing Husbandry*, 1731.

CHAPTER X

WEEDS IN LAWNS, DRIVES, ETC.

A NUMBER of weeds occur in a variety of positions not yet considered, and it will be convenient to deal with these together in a single chapter, although they differ among themselves both in character and in the harm they do. Certain weeds which occur on lawns, paths, and drives are frequently exceedingly troublesome, while Moss and Lichens growing on trees and stonework are equally noxious, and may well be discussed here. (Moss in pastures has been dealt with in Chap. V., at p. 229.)

WEEDS IN LAWNS

Lawns are unfortunately often much disfigured by Plantains, Daisies, Dandelions, and occasionally even with fungus "fairy rings." Lawns, bowling-greens, and cricket pitches, which are weed infested, may be much improved by dressing them in spring with some rich, fine soil, in which a small amount of sulphate of ammonia has been mixed in quantity sufficient to give about 1 lb. to the square rod. This plan tends to the growth of the finer grasses, and helps to suppress weeds and clovers.

Lawn Sands.—Weedy lawns may be improved by the application of what are termed "lawn sands." These consist chiefly of dry fine sand and sulphate of ammonia, and have a magical effect in clearing lawns of Plantains and Daisies. An application of

sulphate of ammonia ($\frac{1}{2}$ –1 oz. per square yard) mixed with fine dry soil acts in a similar manner, and may with advantage be evenly applied once a month from April to July.

Removing Weeds by Hand.—A common plan of ridding lawns of Plantains, Daisies, &c., is to go over the whole plot carefully and remove them *bodily* by means of a knife or spud. They should not be merely cut off below the surface, as many weeds so treated will only sprout afresh. Patent weed extractors may be obtained to remove lawn weeds quickly and well.

Poisoning of Lawn Weeds.—Other methods for killing weeds in lawns consist in the use of salt and acids. A small thimbleful of salt or a pinch of sulphate of ammonia placed on the crown of a Daisy, Plantain, or other broad-leaved weed in the lawn will destroy it; stout, thick-rooted weeds may with advantage be stabbed with a knife or skewer before applying the poison. Sulphuric acid, strong carbolic acid, and liquid weed killers may also be employed for the same purpose; the method of using these is to dip a *wooden* skewer into one or other of the liquids and plunge it into the centre of the plant, so that a drop of the liquid is left behind. Such a plan will quickly kill all the larger weeds. Patent stabbers for the use of weed-killers are also on the market.

In removing weeds by hand, or in destroying them as described above, bare patches may be left in the grass where large Plantains or Dandelions have previously occupied the soil. When this is the case the patches should be raked over in February, dressed with fine soil, and sown with grass seeds. Odd places may easily be treated in this way, or may be filled up with transplanted *Poa annua* (one of the best of lawn grasses), or, in cases where a good surface is wanted immediately,

the lawn may be neatly patched with good turves. However, lawns which are overrun with large weeds are best broken up and re-made.

Removal of Moss.—Where Moss occurs on lawns it may be taken as a sign either that draining is necessary or that the soil is poor. The measures necessary to renovate a mossy lawn are: (1) A sound raking or harrowing, to drag out the Moss and open up the surface as much as possible; (2) the application of a good compost of one part of lime to four of soil, with the addition of a little Peruvian guano; (3) frequent rolling. In bad cases grass seeds should be sown on the dressing of compost; the young grass often rapidly overcomes the Moss present; (4) watering with a 1 per cent solution of sulphate of iron applied through a fine rose, followed by top-dressing as in (2), and if necessary the sowing of seeds. The results of experiments conducted by *Der Kgl. Gärtnerlehranstalt* at Dahlem, and reported in *Der Handelsgärtner* (March 13), indicate that a 5 per cent solution of sulphate of iron is effective in ridding lawns of moss. After the application of the green vitriol solution, the grass should be sprinkled several times with a weak (3 per cent) solution of nitrate of soda.¹ Should such remedial measures not prove satisfactory, draining must be considered.

Fairy Rings in Lawns, &c.—The small fungi which often appear in ring-like patches on grass land may appear in lawns and prove very troublesome. These "fairy rings," as they are termed, expand gradually from the central point where they started, growing year by year in diameter. Messrs. Sutton & Sons state² that "One remedy is a dressing of 2 tons of slaked stone lime per acre. Another is basic slag, at the rate

¹ *Gard. Chron.*, June 19, 1909.

² *Lawns*, p. 36.

of 1 ton per acre. This is rather slower in its action than lime, and in many cases it will be considered objectionable, because it encourages the growth of clovers. The dressing may be necessary for two consecutive years. Spring is the best time, especially when showery weather prevails."

The following note is of considerable interest:—

"A Doncaster correspondent inquires how 'Fairy Rings' may be destroyed on grass land. It may be remarked that in Dr. Gilbert's experience Fairy Rings grow chiefly on impoverished soil. Infested grass land therefore, which is at all poor in character, should be liberally manured, and when the grasses have become more vigorous the Fairy Rings will probably disappear. In the case of lawns and special grass plots 1 ton of slaked lime might be applied in winter, 3 to 4 cwt. of superphosphate, 3 cwt. kainit, and $\frac{1}{2}$ cwt. nitrate of soda in early spring, and 1 to 2 cwt. superphosphate and 1 cwt. nitrate of soda in late spring—all per acre. For pastures, 4 cwt. superphosphate and 2 cwt. kainit may be applied in early spring, and $\frac{1}{2}$ cwt. nitrate of soda early in April."¹

In the case of lawns on soils containing lime or of a damp character, sulphate of ammonia may be substituted for the nitrate of soda with advantage.

Mr. G. H. Robinson (Assistant Vegetable Pathologist, Victoria) found that the fairy ring puff-ball *Lycoperdon polymorphum* Vitt. could be eradicated by watering with a solution of sulphate of iron. In his experiments² an infested bowling-green was divided into plots of 60 square yards, 8 lb. of sulphate of iron in 30 gallons of water being put on that area with zinc watering-cans. The green was well watered over

¹ *Jour. Bd. Agric.*, August 1907, p. 296.

² *Agricultural Gazette*, New South Wales, August 1907.

night, and a further light watering followed the application of the sulphate solution. "Three additional treatments were given, four in all, at intervals of a week, and only two puff-balls were gathered on the whole green after the second dose, though before the first it would have been no hard task to collect a barrowful. Since the third treatment no puff-balls have been seen on the green, and two whole seasons have passed with no trace whatever of anything in the shape of a fairy ring."

In view of the large amount of sulphate of iron used (over 1 ton per acre) it was deemed advisable to give a heavy dressing of lime to reduce any remaining in the ground to a harmless state, and 1 ton per acre of freshly slaked quicklime was evenly applied a week after the last dose of sulphate solution.

WEEDS ON GRAVEL PATHS AND DRIVES

Many weeds occur on gravel paths and drives, and are frequently extremely troublesome, Plantains, Dandelions, Groundsel, Shepherd's Purse, *Poa annua*, and other plants growing freely in such situations if allowed to do so. The use of the hoe and the knife is very desirable in certain cases, but the eradication of Dandelions, Plantains, and Docks is very difficult by such means. There remain, however, other means of treating paths and drives, namely, by the application of weed-killers, especially after the weeds have been hoed out or cut off.

Salt is an effective weed-killer if applied in quantity sufficient to whiten the surface, especially when used during hot weather.

Washing soda may also be applied as a solution, 5 lb. in 10 gallons of water being about the right strength.

Carbolic acid is another weed destroyer which can be used with satisfactory results. "Mr. W. Sowerby, of the Royal Botanic Gardens, Regent's Park, reports that for killing vegetation and preventing its growth on gravel walks he found that carbolic acid in very dilute solutions (one part of No. 5 quality in one hundred parts water) was the best, retaining its effect longer than any other."¹

Copper sulphate (bluestone), used as a 5 to 10 per cent solution, will quickly kill weeds on drives, paths, and courtyards.

Sulphate of iron is also an effective weed killer, but requires to be employed in much stronger solutions than copper sulphate. Solutions of 15 to 25 per cent may be used.

Sulphuric acid may also be used for combating weeds on paths, the most suitable proportions being 4 parts of crude sulphuric acid to 100 of water. Mixing should be done in a wooden pail, and the solution should be passed as quickly as possible through a rose watering-can, which should be well rinsed out immediately after use. In applying such corroding solutions it is well to cover the ground while walking backwards.

Hydrochloric acid in the form of a 2 to 4 per cent solution may replace sulphuric acid.

Patent weed-killers are sold by many firms, and, as a rule, are very effective when used as directed by the makers.

Yellow arsenical sheep-dip, made up with water exactly as for sheep-dipping, has been recommended as a weed-killer for paths.²

Boiling water freely applied through a rose watering-

¹ *Horticultural Directory*, p. 45.

² W. M. T. in *Farmer and Stock Breeder*, August 5, 1907.

pot on a sunny day is also stated to do much towards clearing walks and pavements of weeds.¹

WEEDS AND MOSS ON STONEMWORK, &c.

Weeds are frequently found growing in the interstices between stonework and on brickwork walls, while Moss and Lichens may similarly disfigure stone parapets, tombstones, &c. For the larger weeds, salt, soda, and the other materials just mentioned may be used as for walks and drives, but acids should never be used on marble. Moss and Lichen may be removed from tombstones, stone statuary, and so forth by spirits of salts (hydrochloric acid), 1 pint of the acid to 1 pint of water. The stone should be painted over with the liquid, left for a few minutes, and then scrubbed over with clear water.²

MOSS AND LICHEN ON FRUIT TREES

Moss and Lichen on fruit trees are troublesome and obnoxious, and should not be allowed to cover up the bark. Winter washing is the most useful means of dealing with "weeds" of this class. Lime-wash may be applied in fine weather from January to March, but this is not so useful as a caustic soda wash. The latter (as used at the Woburn Experimental Fruit Farm) is prepared by mixing 6 lb. of caustic soda, 1½ lb. of soft soap, 2 gallons of paraffin, and 28 gallons of water in the following manner:—After dissolving the soft soap in 1 gallon of boiling water the paraffin should be added and the mixture thoroughly churned until a creamy emulsion is obtained. The caustic soda should then be dissolved in the remaining 27 gallons of water

¹ *Journal of Horticulture*, October 4, 1906.

² *Ibid.*, December 12, 1907.

and poured into the soft soap and paraffin emulsion. After a thorough churning the mixture should be applied to the trees at once by means of a spraying machine. Such a mixture as this effectively removes the Moss and Lichen from the bark of trees. It should be applied in fine weather between the middle of February and the end of March, when the trees are dormant—before the buds burst. This caustic soda wash not only removes Moss and Lichen, but aids largely in the suppression of insects and other enemies of fruit trees.

An improvement of the formula given above has been recommended by Mr. S. U. Pickering, F.R.S. (Director of the Woburn Experimental Fruit Farm), and the new wash suggested should consist of: Sulphate of iron, $\frac{1}{2}$ lb.; caustic soda, 2 lb.; lime, $\frac{1}{4}$ lb.; paraffin (solar distillate), 5 pints; and water to make up to 10 gallons. (See Eighth Report, Woburn Experimental Fruit Farm, 1908, p. 27.)

Care is needed in the application of washes containing caustic soda and other alkalis, as these substances have a deleterious or "burning" effect on the skin and also damage clothes. The hands should be protected with gloves (preferably made of rubber), and spraying should take place on a calm day when the "spray" will not blow on to the face and into the eyes of the operator. The eyes may be protected with goggles.

Ivy (*Hedera Helix* L.), which forms such an excellent and beautiful covering for unsightly walls, buildings, and houses, frequently occurs where it is not wanted, and becomes a weed which it is necessary to eradicate. This must be done by cutting down and removing as much of the Ivy as possible, grubbing out the roots, and thereafter regularly removing any new growths that may appear.

CHAPTER XI

PRINCIPLES OF SEED TESTING

OWING to the fact that weed seeds are regularly introduced to farms through the medium of agricultural seeds, the scientific examination or analysis of the latter is intimately connected with the eradication of weeds. The value of such examinations has of late years been fully recognised by all civilised countries, most of which now possess official seed-testing stations. The whole question dates from about 1869, when much information as to the dishonourable manner in which seeds were treated and sold was made public and freely discussed.

Seed-testing Stations.—It may serve a useful purpose to quote here a page from an article by Professor Johnson :¹—

“Although the credit of starting the first Seed-testing Station must be given to Nobbe, measures had been taken as long ago as 1816 in Switzerland to suppress fraud in the seed trade. Thus an inspector had the right of entry into a seed shop or warehouse for inspection of the seeds on sale, punishment following detection of fraud. In England in 1869 the Adulteration of Seeds Act was passed, making it penal to kill or dye seeds. The Royal Horticultural Society of England did much to expose the corruption which had crept into the seed trade. In its second Report

¹ *Science Progress*, Jan. 1907: “The Principles of Seed Testing,” by T. Johnson, D.Sc., Professor of Botany in the Royal College of Science, Dublin.

(*Farmers' Magazine*, February 1869), the Royal Horticultural Society Committee says: ' . . . Everything is thus thrown upon the honesty of the dealer. He fixes the prices, regulates the quality, and the purchaser is kept in the dark, and has no check upon either. This is a temptation beyond what the average frailty of human nature ought in fairness to be exposed. . . . One of the chief functions of the association (of wholesale seedsmen) is . . . the regulation of prices . . . and the determination as to what kinds of seeds should have their average lowered and to what extent it should be done.' With honourable exceptions, trade catalogues offered in addition to 'nett' or pure seed 'trio' seed, *i.e.* seed killed for admixture purposes! The Act of 1869 made the admixture of killed seed an offence, but did not provide machinery for the detection of the offence, as is now the case for artificial manures and feeding stuffs under the Fertilisers and Feeding Stuffs Act of 1893 (*now superseded by the Act of 1906*).

"The revelations of fraud and ignorance published in 1875 by Nobbe in his *Handbuch der Samenkunde* led to vigorous action, and Seed-testing Stations were started in nearly every country in the world, mostly under Government control. At the present time there are some 150."

Important Official Seed-testing Stations now exist in Ireland, Germany, Switzerland, France, Denmark, Hungary, the Netherlands, Belgium, the United States of America, Canada, New Zealand, the Australian Colonies, and the South African Colonies. The work done by these "Control" stations, as they are termed, is of the utmost importance, and of inestimable value to agriculturists, gardeners, and others.

A Departmental Committee was appointed by the Board of Agriculture in 1900 to inquire into the conditions under which agricultural seeds were then sold, and to report whether any further measures could with advantage be taken to secure the maintenance of adequate standards of purity and germinating capacity. The Committee recommended the establishment of one Central Seed-testing Station under Government auspices, with a practice and procedure to be laid down and revised from time to time by a small committee of experts. It was believed that the fees should be moderate and so fixed as to encourage seed-merchants to sell seeds subject to re-testing by the purchaser if desired. The recommendation was dissented from by two members of the Committee (Sir W. T. Thisleton Dyer, then Director of Kew Gardens, and Mr. L. G. Sutton), who considered that there was no strong case in favour of the establishment of such a station, while the results obtained from examination of samples might possibly be found to differ widely from the bulk, as to which no guarantee could be given. Both gentlemen urged strongly that the only satisfactory method of testing seeds lies in growing crops therefrom. No effect has been given to the recommendations of the Committee, and at the present time Great Britain does not possess a Government station, but seed examination is undertaken by the larger agricultural societies, farmers' clubs, agricultural colleges, and agricultural journals.

A Government Station had been established in Ireland prior to the appointment of the English Committee, and some thousands of samples have since been tested. (See also p. 411.)

In this connection it may be remarked that, according to a Board of Agriculture report,¹ the Board have

¹ *Annual Report, Intelligence Division, 1905, p. 36.*

no reason for supposing that the present law is inadequate to meet such cases of fraud as occur, but they deemed it advisable to put the following notice in their *Journal*:—

“The Board of Agriculture consider it desirable again to call the attention of purchasers of farm and garden seeds to the provision of the Adulteration of Seeds Acts of 1869 and 1878. Under these Acts it is a criminal offence to sell or cause to be sold any killed or dyed seed or to kill or dye or to cause to be killed or dyed any seeds. The term ‘to kill seeds’ means to destroy by artificial means the vitality or germinating powers of such seeds. The term ‘to dye seeds’ means to apply to seeds any process of colouring, dyeing, or sulphur smoking. Proceedings under these Acts against any person in respect of selling or causing to be sold any killed or dyed seeds must be commenced within twenty-one days from the time of the commission of the offence. Seeds for use on farms and market gardens should always be bought subject to a guarantee of genuineness and germination, and their germinating power should be tested to see whether the seeds come up to the standard guaranteed. The presence of dye or other colouring matter can mostly be detected by rubbing the seed in soft white paper or by washing a small quantity in water.”

The subject seemed of so much importance, however, that a further note was inserted in the Board’s *Journal* for July 1905, the following being extracted therefrom:—

“Seeds for use on farms and market gardens should always be bought subject to a guarantee for purity,

genuineness, and high germinating power. Purity may be taken to mean that the seeds composing the sample consist of the variety required without admixture of other seeds, or of sand, dirt, chaff, empty husks, &c. Impurity is mainly caused by carelessness in separating weed seeds from the bulk, and from want of care in cleaning and screening, and is one of the most important considerations in purchasing seeds, as impure seed is the cause not merely of a diminished yield, but is responsible for the spread of weeds. Farmers not infrequently make use of the sweepings of hay lofts, and thus encourage the reproduction of weeds, which, later in the season, require much labour to be prevented from choking the cultivated crop. . . .

“In addition to a guarantee of purity, a high percentage of germination should be demanded, and the germinating power of the seeds may usefully be tested to see whether they come up to the standard named.”

According to the report of the Seed Control Station at Zürich for 1908, no less than twenty-four British seedsmen have their seed scientifically examined at that station (Appendix V.). A glance at the catalogues of many of our best seedsmen will convince the purchaser that the seed sold by such business houses is eminently satisfactory, since it is sold under guarantee and subject to analysis by a recognised botanist. One or two statements by firms may usefully be given here. In the terms of guarantee of one firm it is stated that their seeds offered in the list “have been carefully grown, selected, cleaned, and repeatedly tested under our personal superintendence. We are therefore able to guarantee their analytical purity and high germination, and purchasers are invited to submit them immediately to the analysis of any public botanist, and to

return them to us at once if not approved by him. But it is impossible for us to undertake any responsibility, expressed or implied, as to description, purity, productiveness, or any other matter connected with the crop when the seed has been sown. Unless the goods are accepted on these terms they should be returned at once."

In the list of another firm of seed merchants we find the following statement:—"All the seeds offered in this catalogue are *warranted* pure and genuine, and the percentage of germination of each kind of seed is stated and *guaranteed*."

"All seeds are offered and sold subject to the analysis of the Consulting Botanists to the Royal Agricultural Society of England, and the Highland and Agricultural Society of Scotland; also of Dr. Stebler, Director of the Swiss Seed Control Station, Zürich.

"The germination of every parcel of seed offered in this catalogue has been repeatedly tested by the most perfect methods, and duplicate tests of all important lots of grasses and clovers have also been made by Dr. Stebler, of Zürich, whose official reports may be inspected by anyone interested.

"It will be understood that while all the seeds offered in this catalogue are *absolutely guaranteed* to be genuine, of the purest quality; and to possess the highest standard of germinating power, yet no guarantee is given beyond this, as the most perfect seeds may fail when the conditions of season, climate, or culture are unfavourable, and these matters are not under the control of the seller."

CASES SHOWING THE IMPORTANCE OF SEED-TESTING

In order to show conclusively that seed-testing is of immense service to farmers and gardeners, it may be

well to quote here a few cases in which expert examination has clearly demonstrated the worthless character of the seed concerned:—

1. At the first International Conference on Seed-testing held at Hamburg in 1906, Dr. Stebler of the Zürich Control Station quoted¹ a case which, he said, would give an idea of the unclean state of a clover sample. His table shows that in 550 grams (= 19.4 ozs.) of the sample, no less than 8478 seeds foreign to the sample were present. These seeds represented 39 species of plants, the majority being weeds; there were in fact 4500 seeds of *Plantago lanceolata*, 2240 of *Daucus Carota*, 1140 of *Cichorium Intybus*, 160 of *Prunella alba*, and 151 of *Cuscuta Trifolii* (Clover Dodder).

2. In the year 1906, 4779 samples of seeds were tested at the Royal Seed Control Station at Vienna,² and 1273 (= 26.6 per cent) were infested with Dodder; 996 out of 2789 samples of red clover (*Trifolium pratense*), or 35.5 per cent, were infested. The ten year average shows that 27.4 per cent of the red clover samples have contained Dodder.

3. Dodder is not so freely found in clover seed in Britain, but it is still too common. In 1905, for example, 11 per cent of the clover seed samples examined by the Botanist to the Royal Agricultural Society³ were condemned owing to the presence of Dodder seeds, two samples of red clover containing as much as 6 per cent.

4. "In some samples tested in the United States one which contained less than 1 per cent of impurity had about 3000 weed seeds to the pound; while in

¹ *Verhandlungen der 1. internationalen Konferenz für Samenprüfung zu Hamburg vom 10-14 Sept. 1906*, p. 15.

² *Organisation und Entwicklung der kaiserl. konigl. Samen-Kontrol Station in Wien vom Jahre 1881 bis inkl. 1906*, p. 23.

³ *Jour. R.A.S.E.*, 1905, p. 162.

another sample in which $2\frac{1}{2}$ per cent was spurious seed, there were more than 27,600 weed seeds. The number of weed seeds sown to the acre would be enormous, and having an equal chance with the crops among which they grew, might be the cause of considerable loss."¹

5. "The Board also communicated with Mr. D. D. Williams of the Department of Agriculture, Aberystwyth, who has acted as seed Analyst to County Councils in South Wales for several years. In order to make a thorough investigation, he wrote to a very large number of his past students for samples of seeds. Half the amount sent him was detained and analysed at the College, and the other half was sent to the Aynsome Seed-testing Station, Grange-over-Sands, in order to obtain independent opinion on the samples sent. Mr. Remington, the head of that institution, reported on the first five samples of red clover sent as follows":²—

Number.	Germination per Cent.	Purity per Cent.	No. of Weed Families represented.	Remarks.
1.	69	82	15	{ 22 per cent is Trefoil seed. { The sample has been oiled. { 19 per cent is Trefoil seed. { This sample is oiled. { Trefoil present; also 52 Dod- { der seeds in 5 grains. { This sample is oiled; 36 Dod- { der seeds in 5 grains. { Trefoil present, also Dodder.
2.	72	80	26	
3.	62	90	12	
4.	81	92	12	
5.	85	82	18	

6. According to the *Canadian Farmers' Advocate*,³ a chart supplied by the Department of Agriculture showed that in samples of seeds found on sale in Ontario from

¹ *Ann. Report. Intel. Div., Bd. Agric.*, 1905, p. 37.

² *Loc. cit.*, p. 36.

³ February 9, 1905.

6000 to 15,000 weed seeds were present in 1 lb. of what was being sold as red clover, and that in samples of alsike clover as many as 23,556 weed seeds were found in one case, and 49,830 in another. In the former case the sample, having only 72 per cent of pure seed, was priced at \$5.25 (= 21s. 10d.) per bushel, or equal to \$7.29 (= 30s. 4d.) per bushel for the good red clover seed it contained. In the latter case the sample priced at \$8.00 (= 33s. 4d.) per bushel, and containing only 48 per cent of good seed, would really cost \$16.66 (= 69s. 5d.) per bushel for the alsike. "These (says the *Advocate*) are startling figures, and though those quoted may be extreme cases, all will readily agree that if the average sample is one-twentieth as bad in this respect, the condition is truly alarming."

7. In the United States of America clover seed tailings are sometimes used on the farm, the clean seed being sent to market. Such tailings have been found to contain nearly 272,500 weed seeds per pound. A sample of clover seed offered on the Chicago market about 1898, for 2 cents a pound, contained about 338,300 weed seeds per pound, or more than 20 millions per bushel.¹

8. The *Bulletin* referred to in the last paragraph calls attention to a point worthy of earnest attention, for it is a point frequently overlooked. "Some samples of seed contain such a small amount (of weed seeds) that they would be considered practically pure, but even in these the number of weed seeds in a pound is surprisingly large. In one sample that contained in all only one-fifth of 1 per cent of spurious seeds, the number of weed seeds per pound averaged about 990. In a bushel of 60 pounds there were, therefore, more than 59,000 weed seeds." It is quite clear that very small

¹ U.S. Dept. Agric., *Farmers' Bulletin*, No. 111, 1900, p. 9.

percentages of impurity may lead to disastrous consequences for the farmer who sows the seeds.

9. An American sample of lucerne seed was found to contain 6.8 per cent of weed seeds, or nearly 32,500 per pound, no less than 5490 being Dodder.¹

10. A question as to the adulteration of seeds was asked in the House of Commons in 1904, and was answered by the President of the Board of Agriculture. "Mr. Spear, having asked what recent cases of adulteration or misrepresentation in the sale of farm seeds had been brought to his notice, and whether he had considered the advisability of some amendment in or addition to the law as it now stands for the better protection of agriculturists and honest seed merchants, Mr. Fellowes replies: 'A case in which certain foreign seed was sold as English clover was recently brought under the notice of the Board. Proceedings were instituted under the Merchandise Marks Acts, and the vendor was fined £10, with 6s. Court fees and £21 towards the cost of the prosecution. This result goes to confirm the conclusion arrived at by the Departmental Committee of 1900, who expressed the opinion that there is no practical difficulty under the existing law in the way of obtaining thoroughly good and reliable seeds by those who know how to set about it; but we shall be very happy to give full consideration to any representations or suggestions which may be made to us on the subject.'"²

The foregoing examples are but a few of hundreds which could be cited to indicate the extent to which farm seeds may be worthless, and the consequent necessity for seed testing.

¹ U.S. Dept. Agric., *Farmers' Bulletin*, No. 194, 1900, p. 13.

² *The Times*, May 19, 1904.

SEED TESTING FOR FARMERS

A scientific account of the whole system of seed testing cannot be given in a work of this character, which is intended chiefly for the use of farmers, gardeners, and others. It will be sufficient for our present purpose to indicate the main principles involved in testing the general quality of farm and garden seeds.

It may be first pointed out that a complete analysis and test of a seed sample should show :—

1. Whether the seed is true to name.
2. The degree of purity of the seed, *i.e.* whether it is nearly all pure seed, or contains a large percentage of weed seeds, rubbish, or seeds of a species not wanted.
3. The germinating capacity of the seed, or its capacity to germinate and produce strong plants under suitable conditions.
4. The origin of the seed, *i.e.* whether home grown or foreign, though it may not always be possible to ascertain this.
5. Whether the seeds are harbouring injurious fungi which may produce a diseased crop ; and
6. Whether the seeds are old, and have been oiled or otherwise treated to give them the appearance of being good seed.

If seeds are found to contain much impurity, to have not as high a germinating capacity as is consistent with the species, or to be otherwise not up to a high standard, they should be immediately rejected. Only reputable firms who give some adequate guarantee with their seeds should be dealt with. Further, farmers and gardeners are strongly recommended not to hesitate to purchase the best seed, which is always more economical and profitable in the long run, even at a much higher price, than a low-priced seed of doubtful quality, for the latter

entails much trouble, waste of time, and loss of crop. When any suspicion attaches to the seed under consideration it is the best policy to leave it alone. Firms who have once been found to seek an unholy profit by oiling old clover seed, by mixing rape or dead Charlock seed with turnip seed, or trefoil with lucerne or red clover, or meadow fescue with ryegrass, &c., or are guilty of any act of adulteration, should be avoided as unworthy of further confidence.

Purity and germinating capacity of agricultural seeds are often closely related to the quantity of weeds which are found among crops. If the seed samples contain weed seeds, or if the seed partly fails to germinate, there will be fewer cultivated plants in the soil, and hence more room and greater opportunity for weeds to increase and flourish.

Taking a Sample.—The first thing to be done in testing a quantity of seed is to take a representative sample. For taking official samples various institutions have their own rules, and many instruments have been designed for the purpose of obtaining reliable samples. In order to indicate the general principle it will suffice here to give the rules generally adopted.

The seed to be tested should be drawn with a seed sampler if possible, in order to obtain a sample representative of the whole bulk. Small lots should be taken from the top, middle, and bottom of each bag.

The separate lots must be mixed thoroughly together and divided into three parts, one of which is retained by the merchant, while the other two are forwarded to the Seed-testing Station; of the latter, one is used for obtaining the germinating capacity and other points of the sample, and the other is kept for future reference in case of dispute.

Samples taken by merchants, as well as those taken

by farmers, for analysis by competent botanists, should if possible be taken in the presence of witnesses. For the farmer's own tests it is sufficient, however, to remove a handful from the centre of each of the several bags purchased, and, after mixing these lots, a small quantity of the mixture may be taken for the test.

For official samples 2 oz. of the smaller seeds, such as grasses, clovers, turnip, rape, carrot, flax, and parsley, will suffice. Of the larger seeds, such as mangel, sainfoin, hemp, elm, larch, and beech, about 4 oz. samples should be taken ; while of the cereal grains, vetch, peas, beans, acorns, &c., double the latter quantity is required.

The Purity Test for Farmers.—It may be said at once that the average farmer or gardener will only be able to carry out the purity test very roughly, very few being able to recognise the different weed seeds found in the various classes of agricultural seeds. Having obtained a representative sample, however, it should be carefully weighed, after which all the seeds which are true to name should be separated out, for which purpose the sample may be spread on a large sheet of white paper and sorted out with the blade of a pocket-knife. This being done, the balance, consisting of dust, rubbish, and weed seeds is the *impurity*. A further weighing will give its amount, when the percentage of pure seed may be calculated. For ascertaining the purity a small chemical or spring balance will be necessary in order that accurate weighings may be made. The ordinary "purity" of many seeds is given at p. 371.

The Germinating Test for Farmers.—Having removed the rubbish, weed seeds, and other impurities from the sample, and ascertained the purity, 200 to 400 of the pure seeds are now taken and separated into two equal lots. Each of these lots of 100 or 200 is then placed between a folded piece of damp blotting-

paper or flannel (the latter should be washed, and, after soaking in tepid water, squeezed sharply), and finally deposited on an unglazed earthenware saucer, stood in a shallow plate or other vessel of water, and covered with a similar porous saucer. A useful seed-testing vessel is that shown in Fig. 103 ; this may be covered



Photo, 1909.

H. C. Long.

FIG. 103.—Seed-testing Vessel, of porous ware, with cover (perforations in cover not shown).

with a perforated cover or with a glass disc, and is stood in a shallow saucer of water. Seeds so treated and placed in a moderately warm room will, if of good quality, germinate readily. (For the periods necessary for germination see p. 371.) The seeds must not be too close together ; saucers of different sizes are used generally according to the size of the seeds to be tested. It will be found that thin, apparently empty seeds do not germinate at all, and very old seed germinates very irregularly or not at all. With high-class well-filled seeds, germination is regular and

spread over a short period from the day the first sprouting is observed.

Care must be taken that the "seed-bed" (blotting-paper or flannel) is kept moist, and each species should be allowed the times mentioned at p. 371 in which to germinate. The seeds which germinate strongly may be removed from day to day and the number noted. The average of not less than two separate lots of seed should be obtained. The germinating capacities to be expected from good samples of farm seeds are given at p. 371.

True Value of Seed.—It is clear that if the sample under consideration is very impure the germinating capacity alone may give but a very inadequate idea of the value of the seed. It is therefore necessary to consider the two points together, and ascertain the combined percentage value of purity and germinating capacity. This may be done as follows:—Suppose P is the percentage of purity, G the germinating capacity, and T the true or real value of the seed. Then

$$\frac{P \times G}{100} = T.$$

For example, if the purity be 95 per cent and the germinating capacity 80 per cent, then we have

$$T = \frac{95 \times 80}{100} = 76.$$

In other words, such a sample would contain no more than 76 lb. of good seed in every 100 lb. purchased; or, to put it another way, there will be a loss of 24s. on every £5 worth of seed. At the same time, if the 5 per cent of impurity consists of weed seeds, great trouble may be entailed by using the seed on the farm.

Although the foregoing brief account is given to enable the farmer or gardener to make rough tests for his own satisfaction at home, we still believe it will, in general, be wiser for the average purchaser to submit samples for expert opinion. There are, however, a number of well-known firms whose seeds may be absolutely relied on to be what they profess.

WEED SEEDS IN COMMERCIAL SAMPLES OF CLOVER AND GRASS SEEDS

As already pointed out, many weeds gain access to the farm in impurities in commercial samples of red, white, and alsike clovers, kidney vetch, lucerne, ryegrass, timothy and other grasses used for sowing down temporary pastures.

Many farm seeds of this class are harvested from unclean land, or gathered by hand by women and children who have no very special incentive to gather the right kind of seed exclusively. On this account there is necessity for thorough cleaning operations, which should be carried out when the sample reaches the seedsman. Unfortunately farmers do not exercise all the care which they might in the purchase of their seeds, and they are not infrequently offered, by irresponsible persons, samples of clovers and ryegrass which have not been through suitable machinery, which would clear out all objectionable weed seeds.

The only way to deal with trouble of this kind is to purchase direct from seedsmen who have properly equipped establishments in which their wares can be thoroughly cleaned, and whose reputation for a good article is worthy of being maintained.

The plants whose seeds are most commonly found among farm seeds are given below. With proper

handling, however, few of them should appear in well-cleaned samples.

In Samples of Clovers

Ranunculus acris	Chrysanthemum Leucanthemum
" repens	" segetum
Papaver Rhœas	Cnicus arvensis
" dubium	Centaurea Cyanus
Fumaria officinalis	Lapsana communis
Sisymbrium officinale	Cichorium Intybus
Barbarea vulgaris	Sonchus oleraceus
Thlaspi arvense	" asper
Lepidium campestre	Crepis virens
Capsella Bursa-Pastoris	Cuscuta Trifolii
Viola tricolor	" europæa
Reseda lutea	" racemosa
Silene inflata	" chilensis
Arenaria serpyllifolia	Echium vulgare
Cerastium triviale	Hyoscyamus niger
Stellaria graminea	Linaria spuria
" media	" officinalis
Geranium pusillum	" arvensis
" dissectum	Euphrasia officinalis
" molle	Calamintha Acinos
Melilotus officinalis	Stachys arvensis
" alba	Prunella vulgaris
Trifolium arvense	Anagallis arvensis
" procumbens	Plantago major
" minus	" lanceolata
Lotus corniculatus	Chenopodium album
" major	Atriplex patula
Scleranthus annuus	Rumex crispus
Torilis Anthriscus	" Acetosella
Anthriscus sylvestris	" Acetosa
Daucus Carota	Polygonum lapathifolium
Sherardia arvensis	" Persicaria
Galium Aparine	" Aviculare
Knautia arvensis	" Convolvulus
Anthemis arvensis	Carex, sp.
Matricaria inodora	

It may be noted here that certain of these plants are not dealt with in this volume.

*In Samples of Grass Seeds*THE SMALLER SEEDS MOSTLY IN TIMOTHY AND
OTHER SMALL-SEEDED SPECIES

Ranunculus acris	Hypochæris radicata
„ repens	Sonchus oleraceus
Capsella Bursa-Pastoris	Crepis virens
Viola tricolor	Euphrasia officinalis
Lychnis Flos-cuculi	Prunella vulgaris
Arenaria serpyllifolia	Plantago major
Stellaria graminea	„ lanceolata
„ media	Chenopodium album
Geranium dissectum	Rumex crispus
„ pusillum	„ Acetosella
Trifolium procumbens	„ Acetosa
Scleranthus annuus	Polygonum lapathifolium
Anthriscus sylvestris	Carex sp.
Galium Aparine	Agrostis Spica-venti
Knautia arvensis	Festuca myurus
Anthemis arvensis	Molinia cærulea
Chrysanthemum segetum	Bromus secalinus
„ Leucanthemum	Triticum repens
Cnicus arvensis	Lolium temulentum
Centaurea Cyanus	Nardus stricta
Lapsana communis	Aira caryophyllæa
Leontodon autumnalis	„ flexuosa

It may be noted here that certain of these plants are not dealt with in this volume.

Illustrations of seventy-six species of weed seeds are shown in three Plates in Appendix I.

A reference collection of weed seeds embracing over 200 species found in commercial samples of clovers is issued by Professor J. Percival, M.A., University College, Reading.

Farm Seeds

USUAL PURITY AND GERMINATING CAPACITY

	Purity (per cent).	Germinating capacity (per cent).	Aver. time in which seeds germinate.* Days.
Cabbage	96-98	90-95	2
Swede Turnip	"	"	"
White "	"	"	"
Black Mustard	"	85-90	"
White "	98	95	"
Lucerne	96-98	92-98	3
Yellow Trefoil	"	90-95	"
Crimson Clover	90-95	90-95	"
Red "	98	95-98	"
Alsike "	98	"	"
White "	98	"	"
Kidney Vetch	95	"	"
Bird's-foot Clover	98	95	"
Sainfoin	98-100	90	4-6
Carrot	95	70	6
Parsnip	95	60	"
Mangold (fruits).	98-100	125	"
Buckwheat	"	85	4
Sweet Vernal Grass	96	60	5
Meadow Foxtail	96	75-80	6
Timothy	98	90	4
Golden Oat Grass	98	60-70	5
Tall " "	98	90	"
Crested Dogstail	96	80	"
Cocksfoot	98	80-90	7
Smooth-stalked Meadow-grass	98	60-70	"
Rough " " "	"	"	"
Meadow Fescue	98	90-95	5
Hard Fescue	96	70-80	7
Sheep's Fescue	"	"	"
Perennial Ryegrass	98-100	95	5
Italian "	"	"	"

* These figures refer to "energy of germination," or the speed at which high-class samples germinate. In order to complete a test of germinating capacity, however, up to ten days should be allowed in the case of the first thirteen species in the list, and up to fourteen days for the rest, except *Poas*, for which a month should be allowed.

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APPENDICES

APPENDIX I

ILLUSTRATIONS OF WEED SEEDS. PLATE I.

ALL seeds on this plate, except Nos. 4, 8, 18, and 20, are shown natural size, and in two positions magnified. The four specified are shown natural size, and in only one position magnified.

1. Acrid Buttercup (*Ranunculus acris* L.).
2. Creeping Buttercup (*R. repens* L.).
3. Corn or Field Buttercup (*R. arvensis* L.).
4. Common Scarlet Poppy (*Papaver Rhæas* L.).
5. Charlock (*Sinapis arvensis* L.).
6. Shepherd's Purse (*Capsella Bursa-Pastoris* DC.).
7. Field Pepperwort (*Lepidium campestre* Br.).
8. Penny Cress (*Thlaspi arvense* L.).
9. Wild Radish, White Charlock (*Raphanus Raphanistrum* L.).
10. Corn Pansy (*Viola tricolor* L.).
11. Bladder Campion (*Silene inflata* Sm.).
12. White or Evening Campion (*Lychnis vespertina* Sibth.).
13. Corn Cockle (*Agrostemma Githago* L.).
14. Mouse-ear Chickweed (*Cerastium triviale* Link.).
15. Chickweed (*Stellaria media* L.).
16. Spurrey (*Spergula arvensis* L.).
17. Dove's-foot Crane's-bill (*Geranium molle* L.).
18. Cut-leaved Crane's-bill (*G. dissectum* L.).
19. Rest Harrow (*Ononis spinosa* L.).
20. Tufted Vetch (*Vicia Cracca* L.).
21. Silver-weed (*Potentilla Anserina* L.).
22. Salad Burnet (*Poterium Sanguisorba* L.).
23. Wild Carrot (*Daucus Carota* L.).
24. Cleavers (*Galium Aparine* L.).

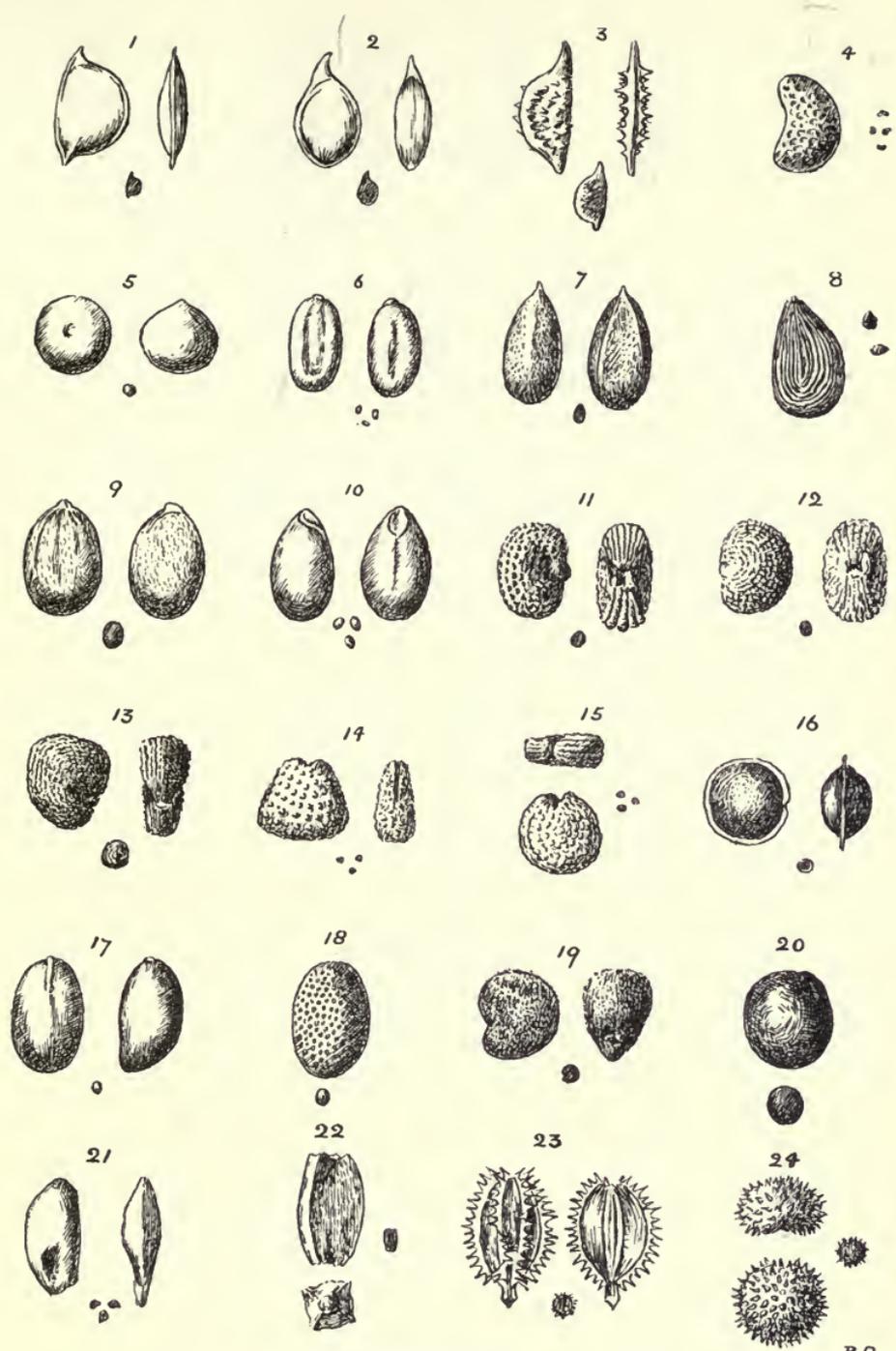


PLATE I.—WEED SEEDS.

B.R.

ILLUSTRATIONS OF WEED SEEDS. PLATE II.

All the seeds on this plate are shown natural size, and in one or two positions magnified.

25. Field Madder (*Sherardia arvensis* L.).
26. Field Scabious (*Scabiosa arvensis* L.).
27. Cudweed (*Gnaphalium sylvaticum* L.).
28. Stinking Mayweed (*Anthemis Cotula* L.).
29. Scentless Mayweed (*Matricaria inodora* L.).
30. Corn Marigold (*Chrysanthemum segetum* L.).
31. Ox-eye Daisy (*C. Leucanthemum* L.).
32. Coltsfoot (*Tussilago Farfara* L.).
33. Groundsel (*Senecio vulgaris* L.).
34. Ragwort (*S. Jacobæa* L.).
35. Burdock (*Arctium Lappa* L.).
36. Knapweed (*Centaurea nigra* L.).
37. Cornflower (*C. Cyanus* L.).
38. Spear Thistle (*Cnicus lanceolatus* Hoffm.).
39. Creeping Thistle (*C. arvensis* Hoffm.).
40. Nipplewort (*Lapsana communis* L.).
41. Dandelion (*Taraxacum officinale* Web.).
42. Cat's-ear (*Hypochæris radicata* L.).
43. Perennial or Corn Sow Thistle (*Sonchus arvensis* L.).
44. Chicory (*Cichorium Intybus* L.).
45. Autumn Hawkbit (*Leontodon autumnalis* L.).
46. Scarlet Pimpernel (*Anagallis arvensis* L.).
47. Viper's Bugloss (*Echium vulgare* L.).
48. Corn Gromwell (*Lithospermum arvense* L.).
49. Field Forget-me-not (*Myosotis arvensis* Hoffm.).
50. Field Convolvulus, Small Bindweed (*Convolvulus arvensis* L.).
51. Clover Dodder (*Cuscuta Trifolii* Bab.).
52. Dodder (*C. racemosa* Mart.).



B.R

PLATE II.—WEED SEEDS.

ILLUSTRATIONS OF WEED SEEDS. PLATE III.

All the seeds on this plate are shown natural size, and in one or two positions magnified.

53. Ribwort Plantain (*Plantago lanceolata* L.).
54. Broad-leaved Plantain (*P. major* L.).
55. Yellow Toadflax (*Linaria vulgaris* Mill.).
56. Eyebright (*Euphrasia officinalis* L.).
57. (Wall) Speedwell (*Veronica arvensis* L.).
58. Yellow Rattle (*Rhinanthus Crista-galli* L.).
59. Broom-rape (*Orobanche minor* Sutt.).
60. Self-heal (*Prunella vulgaris* L.).
61. Annual Knawel (*Scleranthus annuus* L.).
62. Goosefoot, Fat Hen (*Chenopodium album* L.).
63. Spreading Orache (*Atriplex patula* L.).
64. Knotgrass (*Polygonum Aviculare* L.).
65. Persicaria, Redshank (*P. Persicaria* L.).
66. Curled Dock (*Rumex crispus* L.).
67. Sheep's Sorrel (*R. Acetosella* L.).
68. Wild Onion (*Allium vineale* L.).
69. Slender Foxtail (*Alopecurus agrestis* L.).
70. Fine Bent-grass, Black Couch (*Agrostis vulgaris* With.).
71. Yorkshire Fog (*Holcus lanatus* L.).
72. Wild Oat (*Avena fatua* L.).
73. Soft Brome Grass (*Bromus mollis* L.).
74. Darnel (*Lolium temulentum* L.).
75. Tufted Hair-grass (*Aira cæspitosa* L.).
76. Couch (*Triticum repens* L.).

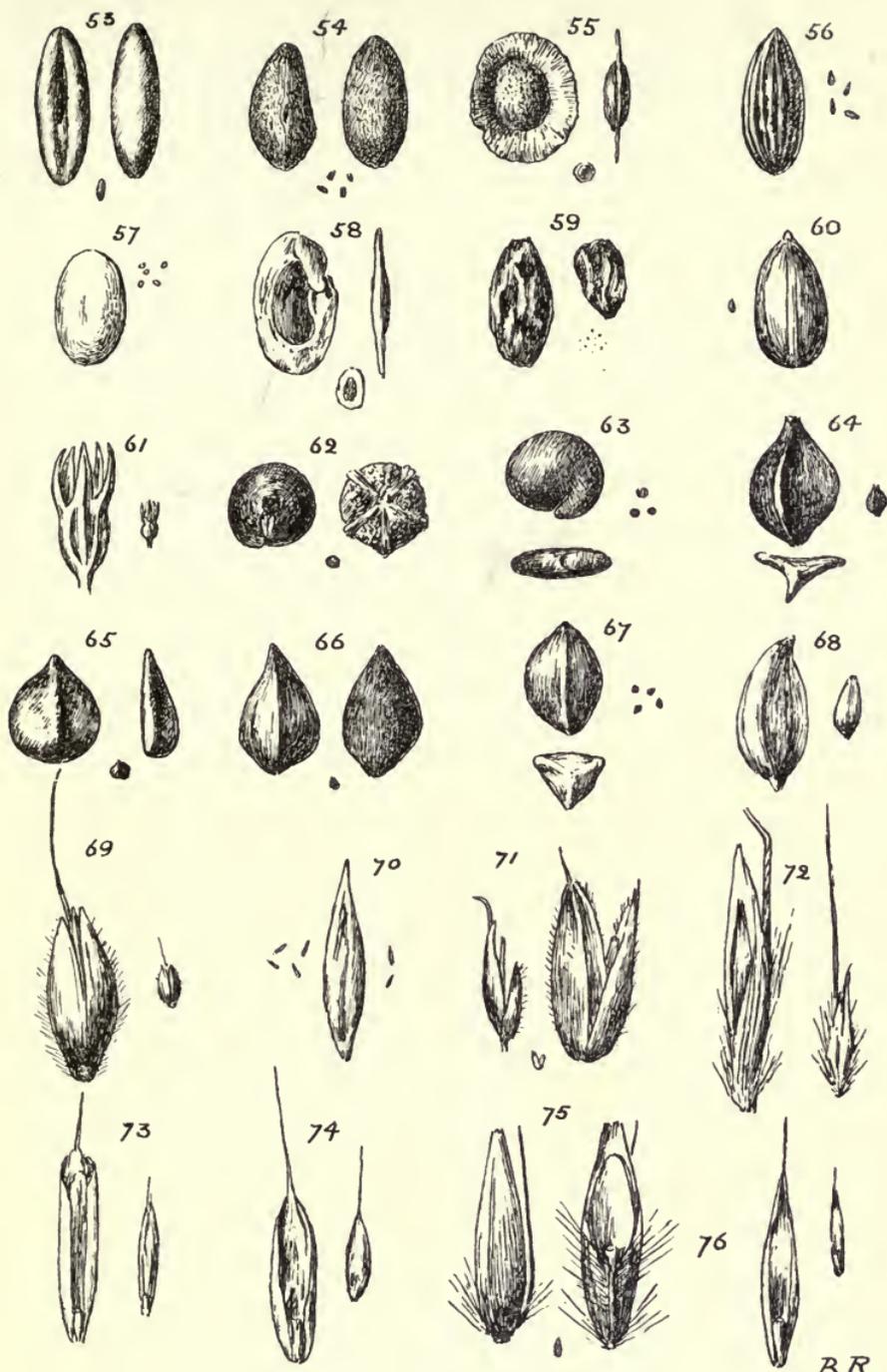


PLATE III.—WEED SEEDS.

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APPENDIX II

LIST OF "WEEDS" AND "POISONOUS PLANTS"

NOTE.—Plants marked * are especially important. The soils given are those on which each weed is found chiefly prevalent.

No.	Order. Specific Name.	Common Name.	Soil.	Situation.	Time of Flowering.	Method of Propa- gation.	Annual (A.) or Peren- nial (P.).	Referred to at Page	No.
1	Ranunculaceæ <i>Clematis Vitalba</i> L.	Traveller's Joy, Old Man's Beard	Chiefly chalk	Hedges	July-Aug.	...	P.	151	1
2	<i>Thalictrum flavum</i> L.	Meadow Rue	...	Wet meadows, &c.	July-Aug.	Seeds and creeping rootstock	P.	152	2
3	<i>Anemone Pulsatilla</i> L.	Pasque Flower	Chalk, lime- stone	Chalk downs and limestone pas- tures	May-June	Seeds	P.	...	3
4	<i>Anemone nemorosa</i> L.	Wood Anemone	...	Woods and copses	April-May	Seeds and root- stock	P.	280	4
5	<i>Myosurus minimus</i> L.	Mousetail	...	Damp cornfields	April-June	Seeds	A.	50	5
6	<i>Ranunculus Lingua</i> L.	Spearwort	...	Marshes and ditches	July-Sept.	Seeds	P.	325	6
7	<i>R. fluitans</i> Fries.; <i>R. fluitans</i> Lamk.	Water Crowfoot	...	Ponds, ditches, &c.	May-Aug.	...	P.	325	7
8	<i>R. Flammula</i> L.	Lesser Spearwort	...	Wet places	June-Aug.	Seeds and by creeping Seeds	P.	279	8
9*	<i>R. sceleratus</i> L.	Celery-leaved Crowfoot	...	Ditches and wet places	May-Sept.		A.	279	9

10	<i>R. aquatilis</i> L.	Water Crowfoot	Nearly all	Ponds and ditches	May-Aug.	P.	...	10
11*	<i>R. acris</i> L.	(Acrid) Buttercup	...	Meadows and pastures	April-Sept.	P.	152, 279	11
12*	<i>R. repens</i> L.	Creeping Buttercup	...	Meadows and pastures, arable land	May-Aug.	P.	50, 153	12
13*	<i>R. bulbosus</i> L.	Bulbous Buttercup	Calcareous loams	Meadows and pastures	May-June	P.	152, 279	13
14*	<i>R. arvensis</i> L.	Corn or Field Buttercup	All	Cornfields	May-July	A.	52	14
15	<i>R. Ficaria</i> L.	Lesser Celandine, Pilewort	...	Pastures, waste places, hedge banks	March-May	P.	153, 280	15
16	<i>Helleborus viridis</i> L.	Bear's Foot, Green Hellebore	Chiefly chalk or limestone	Woods, hedges, &c.	March-April	P.	"	16
17	<i>H. fetidus</i> L.	Stinking Hellebore	Chalk and limestone	Pastures and thickets	Feb.-April	P.	"	17
18	<i>Delphinium Ajacis</i> Reich.	Larkspur	...	Cornfields (local)	June-July	A.	"	18
19	<i>Aconitum Napellus</i> L.	Monkshood, Wolfsbane	...	Shady places, near streams, &c.	July-Sept.	P.	276	19
20	<i>Caltha palustris</i> L.	Marsh Marigold	...	Marshes and ditches	Mar-chMay	P.	325	20
21*	Papaveraceæ <i>Papaver dubium</i> L.	Long Smooth-headed Poppy	Calcareous	Cornfields	May-July	A.	53	21
22*	<i>P. Rheas</i> L.	Common Scarlet Poppy, Corn Rose	Nearly all soils	Cornfields	June-Aug.	A.	53, 281	22
23	<i>Chelidonium majus</i> L.	Celandine	...	Hedgerows and waste places	May-Aug.	P.	282	23
24	Berberidaceæ <i>Berberis vulgaris</i> L.	Barberry	...	Copses and hedges	May-June	P.	155	24

LIST OF "WEEDS" AND "POISONOUS PLANTS"—Continued

No.	Order. Specific Name.	Common Name.	Soil.	Situation.	Time of Flowering.	Method of Propagation.	Annual (A) Biennial (B) or Perennial (P.).	Referred to at Page	No.
25*	Fumariaceæ <i>Fumaria officinalis</i> L.	Common Fumitory	Light sandy and loamy soils	Cornfields and waste places	May-Sept.	Seeds	A.	57	25
26	Nymphæaceæ <i>Nuphar luteum</i> L.	Yellow Water-lily, Brandy-bottle	...	Still waters	June-Aug.	Creeping root-stock, seeds	P.	325	26
27	<i>Nymphaea alba</i> L.	White Water-lily	...	Ponds, lakes, slow streams	June-Aug.	Fleshy root-stock, seeds	P.	326	27
28	Cruciferae <i>Cardamine pratensis</i> L.	Lady's Smock, Cuckoo Flower, Bitter Cresses	...	Moist meadows and pastures	April-June	Seeds and roots	P.	156	28
29	<i>Sisymbrium officinale</i> L.	Hedge Mustard	Sandy, loamy, and calcareous	Banks, waste places	June-July	Seeds	A.	58	29
30	<i>S. Alliaria</i> L.	Garlic Mustard, Sauce-alone, Jack-by-the-Hedge	Clays and the heavier soils	Hedge banks, &c.	April-June	Seeds	A.	"	30
31*	<i>Sinapis arvensis</i> L.	Charlock, Kedge, Wild Mustard, Skellock	All soils	Arable land (ubiquitous)	May-Aug.	Seeds	A.	58, 283	31
32	<i>Brassica campestris</i> L.	Navev	All soils	Arable land	June-Sept.	Seeds	A.	...	32
33	<i>B. Rapa</i> L.	Wild Turnip	Do.	Do.	Do.	Seeds	A.	...	33
34	<i>Camelina sativa</i> L.	Gold of Pleasure	...	Flax fields— escape from cultivation	June-July	Seeds	A.	63	34

35*	<i>Capsella Bursa-</i> <i>Pastoris</i> DC.	Shepherd's Purse	All	...	Arable land (ubi- quitous)	Mar.-Nov.	Seeds	A.	63	35
36*	<i>Lepidium campestre</i> Bt.	Field Pepperwort	...	...	Arable land, road- sides	April-Aug.	Seeds	A. or B.	65	36
37	<i>L. Draba</i> L.	Pepperwort	...	...	Do.	May-June	Seeds	P.	66	37
38*	<i>Thlaspi arvense</i> L.	Penny Cress, Mithridate Mus- tard	...	...	Arable land	May-July	Seeds	A.	„	38
39	<i>Iberis amara</i> L.	Candytuft	Dry, chalky	...	Cornfields	July-Aug.	Seeds	A.	67	39
40*	<i>Raphanus Rapa-</i> <i>nistrum</i> L.	Wild Radish, White Charlock	All	...	Arable land, corn- fields	May-Sept.	Seeds	A.	62	40
41	<i>R. microcarpus</i> Willk.	Closely resembling White Charlock	...	...	Arable land, corn- fields (uncom- mon)	May-Sept. (?)	Seeds	A.	„	41
42	<i>R. sativus</i> L., var. <i>oleifer</i> DC.	White Charlock	...	...	Arable and waste land	June-Sept.	Seeds	A. or B.	68	42
43*	Violaceæ <i>Viola tricolor</i> L. (and sub-species)	Heart's-ease, Corn Pansy	All	...	Waste places, pastures, corn- fields	May-Sept.	Seeds	A.	„	43
44*	Caryophyllaceæ <i>Silene inflata</i> Sm.	Bladder Campion, White-Bottle	All	...	Waste places, cornfields, mea- dows	June-Aug.	Seeds	P.	69	44
45	<i>Lychnis Flos-cuculi</i> L.	Ragged Robin	...	...	Moist pastures	May-June	Seeds	P.	156	45
46	<i>L. diurna</i> Sibth.	Red Campion	...	...	Hedgerows, mea- dows, arable land	June-July	Seeds	P.	69	46
47*	<i>L. vespertina</i> Sibth.	White or Evening Campion	Sandy	...	Arable land (espe- cially cornfields), hedgerows, mea- dows, &c.	June-Sept.	Seeds	B. or P.	„	47

LIST OF "WEEDS" AND "POISONOUS PLANTS"—Continued

No.	Order. Specific Name.	Common Name.	Soil.	Situation.	Time of Flowering.	Method of Propagation.	Annual (A.) Biennial (B.) or Perennial (P.).	Referred to at Page	No.
	Caryophyllaceæ								
	—Continued								
48*	<i>Agrostemma Githago</i> L.	Corn Cockle	Sandy, clays, and loams	Cornfields	June-Aug.	Seeds	A.	69, 283	48
49*	<i>Cerastium triviale</i> Link.	Mouse-ear weed	All	Arable land, meadows, and pastures	April-Aug.	...	[B.or]P.	69, 156	49
50	<i>C. arvense</i> L.	Do.	Sandy	Arable land	April-Aug.	Seeds	P.	69	50
51*	<i>Stellaria media</i> L.	Chickweed	All	Arable land	March-Oct.	Seeds	A.	70	51
52	<i>Arenaria tenuifolia</i> L.	Sandwort	Sandy	Fields and waste places (uncommon)	May-Aug.	Seeds	A	71	52
53	<i>A. serpyllifolia</i> L.	Thyme-leaved Sandwort	...	Dry places, cornfields	June-Aug.	Seeds	A.	"	53
54*	<i>Spergula arvensis</i> L.	Spurrey, Corn Spurrey	All	Cornfields	June-Aug.	Seeds	A.	"	54
55*	Illecebraceæ <i>Scleranthus annuus</i> L.	Annual Knawel	Sandy	Arable land	June-Sept.	Seeds	[A.or]B.	75	55
56	Malvaceæ <i>Malva sylvestris</i> L.	Common Mallow	...	Damp meadows, &c.	June-Sept.	...	B. or P.	158	56
57	Linaceæ <i>Linum catharticum</i> L.	Bitter or Purging Flax	Light, cal- careous	Pastures and meadows	June-Aug.	Seeds	A.	"	57

58	Geraniaceæ <i>Geranium pratense</i> L.	Meadow Crane's-bill	...	Moist meadows and pastures	June-Sept.	...	P.	159	58
59*	<i>G. molle</i> L.	Sandy, loamy, calcareous	...	Arable and grass land	May-Sept.	Seeds	A. or B.	77, 159	59
60*	<i>G. dissectum</i> L.	As the last	...	Arable land, hedges, waste places	May-Aug.	Seeds	A. or B.	77	60
61	<i>G. Robertianum</i> L.	Loams, clays, calcareous	...	Hedges, arable land	May-Sept.	Seeds	A. or B.	78	61
62	<i>Oxalis Acetosella</i> L.	...	...	Woods and shady places	April-Aug.	Seeds and creeping root-stock	P.	...	62
63	Celastraceæ <i>Euonymus europæus</i> L.	Spindle Tree	...	Copses and hedges	May-June	...	P.	288	63
64	Rhamnææ <i>Rhamnus catharticus</i> L.	Buckthorn	Chiefly on chalk	Woods and thickets	May-July	...	P.	"	64
65*	Leguminosæ <i>Genista tinctoria</i> L.	Dyer's Green-weed	Clays	Pastures and meadows	July-Sept.	...	P.	159	65
66	<i>Ulex europæus</i> L.	Gorse, Whin, Furze	Poor sands and gravels	Stony and sandy fields, commons, &c.	Feb.-May and Aug.-Sept.	Seeds	P.	161	66
67	<i>Cytisus Laburnum</i> L.	Laburnum	...	...	May-June	...	P.	292	67
68	<i>C. scoparius</i> Link.	Broom	Poor sandy soil	Heaths, commons, stony and sandy fields	May-June	Seeds	P.	161	68
69*	<i>Ononis spinosa</i> L.	Rest Harrow	Poor, heavy and dry, sandy or gravelly soils	Arable and grass land	June-Sept.	Seeds and creeping root-stock	P.	163	69

LIST OF "WEEDS" AND "POISONOUS PLANTS"—Continued

No.	Order. Specific Name.	Common Name.	Soil.	Situation.	Time of Flowering.	Method of Propa- gation.	Annual (A), Biennial (B), or Peren- nial (P.).	Referred to at Page	No.
	Leguminosæ —Continued								
70	<i>Lathyrus</i> sp.	Indian Tares	...	...	...	...	...	289	70
71	<i>Lupinus</i> sp.	Lupins	...	...	...	...	...	"	71
72*	<i>Phaseolus lunatus</i>	"Java" Beans	...	...	...	...	...	290	72
	Rosaceæ								
73	<i>Prunus lauro-cerasus</i> L.	Cherry Laurel, a common ever-green shrub	...	...	...	...	P.	292	73
74	<i>Spiræa Ulmaria</i> L.	Queen of the Meadow, Meadow-sweet	...	Meadows and damp places	June-Aug.	...	P.	163	74
75	<i>Rubus fruticosus</i> L.	Blackberry, Bramble	All	Hedges and waste places	July-Sept.	...	P.	164	75
76	<i>Geum urbanum</i> L.	Wood Avenas, Herb Benet	...	Hedge banks, borders of fields	June-Aug.	...	P.	"	76
77*	<i>Potentilla Anserina</i> L.	Silver-weed, Goose Grass	All	Arable land, roadsides, meadows	June-Aug.	Seeds and by runners	P.	78	77
78*	<i>P. reptans</i> L.	Creeping Cinquefoil	All	Arable land, roadsides, and meadows	June-Aug.	Seeds and by runners	P.	79, 164	78
79	<i>P. Tormentilla</i> Sibth.	Tormentil	All	Pastures and meadows	June-Sept.	...	P.	165	79
80	<i>Alchemilla arvensis</i> Lamk.	Parsley Piert, Field Lady's Mantle	Dry loams and calcareous soils	Cornfields	May-Aug.	Seeds	A.	80	80
81	<i>A. vulgaris</i> L.	Common Lady's Mantle	All	Moist meadows and pastures	June-Aug.	...	P.	165	81

82	<i>Agrimonia Eupatoria</i> L.	Common Agrimony	...	Border of corn-fields, pastures	June-Aug.	...	P.	165	82
83	<i>Poterium Sanguisorba</i> L.	Salad Burnet	Dry calcareous	Pastures	June-Aug.	...	P.	"	83
84	<i>P. officinale</i> Hook. f.	Great Burnet	All	Damp meadows	June-Aug.	...	P.	"	84
85	<i>Rosa canina</i> L.	Dog Rose	...	Hedges, thickets, and waste places	June-July	...	P.	166	85
86	Onagraceæ <i>Epilobium hirsutum</i> L.	Codlins-and-Cream, Great Willow Herb	...	Sides of ditches and streams	July-Aug.	Seeds and suckers	P.	"	86
87	<i>E. parviflorum</i> Schreb.	Lesser, or Small-flowered Hairy Willow Herb	...	Damp fields, and by streams and ditches	July-Aug.	Seeds and runners	P.	"	87
88	Cucurbitaceæ <i>Bryonia dioica</i> L.	[White or Common] Bryony	...	Hedges, &c.	May-Sept.	Seeds and fleshy tubers	P.	293	88
89	Umbelliferæ <i>Hydrocotyle vulgaris</i> L.	Marsh Pennywort, White-rot Hemlock	Damp marshy	Bogs, marshes, damp places	May-Aug.	Creeping stem, seeds	P.	167	89
90*	<i>Conium maculatum</i> L.		...	Hedges, waste places	June-July	Seeds	B.	294	90
91*	<i>Cicuta virosa</i> L.	Cowbane, Water Hemlock	...	Ponds, ditches, wet places	July-Aug.	...	P.	296	91
92	<i>Sium latifolium</i> L.	Water Parsnip	...	Ponds, wet places	July-Aug.	Stoloniferous rootstock	P.	...	92
93	<i>S. angustifolium</i> L.	Do.	...	Do.	In summer	Do.	P.	328	93
94	<i>Asopodium Podagraria</i> L.	Gout Weed, Bishop's Weed, Herb Gerard	...	Damp and waste places	June-Aug.	Creeping rootstock, seeds	P.	167	94
95	<i>Conopodium denudatum</i> Koch.	Earth-nut, Pig-nut, Arnut	All	Pastures, &c.	May-June	Tuberous rootstock, seeds	P.	"	95

LIST OF "WEEDS" AND "POISONOUS PLANTS"—Continued

No.	Order, Specific Name.	Common Name.	Soil.	Situation.	Time of Flowering.	Method of Propa- gation.	Annual (A.) or Peren- nial (P.).	Referred to at Page	No.
	Umbelliferae —Continued								
96*	<i>Scandix Pecten- Veneris</i> L.	Shepherd's Needle, Needles, Venus' Comb	Light, chalk	Cornfields, &c.	June-Sept.	Seeds	A.	81	96
97	<i>Apium nodiflorum</i> Reich.	Marshwort	...	Marshes, water- cross beds	July-Aug.	Procumbent stems, rooting at nodes, seeds	P.	328	97
98	<i>A. inundatum</i> Reich.	Do.	...	...	June-July	Creeping stems, seeds	P.	"	98
99	<i>Anthriscus vulgaris</i> Pers.	Common Beaked Parsley	All	Hedge banks, roadsides, &c.	May-June	Seeds	A.	168	99
100	<i>A. sylvestris</i> Hoffm.	Beaked Parsley, Kex	All	Hedge banks, grassland	April-June	...	P.	"	100
101*	<i>Enanthe crocata</i> L.	Water Dropwort, Water Hemlock	...	Ditches, ponds, &c.	July	...	P.	296	101
102*	<i>Æthusa Cynapium</i> L.	Fool's Parsley	Calcareous, loams	Arable and grass land	July-Aug.	Seeds	A.	83, 298	102
103	<i>Heracleum Sphon- dylitum</i> L.	Cow Parsnip, Hog Weed	...	Pastures, hedge banks, &c.	July	...	P.	169	103
104*	<i>Daucus Carota</i> L.	Wild Carrot	Calcareous, loams	Arable or grass land	June-Aug.	Seeds	A. or B.	170	104
105	<i>Torilis nodosa</i> L.	Hedge Parsley, Henfoot	...	Hedges, margins of fields	May-July	Seeds	A.	82	105
106	<i>T. Anthriscus</i> Huds.	Hedge Parsley	...	Hedges, waste places	July-Sept.	Seeds	A.	171	106
107	Valerianaceæ <i>Valeriana officinalis</i> L.	Valerian, All-heal	...	Ditches, marshy places	June-Aug.	Stoloniferous rootstock, seeds	P.	329	107

108	Araliaceæ <i>Hedera Helix</i> L.	Ivy	...	Climbing on trees, walls, rocks, &c.	Oct.-Nov.	Berries	P.	352	108
109	Haloragaceæ <i>Hippuris vulgaris</i> L.	Mare's-tail	...	Margins of ponds, lakes, &c.	June-July	Creeping root-stock, seeds	P.	326	109
110	<i>Myriophyllum verticillatum</i> L. <i>M. alterniflorum</i> L.)	Water Milfoil	...	Ponds and ditches	June-Aug.	Creeping root-stock, seeds	P.	327	110
111	<i>Callitriche verna</i> L.	Water Starwort	...	Ponds, ditches, slow streams	April-Oct.	Seeds	A. or P.	326	111
112	Rubiaceæ <i>Galium verum</i> L.	Yellow Bedstraw	Sandy, loamy, and calcareous	Grass land	June-Sept.	Seeds and stoloniferous rootstock	P.	172	112
113	<i>G. palustre</i> L.	[Water] Bedstraw	...	Moist meadows, marshes, ditches	June-Aug.	Creeping root-stock, seeds	P.	...	113
114*	<i>G. Aparine</i> L.	Cleavers, Cliver, Goose Grass, Hariff	Light open soils	Arable land, hedges, and waste places	June-July	Seeds	A.	83	114
115	<i>G. tricornis</i> With.	[Rough-fruited] Corn Bedstraw	Chalk	Cornfields, arable land	June-Oct.	Seeds	A.	85	115
116*	<i>Sherardia arvensis</i> L.	Field Madder	Sandy, loamy, calcareous	Arable land	April-Oct.	Seeds	A.	"	116
117	Dipsacaceæ <i>Dipsacus sylvestris</i> L.	Wild Teazle	...	Hedges, rough damp meadow-land	Aug.-Sept.	Seeds	B.	172	117
118	<i>Scabiosa succisa</i> L.	Devil's-bit Scabious	...	Dry pastures	July-Oct.	...	P.	173	118
119	<i>S. arvensis</i> L.	Field Scabious	All	Arable and grass land	July-Sept.	...	P.	172	119
120	<i>S. Columbaria</i> L.	Small Scabious	Calcareous	Dry pastures	July-Sept.	Seeds	P	...	120

LIST OF "WEEDS" AND "POISONOUS PLANTS"—Continued

No.	Order. Specific Name.	Common Name.	Soil.	Situation.	Time of Flowering.	Method of Propagation.	Annual (A.) or Perennial (P.).	Referred to at Page	No.
	Compositæ								
121*	<i>Arctium Lappa</i> L.	Burdock	Damp land	Waste places, sides of ditches, rough grass land	July-Aug.	Seeds	B.	173	121
122	<i>Eupatorium cannabinum</i> L.	Hemp Agrimony	...	Wet ditches, banks of streams	July-Sept.	Seeds	P.	329	122
123*	<i>Centaurea nigra</i> L.	Knapweed, Hardheads	Clays and loams	Pastures and meadows [lawns]	June-Sept.	...	P.	175	123
124*	<i>C. Cyanus</i> L.	Cornflower, Corn Bluebottle	...	Cornfields, pastures	June-Sept.	Seeds	A. or B.	86	124
125	<i>C. Scabiosa</i> L.	Field Scabious, Hardheads	Calcareous	Pastures and arable land	June-Sept.	...	P.	177	125
126*	<i>Cnicus lanceolatus</i> Hoffm.	Spear Thistle	All	Pastures, meadows, roadsides, &c.	July-Oct.	Seeds	B.	178	126
127*	<i>Cnicus arvensis</i> Hoffm.	Creeping Thistle	All	Arable and grass land	July-Sept.	Seeds and creeping roots	P.	86, 180	127
128	<i>Cnicus palustris</i> Hoffm.	Marsh Thistle	All	Damp pastures and meadows, near ditches, &c.	July-Sept.	Seeds	B.	178	128
129*	<i>Cnicus acaulis</i> Hoffm.	Dwarf or Stemless Thistle	Dry, calcareous, and gravelly soils	Pastures	July-Sept.	...	P.	"	129
130	<i>Onopordon Acanthium</i> L.	Cotton Thistle	...	Dry soils and waste places	July-Sept.	Seeds	B.	182	130
131*	<i>Petasites vulgaris</i> Desf.	Butter-bur	...	Wet meadows, &c.	March-May	Creeping root-stock, seeds	P.	"	131
132*	<i>Tussilago Farfara</i> L.	Coltsfoot, Foal's-foot	All, especially heavy and calcareous	Arable land [pastures]	March-April	Branching root-stock, with stolons; seeds	P.	87, 185	132

133	<i>Bellis perennis</i> L.	Common Daisy	All	Pastures and meadows, lawns	All the year	...	P.	185	133
134	<i>Anthemis arvensis</i> L.	Corn Chamomile	...	Arable land [corn-fields]	June-Aug.	Seeds	A.	90	134
135*	<i>Anthemis Cotula</i> L.	Stinking Mayweed	...	Arable land [corn-fields]	June-Sept.	Seeds	A.	"	135
136	<i>Achillea Millefolium</i> L.	Yarrow, Milfoil	All	Only a weed in meadows	May-Sept.	Creeping root-stock, seeds	P.	185	136
137	<i>Matricaria Chamomilla</i> L.	Wild Chamomile	...	Arable land [corn-fields]	June-Aug.	Seeds	A.	90	137
138*	<i>M. inodora</i> L.	Scentless Mayweed, Corn Feverfew, Horse Daisy	All	Arable land	June-Oct.	Seeds	A. or B.	92	138
139*	<i>Chrysanthemum segetum</i> L.	Corn Marigold	Sandy, loamy	Arable land [corn-fields]	June-Sept.	Seeds	A.	"	139
140*	<i>C. Leucanthemum</i> L.	Ox-eye Daisy	Clays, loams, calcareous	Arable and grass land	June-Aug.	...	P.	186	140
141	<i>Tanacetum vulgare</i> L.	Tansy	...	Arable and waste land	Aug.-Sept.	...	P.	95	141
142	<i>Gnaphalium uliginosum</i> L.	Marsh Cudweed	Damp, light, sandy soils	Arable and grass land	July-Sept.	Seeds	A.	96, 187	142
143*	<i>Senecio vulgaris</i> L.	Groundsel	All good soils	Arable land	All the year	Seeds	A.	96	143
144*	<i>S. Jacobaea</i> L.	Ragwort, Ragweed	Light, medium, and calcareous	Pastures and meadows	June-Sept.	Seeds	P.	187	144
145*	<i>Lapsana communis</i> L.	Nippelwort	Sands, loams, clays	Arable [and grass] land	June-Aug.	Seeds	A.	97	145
146	<i>Cichorium Intybus</i> L.	Wild Chicory	Sandy and chalky soils	Arable and waste land	July-Oct.	Seeds	P.	99	146
147	<i>Hypochaeris radicata</i> L.	Cat's-car	All	Grass land	June-Sept.	Seeds	P.	191	147
148	<i>Tragopogon pratensis</i> L.	Goat's-beard	Medium and heavy	Arable and grass land	June-July	Seeds	B.	"	148
149	<i>Leontodon hispidus</i> L.	Rough Hawkbit	All dry soils	Pastures and meadows	June-Sept.	Seeds	B.	"	149

LIST OF "WEEDS" AND "POISONOUS PLANTS"—Continued

No.	Order. Specific Name.	Common Name.	Soil.	Situation.	Time of Flowering.	Method of Propa- gation.	Annual (A.) or Peren- nial (P.).	Referred to at Page	No.
Compositæ —Continued									
150	<i>L. autumnalis</i> L.	Autumnal Hawk- bit	All	Pastures and mea- dows	July-Sept.	Seeds	P.	191	150
151*	<i>Taraxacum officinale</i> Web.	Dandelion	All	Pastures and mea- dows [lawns, paths, &c.]	March-Oct.	Seeds	P.	193	151
152	<i>Crepis taraxacifolia</i> Thuill.	Hawk's-beard	Dry, chalky	Pastures and mea- dows (local)	June-July	Seeds	B.	...	152
153*	<i>Sonchus arvensis</i> L.	Perennial or Corn Sow Thistle	All	Arable land	Aug-Sept.	Seeds and creep- ing rootstock	P.	101	153
154*	<i>S. oleraceus</i> L.	Annual Sow Thistle	Medium, sandy, and calcareous	Arable land	June-Sept.	Seeds	A.	99	154
155	<i>Hieracium Pilosella</i> L.	Mouse-ear Hawk- weed	...	Dry pastures	May-Aug.	Seeds and creep- ing rootstock	P.	194	155
156	<i>H. aurantiacum</i> L.	Orange Hawk- weed	...	Pastures, &c.	June-Aug.	Seeds and creep- ing rootstock	P.	"	156
Campanulacæ									
157	<i>Jasione montana</i> L.	Sheep's-bit or Sheep's Scabious	Heathy and light soils	Dry hilly pastures	June-Sept.	Seeds	B.	195	157
Ericacæ									
158	<i>Erica Tetralix</i> L.	Cross-leaved Heath	Heathy moor- land soils	Heaths and com- mons, and up- land pastures	July-Sept.	...	P.	"	158
159	<i>Calluna vulgaris</i> Salisb.	Common Heather or Ling	Heathy moor- lands	Heaths and rough grazing land	July-Sept.	...	P.	"	159
160	<i>Rhododendron</i> sp.	Rhododendron	...	Gardens, &c.	...	...	P.	299	160
161	<i>Asalea</i> sp.	Asalea	...	Gardens, &c.	...	...	P.	"	161

162	Gentianaceæ <i>Erythraea Centaurium</i> Pers.	Common Centaury	Dry, sandy soils	Dry pastures and waste land	June-Sept.	Seeds	A.	195	162
163	<i>Gentiana campestris</i> L.	Field Gentian	...	Hilly pastures	July-Oct.	Seeds	A.	196	163
164*	Convolvulaceæ <i>Convolvulus arvensis</i> L.	Field or Small Bindweed, Bearbine	Medium and sandy, or nearly all	Arable land, waste places, hedges	July-Sept.	Seeds and extensive creeping rootstock	P.	102	164
165*	<i>C. sepium</i> L.	Great Bindweed, Bearbine	...	Arable land, hedges, &c.	June-Aug.	Seeds and creeping rootstock	P.	103	165
166*	<i>Cuscuta Trifolii</i> Bab.	Clover Dodder	...	Parasitic on clover	July-Sept.	Seeds	A. (?)	258	166
167*	{ <i>C. Epilinum</i> Weibe. <i>Cuscuta</i> sp.	Flax Dodder	...	Parasitic on flax	July-Aug.	Seeds	A. (?)	259	167
168	Boraginæ <i>Echium vulgare</i> L.	Viper's Bugloss	Calcareous and light	Arable and waste land	June-Aug.	Seeds	A. or B.	106	168
169	<i>Symphytum officinale</i> L.	Common Comfrey	Damp soils	Banks of streams and damp places	May-June	...	P.	196	169
170	<i>Anchusa arvensis</i> Bieb.	Bugloss	Light	Cornfields and waste places	June-July	Seeds	A.	106	170
171*	<i>Lithospermum arvense</i> L.	Corn Gromwell, Grey Millet	...	Cornfields, waste places	May-June	Seeds	A.	107	171
172	<i>Myosotis arvensis</i> Hoffm.	Field Forget-me-not or Scorpion Grass	All	Arable land	June-Aug.	Seeds	A. or B.	"	172
173	<i>M. versicolor</i> Reich.	Corn or Particoloured Scorpion Grass	All	Arable land	April-June	Seeds	A.	"	173
174	<i>M. palustris</i> With.	Common Forget-me-not	Wet marshy soils	Wet land	May-July	Seeds and creeping rootstock	P.	...	174
175	<i>Cynoglossum officinale</i> L.	Hound's Tongue	...	Fields and waste places (not common)	June-July	Seeds	B.	299	175

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Solanaceæ									
176*	<i>Hyoxyamus niger</i> L.	Henbane	Sandy	Waste places	June-Aug.	Seeds	A. or B.	302	176
177*	<i>Solanum Dulcamara</i> L.	Bitter-sweet, Woody Night- shade	...	Hedges, &c.	June-Aug.	Creeping root- stock, seeds	P.	"	177
178*	<i>S. nigrum</i> L.	Black Nightshade	...	Gardens, waste ground	July-Oct.	Seeds	A.	108, 304	178
179*	<i>Atropa Belladonna</i> L.	Deadly Night- shade, Dwale	Calcareous	Waste places, near ruins	June-Aug.	Creeping root- stock, seeds	P.	300	179
180	<i>Datura Stramonium</i> L.	Thorn Apple	...	Waste places, gardens (not common)	June-July	Seeds	A.	305	180
Plantagineæ									
181*	<i>Plantago major</i> L.	Greater or Broad- leaved Plantain, Way-bread	All	Arable and grass land, roadsides	May-Sept.	Seeds	P.	198	181
182*	<i>P. media</i> L.	Hoary Plantain, Lamb's Tongue	Dry, calcareous	Grass land, lawns	June-Oct.	Seeds	P.	"	182
183*	<i>P. lanceolata</i> L.	Ribwort Plantain, Ribgrass	All	Pastures and mea- dows, arable land	May-Oct.	Seeds	P.	108, 196	183
Scrophulariaceæ									
184	<i>Linaria vulgaris</i> Mill.	Yellow Toadflax	Damp loams	Arable and waste land	July-Oct.	Creeping root- stock, seeds	P.	109	184
185*	<i>Digitalis purpurea</i> L.	Foxglove	...	Hedge banks and shady places	July-Sept.	Seeds	P.	307	185
186	<i>Scrophularia aqua- tica</i> L.	Water or Marsh Figwort	...	Edges of ponds and rivers, and damp places	July-Sept.	Seeds, creeping rootstock	P.	329	186

187	<i>S. nodosa</i> L.	Knotted Figwort	...	Damp shady places	July-Oct.	Seeds	P.	329	187
188	<i>Veronica agrestis</i> L.	Corn Speedwell	All	Arable land	April-Sept.	Seeds	A.	109	188
189	<i>V. hederaefolia</i> L.	Ivy-leaved Speedwell	All	Arable land	March-Aug.	Seeds	A.	"	189
190	<i>V. Chamædrys</i> L.	Common or German Speedwell	All	Grass land, hedges, &c.	May-June	Seeds	P.	199	190
191	<i>V. Anagallis</i> L.	Water Speedwell	...	Ditches, watery places	July-Aug.	Seeds	P.	330	191
192	<i>V. Beccabunga</i> L.	Brooklime	...	Do.	May-Sept.	Seeds, procut-bent stems	P.	"	192
193	<i>Bartsia viscosa</i> L.	Yellow or Viscid Bartsia	...	Damp grass land	June-Oct.	Seeds	A.	199, 272	193
194	<i>B. Odontites</i> Huds.	Red Bartsia	...	Grass land, waste places, cornfields	June-Aug.	Seeds	A.	"	194
195	<i>Euphrasia officinalis</i> L.	Eyebright	Light sandy loams and calcareous	Grass land	May-Sept.	Seeds	A.	271	195
196*	<i>Rhinanthus Crista-galli</i> L.	Yellow Rattle, Rattles, Cock's Comb	All	Grass land	May-July	Seeds	A.	268	196
197	<i>Pedicularis palustris</i> L.	Lousewort, Marsh Red-rattle	Wet soils	Damp meadows and pastures	May-Sept.	Seeds	A.	272	197
198	<i>Melampyrum pratense</i> L.	Common or Yellow Cow-wheat	...	Woods and meadows	June-Sept.	Seeds	A.	"	198
199*	Orobanchaceæ { <i>Orobanche minor</i> Sutt. <i>Orobanche</i> sp. <i>Lathraea squamaria</i> L.	Lesser Broom-rape Toothwort	...	Parasitic on roots of clover (and other plants) Semi-parasitic on roots of hazel, elm, &c., in shady places	June-Oct. April-May	Seeds ...	A. P.	264 273	199 200

LIST OF "WEEDS" AND "POISONOUS PLANTS"—Continued

No.	Order. Specific Name.	Common Name.	Soil.	Situation.	Time of Flowering.	Method of Propaga- tion.	Annual (A), Biennial (B), or Peren- nial (P.).	Referred to at Page	No.
	Labiatae								
201*	<i>Mentha arvensis</i> L.	Corn or Field Mint	All, especially damp soils	Arable land	July-Sept.	Creeping root- stock, seeds	P.	110	201
202	<i>M. aquatica</i> L.	Capitate Mint	...	River sides, marshes, ditches	Aug.-Sept.	Do.	P.	330	202
203*	<i>Prunella vulgaris</i> L.	Self-heal	All	Grass land	July-Sept.	Creeping root- stock, seeds	P.	199	203
204	<i>Scutellaria galeri- culata</i> L.	Skull-cap	...	Ditches, banks of streams	July-Sept.	Creeping root- stock, seeds	P.	330	204
205	<i>Stachys arvensis</i> L.	Corn Woundwort	...	Arable land	April-Nov.	Seeds	A.	112	205
206	<i>S. palustris</i> L.	Marsh Woundwort	...	River banks, &c.	July-Sept.	Creeping root- stock, seeds	P.	330	206
207	<i>Galeopsis Tetrahit</i> L.	Hemp Nettle, Day Nettle	Sandy and cal- careous loams	Arable land	July-Sept.	Seeds	A.	112	207
208	<i>Lamium purpureum</i> L.	Red Dead Nettle	All	Arable land, waste places	April-Oct.	Seeds	A.	"	208
209	<i>L. album</i> L.	White Dead Nettle	...	Fields and waste places	May-Dec.	Creeping root- stock, seeds	P.	113	209
210	<i>L. amplexicaule</i> L.	Henbit, or Hen- bit Dead Nettle	Sandy soils	Arable land, waste places	May-Aug.	Seeds	A.	"	210
211	<i>Ajuga reptans</i> L.	Common Bugle	...	Grass land	May-July	Creeping stems, seeds	P.	200	211
	Primulaceae								
212	<i>Primula veris</i> L.	Cowslip	Calcareous loams	Meadows and pas- tures	April-May	...	P.	201	212
213	<i>Anagallis arvensis</i> L.	Scarlet Pimpernel, Poor-man's Weather-glass	Sandy and cal- careous loams	Arable land	May-Oct.	Seeds	A.	113	213

214*	Polygonaceæ <i>Polygonum Persicaria</i> L.	Persicaria, Red-shank	All	Arable land	July-Oct.	Seeds	A.	114	214
215*	<i>P. Aviculare</i> L.	Knotgrass	All, especially light soils, sands, and gravels	Arable land, roadsides, &c.	May-Oct.	Seeds	A.	115	215
216*	<i>P. Convolvulus</i> L.	Black Bindweed, Climbing Buckwheat	All	Arable land	July-Sept.	Seeds	A.	116	216
217*	<i>Rumex obtusifolius</i> L.	Common or Broad-leaved Dock	All	Ubiquitous	Aug.-Sept.	Seeds	P.	201	217
218*	<i>R. crispus</i> L.	Curled Dock	All	Ubiquitous	June-Oct.	Seeds	P.	"	218
219*	<i>R. sanguineus</i> L.	[Bloody-veined] Dock	All	Arable land, roadsides, &c.	June-Aug.	Seeds	P.	203	219
220*	<i>R. Acetosa</i> L.	(Common) Sorrel	All	Ubiquitous	May-Aug.	Seeds	P.	206	220
221*	<i>R. Acetosella</i> L.	Sheep's Sorrel	All dry soils	Pastures, &c.	May-Aug.	Creeping root-stock, seeds	P.	119, 204, 308	221
222	<i>R. Hydrocotyloides</i> Huds.	Great Water Dock	...	Ditches, river sides	July-Aug.	Seeds	P.	331	222
223*	Chenopodiaceæ <i>Chenopodium album</i> L.	Goosefoot, Fat Hen, Lamb's Quarters	All, especially good soils	Arable land	July-Sept.	Seeds	A.	119	223
224*	<i>Atriplex patula</i> L.	Spreading Orache	All	Arable land	June-Oct.	Seeds	A.	122	224
225	<i>A. hastata</i> L.	Halberd-leaved Orache	All	Arable land	July-Oct.	Seeds	A.	"	225
226	Thymelaceæ { <i>Daphne Laureola</i> L. <i>D. Mezereum</i> L.	Spurge Laurel Mezereon	Stiff soils	Copses and hedge banks	Jan.-April	...	P.	308	226

LIST OF "WEEDS" AND "POISONOUS PLANTS"—Continued

No.	Order. Specific Name.	Common Name.	Soil.	Situation.	Time of Flowering.	Method of Propa- gation.	Annual (A.) or Biennial (B.) or Perennial (P.)	Referred to at Page	No.
227	Loranthaceæ <i>Viscum album</i> L.	Mistletoe	...	Parasitic on various trees	March-May	Seeds	P.	274	227
228	Euphorbiaceæ <i>Euphorbia Hclio- scopia</i> L.	Sun Spurge	Sandy, clay, loams	Arable land	June-Oct.	Seeds	A.	124	228
229	<i>E. Peplus</i> L.	Petty Spurge	Loams	Arable land (gar- dens)	July-Nov.	Seeds	A.	"	229
230*	<i>E. Lathyris</i> L.	Caper Spurge	Loams	Arable land (gar- dens)	June-July	Seeds	B.	124, 309	230
231	<i>E. exigua</i> L.	Dwarf Spurge	Loams	Arable land	July-Oct.	Seeds	A.	124	231
232*	<i>Mercurialis perennis</i> L.	Dog's Mercury	...	Woods and shady places	March-April	Creeping root- stock, seeds	P.	309	232
233*	<i>M. annua</i> L.	Annual Mercury	...	Fields, gardens	July-Oct.	Seeds	A.	"	233
234	<i>Buxus sempervirens</i> L.	Box	Chalk	Hills, gardens	April-May	...	P.	311	234
235*	Ceratophyllaceæ <i>Ceratophyllum demersum</i> L.	Hornwort	...	Ponds, ditches, &c.	June-Sept.	...	P.	331	235
236*	Urticaceæ <i>Urtica dioica</i> L.	Great (stinging) Nettle	All	May occur in any position	June-Sept.	Creeping root- stock, seeds	P.	124, 207	236
237*	<i>U. urens</i> L.	Lesser or Small (stinging) Nettle	All	Same as last	June-Sept.	Seeds	A.	125	237

238	Cannabaceæ <i>Humulus Lupulus</i> L.	Hop	...	Hedges, &c.	July-Aug.	Seeds	P.	208	238
239*	Coniferæ <i>Taxus baccata</i> L.	Yew	...	Hillsides, woods, gardens, &c.	March	...	P.	312	239
240	<i>Cupressus</i> sp.	Cypress	...	Ornamental tree	...	...	P.	313	240
241	Amentaceæ <i>Quercus Robur</i> L.	Oak	...	...	April-May	...	P.	"	241
242*	Hydrocharidaceæ <i>Elodea canadensis</i> Michx.	American or Canadian Pond-Weed, Water-Thyme	...	Ponds, ditches, streams, rivers	May-Oct.	Branching and rooting stems	P.	332	242
243	Orchidaceæ <i>Orchis mascula</i> L.	Purple Orchis	...	Grass land, woods	April-June	Tubers, seeds	P.	208	243
244	<i>O. maculata</i> L.	Spotted Orchis	...	Moist grass land, commons, &c.	May-July	Tubers, seeds	P.	"	244
245	Iridaceæ <i>Iris Pseud-acorus</i> L.	Yellow Flag	...	Ditches, river banks, &c.	May-Aug.	Creeping root-stock	P.	333	245
246	Alismaceæ <i>Alisma Plantago</i> L.	Water Plantain	...	Ditches, edges of rivers, &c.	June-Aug.	...	P.	335	246
247	<i>Sagittaria sagittifolia</i> L.	Arrow-head	...	Ditches, rivers, &c.	July-Sept.	Stoloniferous stem, seeds	P.	336	247

LIST OF "WEEDS" AND "POISONOUS PLANTS"—Continued

No.	Order. Specific Name.	Common Name.	Soil.	Situation.	Time of Flowering.	Method of Propa- gation.	Annual (A.) Biennial (B.) or Peren- nial (P.).	Referred to at Page	No.
	Naiadaceæ								
248*	<i>Potamogeton natans</i> L.	Floating Pond- weed	...	Ponds, ditches, lakes	July-Sept.	...	P.	336	248
249	<i>P. polygonifolius</i> Poir.	Do.	...	Do.	Do.	...	P.	"	249
250	<i>P. heterophyllus</i> Schreb.	Various-leaved Pondweed	...	Ponds, lakes, &c.	July-Sept.	...	P.	"	250
251	<i>P. lucens</i> L.	Lucid Pondweed	...	Do.	June-Sept.	...	P.	338	251
252*	<i>P. crispus</i> L.	Curly Pondweed	...	Ponds, ditches, &c.	June-Aug.	...	P.	"	252
253	<i>P. perfoliatus</i> L.	Pondweed	...	Ponds, lakes, streams	July-Sept.	...	P.	"	253
254*	<i>P. densus</i> L.	Opposite-leaved Pondweed	...	Ponds and streams	June-Sept.	...	P.	"	254
255	<i>P. pusillus</i> L.	Small Pondweed	...	Ponds, lakes, ditches, rivers	June-Aug.	...	P.	"	255
	Liliaceæ								
256	<i>Paris quadrifolia</i> L.	Herb Paris	...	Woods and shady places	May-June	Creeping root- stock, seeds	P.	317	256
257	<i>Convallaria majalis</i> L.	Lily-of-the-Valley	...	Woods (local)	May-June	Creeping root- stock	P.	"	257
258*	<i>Allium vineale</i> L.	Crow Garlic, Wild Onion	All	Arable and grass land	June-July	Bulbs and seeds	P.	125, 209	258
259*	<i>A. oleraceum</i> L.	Field Garlic	...	Arable land	July-Aug.	Bulbs and seeds	P.	126	259
260*	<i>A. ursinum</i> L.	Ramsons, Broad- leaved Garlic	...	Woods, moist and shady places	April-June	Bulbs and seeds	P.	211	260
261*	<i>Colchicum autumnale</i> L.	Meadow Saffron, Autumn Crocus	Light soils	Grass land	Aug.-Oct.	Cornus and seeds	P.	314	261

262*	Juncaceæ <i>Juncus effusus</i> L. and other sp.	Common Rush and other sp.	...	Moist meadows, water meadows, &c. Dry meadows and pastures, heaths	July	...	P.	211	262
263*	<i>Luzula campestris</i> Willd.	Wood-rush	All	...	April-June	Creeping root- stock, seeds	P.	212	263
264	Cyperaceæ <i>Eriophorum vagi- natum</i> L.	Hare's-tail Cotton- grass	...	Bogs, moors, water meadows Do.	April-May	Seeds	P.	213	264
265	<i>E. angustifolium</i> Roth.	Common Cotton- grass	...	Do.	May-June	Seeds	P.	"	265
266	<i>Scirpus lacustris</i> L.	Bulrush	...	Lakes, ditches, marshes	July-Aug.	Creeping root- stock, seeds	P.	338	266
267	<i>Carex vulgaris</i> Fries.	Common Carex or Sedge	...	Marshes, wet meadows, water meadows	May-July	Creeping root- stock, seeds	P.	214	267
268*	<i>C. paludosa</i> Good.	Sedge	...	Ditches, river banks	May-June	Do.	P.	339	268
269	<i>C. præcox</i> Jacq. and other sp.	Sedge	...	Heaths, pastures, &c.	April-May	Do.	P.	214	269
270	Aroidæ <i>Arum maculatum</i> L.	Cuckoo-Pint, Lords-and-Ladies	...	Hedges, woods, sides of ditches	April-May	Annual corms, seeds	P.	317	270
271*	Lemnaceæ <i>Lemna minor</i> L.	Lesser Duckweed	...	Ponds, still waters, &c.	June-Aug.	Budding off- sets, hibernat- ing bulbils	A.	334	271
272	<i>L. trisulca</i> L.	Ivy-leaved Duck- weed	...	Do.	June-July	Do.	A.	335	272
273	<i>L. polyrrhiza</i> L.	Duckweed	...	Do.	...	Do.	A.	"	273

LIST OF "WEEDS" AND "POISONOUS PLANTS"—Continued

No.	Order. Specific Name.	Common Name.	Soil.	Situation.	Time of Flowering.	Method of Propagation.	Annual (A), Biennial (B), or Perennial (P.).	Referred to at Page	No.
	Typhaceæ								
274	<i>Spartanium ramosum</i> Huds.	Branched Bur-reed	...	Ponds, ditches, river banks	June-July	Creeping root-stock, seeds	P.	333	274
275	<i>S. simplex</i> Huds.	Bur-reed	...	Do.	Do.	Do.	P.	334	275
276	<i>Typha latifolia</i> L.	Club rush, "Bulrush," Reed-mace	...	Lakes, river banks	July-Aug.	Do.	P.	"	276
	Gramineæ								
277	<i>Nardus stricta</i> L.	Mat-weed	Dry heathy soils	Dry pastures, heaths	June-July	Creeping root-stock, seeds	P.	216	277
278	<i>Alopecurus agrestis</i> L.	Slender or Foxtail	Dry sandy	Arable land	May-Oct.	Seeds	A.	126	278
279*	<i>A. geniculatus</i> L.	Floating Foxtail	...	Wet meadows, ditches, ponds	May-Aug.	Procumbent rooting stems, seeds	P.	216	279
280*	<i>Agrostis canina</i> L.	Brown Bent-grass	Wet soils	Peaty ground	July-Aug.	Seeds	P.	218	280
281*	<i>A. vulgaris</i> With.	Fine Bent-grass, Black Couch	Sandy soils	Arable and grass land	June-Sept.	Creeping stems, seeds	P.	128, 218	281
282*	<i>A. alba</i> L.	Marsh Bent-grass, Fiorin	...	Arable and grass land	July-Sept.	Seeds (stoloniferous stems)	P.	217	282
283*	<i>A. stolonifera</i> Koch.	Fiorin	Moist soils	Do.	Do.	Do.	P.	128, 218	283
284*	<i>Aira flexuosa</i> L.	Wavy Hair-grass	Sandy heaths	Heaths, dry pastures	June-Aug.	Seeds	P.	218	284
285*	<i>A. cæspitosa</i> L.	Tussock Grass, Tufted Hair-grass	...	Damp pastures and meadows	June-July	Seeds	P.	220	285

286*	<i>Avena fatua</i> L.	Wild Oat-grass	...	Arable land, especially cornfields	June-Aug.	Seeds	A.	128	286
287	<i>A. pubescens</i> L.	Downy Oat-grass	Dry chalk and limestone	Pastures	June-July	Seeds and creeping roots	P.	...	287
288	<i>A. pratensis</i> L.	Narrow-leaved Oat-grass	As the last	Pastures	June-July	As the last	P.	...	288
289*	<i>Holcus lanatus</i> L.	Yorkshire Fog	Calcareous loams	Grass land	June-July	Seeds	P.	220	289
290	<i>H. mollis</i> L.	Creeping Soft-grass	Sandy soils	Grass land	June-Aug.	Seeds and creeping rootstock	P.	222	290
291*	<i>Poa annua</i> L.	Annual Meadow Grass	All	Ubiquitous in arable land, paths, &c.	April-Sept.	Seeds	A.	129	291
292*	<i>Brisa media</i> L.	Quaking-grass	Dry, light	Poor pastures and meadows	June	Creeping stems, seeds	P.	222	292
293*	<i>Bromus mollis</i> L.	Soft Bromo Grass	Dry soils	Grass land, roadsides, &c.	May-July	Seeds	A. or B.	223	293
294*	<i>B. sterilis</i> L.	Sterile Bromo Grass	Dry soils	Fields and waste places	June-July	Seeds	A.	"	294
295*	<i>B. secalinus</i> L.	Rye-like Bromo Grass	...	Arable land, pastures	June-July	Seeds	A.	130	295
296*	<i>Arrhenatherum avenaceum</i> Beauv., var. <i>bulbosum</i> Lindl.	"Onion" Couch	Lighter soils	Arable land	June-July	Seeds and swollen onion-like internodes	P.	131	296
297*	<i>Triticum repens</i> L.	Couch, Twitch Grass	All	Arable land	June-Aug.	Creeping rootstock, seeds	P.	132	297
298*	<i>Lolium temulentum</i> L.	Darnel	...	Arable land, especially cornfields	June-Aug.	Seeds	A.	319	298
299	<i>Hordeum murinum</i> L.	Barley-grass, Way-bent	Dry	Waste places, roadsides	June-July	Seeds	A.	226	299
300	<i>H. pratense</i> Huds.	Meadow Barley-grass	...	Damp meadows	June-July	Seeds and creeping rootstock	P.	223	300
301	<i>Phragmites communis</i> Trin.	Reed	...	Shallow water, edges of lakes, &c.	July-Aug.	Creeping rootstock, seeds	P.	339	301

LIST OF "WEEDS" AND "POISONOUS PLANTS"—Continued

No.	Order. Specific Name.	Common Name.	Soil.	Situation.	Time of Flowering.	Method of Propagation.	Annual (A) Biennial (B) or Perennial (P.)	Referred to at Page	No.
302*	Filices <i>Pteris aquilina</i> L.	Bracken, Fern	...	Heaths, moors, upland pastures, woods, forests	Fructification July-Aug.	Creeping root- stock, spores	P.	226	302
303	<i>Ophioglossum vulgatum</i> L.	Adder's Tongue	...	Upland and damp pastures, woods	Fructification May-July	Spores	P.	...	303
304	Equisetaceæ <i>Equisetum arvense</i> L.	Horse-tail, Mare's- tail, Paddock- pipes, Cat's-tail	Generally damp soils	Arable and grass land	Fructification April	Spores	P.	136, 228	304
305	<i>E. limosum</i> L.	Horse-tail	...	Shallow water	Fructification June-July	Spores	P.	340	305
306*	Musci <i>Hypnum, Funaria,</i> <i>Sphognum, &c.</i>	Mosses	Damp soils	Pastures	...	...	P.	229	306
307	Characeæ { <i>Chara</i> sp. <i>Nitella</i> sp.	Stoneworts	...	At bottom of fresh and brackish water	...	...	...	340	307
308	Fungi <i>Lycoperdon, &c.</i>	Fairy Rings	...	Pastures and lawns	...	...	...	231, 347	308
309	<i>Claviceps purpurea</i> Tul.	Ergot of Rye	...	Parasitic on grasses	...	...	...	319	309

APPENDIX III

LEGISLATION ENFORCING THE DESTRUCTION OF NOXIOUS WEEDS IN THE CHIEF AGRICULTURAL COUNTRIES OF THE WORLD

LEGISLATION for the prevention of the dissemination of noxious weeds exists in the majority of the chief agricultural countries of the world. In the British Empire more or less stringent laws in this behalf are on the Statute Books of the Australasian and South African Colonies; but in the British Islands the only laws requiring the destruction of weeds refer to Ireland and the Isle of Man. A summary of these laws, and of those of such foreign countries for which it has been found possible to obtain information, is given below.

UNITED KINGDOM

There are no laws or regulations in force in Great Britain which render compulsory the destruction of weeds; but it will be of interest if the provisions of the Adulteration of Seeds Acts, 1869 and 1878, are stated here.

The Adulteration of Seeds Act, 1869, provides that every person who, with intent to defraud or to enable another person to defraud, "kills or causes to be killed any seeds; or, dyes or causes to be dyed any seeds; or, sells or causes to be sold any killed or dyed seeds," shall be liable to a penalty not exceeding £5 for a first offence, or to a penalty not exceeding £50 for a second or subsequent offence. In the case of a second or subsequent offence the Court is empowered, besides inflicting the penalty, "to order the offender's name, occupation, place of abode, and place of business, and particulars of his punishment under this Act, to be published, at the expense of such offender, in such newspaper or newspapers, or in such

other manner as the Court may think fit to prescribe." Under this Act it is not necessary to prove an intent to defraud any particular person or to enable any particular person to defraud another particular person, but it is sufficient to prove that the accused party did the act with an intent to defraud or to enable some or any other person to defraud. In this Act the term "to kill seeds" is defined as destroying the vitality or germinating power of such seeds by artificial means.

The Adulteration of Seeds Act, 1878, defines the term "to dye seeds" in the Act of 1869 as meaning the application to seeds of any process of colouring, dyeing or sulphur smoking.

Some indications as to the legal aspect of the subject will be gathered from the following summaries of cases quoted in Dixon's *Law of the Farm* :—

It is a nuisance if a man allows the boughs of his trees so to grow that they overhang his neighbour's land (*Lonsdale (Earl) v. Nelson*, 2 L. J. (O. S.) K. B., 28 ; 2 B. & C., 311). The owner of land so overhung is entitled, without notice, if he does not trespass on his neighbour's land, to cut the branches so far as they overhang, even though they have done so for more than 20 years (*Lenmon v. Webb*, 63 L. S., ch. 570 [1895] A. C.). See also, with regard to poisonous trees, *Wilson v. Newberry*, 41 L. J., Q. B., 31 ; L. R., 7 Q. B., 31. In *Crowhurst v. Amersham Burial Board* (48 L. J., Ex., 109 ; 4 Ex. D., 5) a Burial Board was held liable for the loss of a horse poisoned by eating leaves of a yew tree planted in the cemetery belonging to the Board, which had grown through and over their fence and projected on to the meadow occupied by the plaintiff. Kelly, C.B., said : "We do not think that the plaintiff was bound to examine all the boundaries to see that no tree likely to be injurious to his horse was projecting over the field he had hired." In *Ponting v. Noakes* (63 L. J., Q. B., 549 ; [1894] 2 Q. B., 281) the parties occupied adjoining fields, separated by a fence and ditch belonging to defendants. The ditch was on the plaintiff's side, the edge of the ditch being his boundary. On the defendants' side was a yew tree, the branches of which extended over the hedge and partly over the ditch ; but no part extended up to or over the plaintiff's boundary. The defendants were under no liability to fence against their neighbour's cattle. Plaintiff's horse ate of the branches extending over the ditch, and died therefrom ; and

the plaintiff brought an action for damages. The Court held that there was no liability, inasmuch as there was no duty on defendants not to grow a poisonous tree on their property, even though it might be so near the boundary as possibly to be accessible to the plaintiff's cattle. This case differed from the Amersham case cited above, because there the tree extended over the plaintiff's land, and defendants were liable on the principle laid down in *Rylands v. Fletcher* (37 L. J., Ex. 161; L. R., 3, H. L., 330) that the person who, for his own purposes, brings on his land, and collects and keeps there, anything likely to do mischief, is liable if it escapes and does mischief.

An interesting decision was given in the case of *Giles v. Walker* (59 L. J., Q.B., 416; 24 Q. B. D., 656), where it was held that an occupier of land is under no duty towards his neighbour periodically to cut the thistles naturally growing on his land, so as to prevent them from seeding; and if, owing to his neglect to cut them, the seeds are blown to his neighbour's land and do damage he is not liable.

As regards the cleansing of watercourses in England, Section 14 of the Land Drainage Act enacts that where, by the neglect of an occupier to cleanse and scour, or to join in cleansing and scouring, the channels of existing drains, streams, or watercourses in or bounding his lands, injury is caused to other land, the occupier of that land may serve a notice requiring the offending occupier to maintain the banks or cleanse and scour the channel, or in default do it himself and recover a proper proportion of the cost. (See also *Leaflet* No. 181, Board of Agriculture and Fisheries.)

IRELAND

A Seed-testing Station has already been established by the Irish Department of Agriculture, in order that the danger of using impure seed, and thereby increasing the spread of weeds and correspondingly decreasing the yield of the crop, may as far as possible be obviated. The Station furnishes for each sample a statement of the percentage and nature of the impurity, and the percentage of germination. Farmers are charged 3d. per sample, and seedsmen 1s., for a report on purity, and 2s. if a germination report be also required.

In 1909 the Weeds and Agricultural Seeds (Ireland) Act,

1909, was passed to prevent the spread of noxious weeds in Ireland, and to make provision for the testing of agricultural seeds. This Act vests in the Department of Agriculture and Technical Instruction power, with the consent of the Council of any county, to declare Ragwort, Charlock, Coltsfoot, Thistle, and Dock to be noxious weeds throughout the county. It provides that notices may be served on occupiers of land, ordering them to destroy, in the manner specified, the noxious weeds thereon, and defaulters are rendered liable to penalties not exceeding £5 for a first offence, or £10 for a second or subsequent offence. The Act empowers the Inspectors of the Department to enter upon land in order to search for noxious weeds. The County or District Council is regarded as the occupier of roads.

The Act further makes provision for taking samples of certain agricultural seeds, and for their testing for purity and germination. The names and addresses of the persons upon whose premises the samples were taken may be published, together with the results of the tests. This Act came into force on January 1, 1910.

ISLE OF MAN

In the Isle of Man the "Weeds Act, 1900," is designed to secure the destruction of weeds defined as "thistles, cushags, and common docks." If weeds growing on any land, including the half of any public road adjoining thereto (other than roads usually repaired by the Highway Board), remain uncut on the 1st August in any year, or sooner period when they are developing flowers, Commissioners of Districts may serve notices upon the occupiers of such lands requiring the weeds to be cut; and if the cutting is not carried out within ten days thereafter the occupier is liable to a penalty not exceeding £10, and to a further penalty not exceeding £1 for each day that the offence is continued. A Court of Summary Jurisdiction has power to authorise a person to cut down the weeds, having regard to the state of cultivation and cropping; and a Justice of the Peace may, on complaint from the Commissioners or from any person residing within one mile of the land, authorise a person to enter the land in order to ascertain whether in fact such weeds are present thereon.

CANADA

By the Seed Control Act (4 & 5 Ed. VII., c. 41) the Governor in Council may make regulations determining the maximum proportion of the seeds of the weeds mentioned below that may be tolerated in agricultural and other seeds without affecting their character as being free from the seeds of the said weeds. The Act gives powers of entry for inspection and taking of samples. Its provisions do not, however, apply to persons growing or selling seed for the purpose of food, or selling or storing seed which is to be cleaned and graded, or which is marked "not absolutely clean" and held or sold for export only.

The prohibitory clauses of the Act require that no person shall sell, or offer, expose or have in his possession for sale, for the purpose of seeding, any seeds of cereals, grasses, clovers or forage plants, unless they are free from any seeds of the following weeds:—

- Wild Mustard or Charlock (*Brassica Sinapis* Boiss. = *Sinapis arvensis* L.)
- Tumbling Mustard (*Sisymbrium Sinapis* Crantz.)
- Hare's-ear Mustard (*Coringia orientalis* (L.) Dumort.)
- Ball Mustard (*Neslia paniculata* Desv.)
- Field Penny Cress or Stinkweed (*Thlaspi arvense* L.)
- Wild Oats (*Avena fatua* L. and *A. strigosa* Schreb.)
- Bindweed (*Convolvulus arvensis* L.)
- Perennial Sow Thistle (*Sonchus arvensis* L.)
- Ragweed (*Ambrosia artemisiifolia* L.)
- Great Ragweed (*Ambrosia trifida* L.)
- Purple Cockle (*Lychnis Githago* Lam.)
- Cow Cockle (*Vaccaria Vaccaria* (L.) Britton)
- Orange Hawkweed or Paint Brush (*Hieracium aurantiacum* L. and *Hieracium præaltum* Vill.)
- The Sclerotia known as Ergot of Rye (*Claviceps purpurea* Tul.),

unless each and every receptacle, package, sack, or bag containing such seeds, or a label securely attached thereto, is marked in a plain and indelible manner—

- (a) with the full name and address of the seller;
- (b) with the name of the kind or kinds of seed;
- (c) with the common name or names of the weeds named, the seeds of which are present in the seed sold, offered, or exposed or had in possession for sale.

Further, no person shall sell, or offer, expose or have in his possession for sale, any seeds of timothy, red clover, alsike, or any mixture containing the said seeds, in or from any receptacle, package, sack, or bag upon which is marked "No. 1" or any other designation which represents such seeds as of first quality, unless they are free from the seeds of the above-mentioned weeds, and are also free from the seeds of—

White Cockle (*Lychnis vespertina* Sibth.).
 Night-flowering Catchfly (*Silene noctiflora* L.).
 False Flax (*Camelina sativa* Crantz.).
 Canada Thistle (*Cnicus arvensis* Hoffm.).
 Ox-eye Daisy (*Chrysanthemum Leucanthemum* L.).
 Curled Dock (*Rumex crispus* L.).
 Blue Weed (*Echium vulgare* L.).
 Ribgrass (*Plantago lanceolata* L.).
 Chicory (*Cichorium Intybus* L.).

They must also contain not less than 99 per cent of the seeds represented, or seeds of other useful and harmless grasses or clovers, of which 99 per cent 90 must be germinable.

No person shall sell, or offer, expose or have in his possession for sale for the purpose of seeding in Canada, any seeds of timothy, alsike or red clover, or any mixture containing the said seeds, if the seeds of the weeds mentioned in the Act are present in a greater proportion than 5 in 1000 of the seed sold, &c.

Penalties to the extent of 1-25 dollars per bag are levied in respect of offences against the Act, and the person on whose behalf the seed is sold, &c., is *prima facie* liable for the violation of the Act.

The Act also makes provision for the analysis and testing of seeds.

The object of the Act is not to induce farmers to purchase for their own use seeds of a better quality than they desire, except in so far as noxious weeds are held to be a public nuisance, but to provide means whereby users of seeds may protect themselves against the introduction of noxious weeds on their lands, and to fix a minimum standard alike of purity and vitality. Specimens of 100 noxious weeds may be obtained by seed merchants from the Seed Branch of the Department of

Agriculture, Ottawa, in order to assist them in the identification of the species.

In the tests for purity the report must state, *inter alia*, the number of the seeds of the scheduled weeds found in the sample, and the number per 1000 seeds; and in the case of timothy, alsike, or red clover, described as first quality, the percentage of useless and harmful seeds not named in the Act.

The various Provinces of the Dominion have passed laws on the subject, which may be briefly summarised as follows:—

In Manitoba the "Noxious Weeds Act" of 1906 schedules, among other weeds, Common Wild Mustard (Charlock), Canada (or Creeping) Thistle, Perennial Sow Thistle, Wild Oats, "Stink-weed" (Penny Cress), and False Flax, and all other noxious weeds to which the Act may be extended by municipal by-law. Owners and occupants of land are compelled to cut down or destroy the above-mentioned weeds in time to prevent seeding, and this provision extends to railway companies as regards land in their possession. In default a fine of from 5 to 25 dollars may be levied, and in addition a fine of 5 dollars for each day of neglect subsequent to conviction. Powers are given for Inspectors to enter premises of defaulters and destroy the weeds, even when they are among growing crops. Powers are also given for the searching of seed warehouses for traces of seeds of noxious weeds. Vendors of seeds—whether for seed or fodder—which are found to contain seeds of noxious weeds are liable to fines of from 10 to 100 dollars, and to the destruction of the seed sold; while for exporting cleanings or refuse from elevators or mills which are found to contain noxious seeds, the owners are liable to fines ranging from 25 to 100 dollars. The Lieutenant-Governor in Council has power to make further regulations if necessary.

In Ontario, Chapter 279 of the Law Book provides that every occupier must cut down all Canada Thistles, Ox-eye Daisies, Wild Oats, Ragweed, Burdock, and all other noxious weeds to which the Act may be extended by municipal by-law so often as to prevent the ripening of seed, provided, however, that this does not entail the destruction of the growing grain. Municipalities may, on the application of thirty ratepayers, suspend the operation of the Act as regards any waste or unoccupied lands, but they have power to extend the Act to include any weed or weeds. Penalties

are attached to neglect to comply with the provisions of the Act, and Inspectors are empowered to enter the premises of defaulting occupiers and to cut down all noxious weeds except on land sown with grain. Highway overseers must see that the roads under their control are kept free from the weeds. Any person knowingly selling seeds containing the seeds of the noxious weeds referred to above renders himself liable to a fine of 5 to 20 dollars.

In the North-West Territories the Noxious Weeds Ordinance of 1903 schedules, among others, the following species as noxious weeds: Common Wild Mustard (Charlock), False Flax, Shepherd's Purse, Stinkweed (Penny Cress), Canada (or Creeping) Thistle, Ragweed, and Wild Oats. Occupiers of land must destroy all these weeds on their premises, and in addition on the land between the centre of the highway and their boundary, or in default be liable to a penalty up to 100 dollars and costs. An Inspector finding noxious weeds in a corn crop may order the owner to cut down or plough under such crop, or any part of it, within a stated time, or to fence off and burn all straw and screenings from such crop within ten days of thrashing. Inspectors have power to act in the case of an occupier's default. No person must sell, dispose of, or offer for sale any grain, grass, clover, or other seeds for seed in which there is seed of noxious weeds. No bran, shorts, chopped or crushed grain, or cleanings containing seeds of noxious weeds may be removed from any premises until the germinating power of such seeds has been destroyed. An exception is, however, made in the case of material from elevators or warehouses which is destined for sheep feeding or other purposes whereby the complete destruction of germinative capacity is secured, but the removal must be made under the authority of Regulations prescribed by the Lieutenant-Governor. No such seed may be placed outside a mill until germination has been destroyed. It is further provided that thrashing-machines shall be thoroughly cleaned before removal from one place to another.

As regards British Columbia, the Noxious Weeds Prevention Act of 1888 prescribes that any person who imports and offers for sale any grain, grass, clover, or other seed, or any seed grain among which there is seed of Canada Thistle, Ox-eye Daisy, Wild Oats, Ragweed, Charlock, Sorrel, Burdock, or any

other foul seeds, or who shall knowingly convey from one farm to another any of these noxious seeds or grains, either in thrashing-machines or fanning mills, shall for every such offence be liable to a fine of not less than 20 and not more than 100 dollars.

In Quebec, Article 5556 of the Civil Code ordains that any person may, by special notice, require any occupier of any land or common, not actually under seed, to cut and destroy, between the 20th June and the 1st August, the Daisies, Wild Endive, Chicory, Celandine, and all other noxious weeds or plants considered as such, growing on the land or common. A fine of 40 cents per diem, and costs, is provided in default of complying with such notice. Any person who scatters, or causes to be scattered, the seeds of weeds to the prejudice of another person shall incur a penalty of 1 to 8 dollars. Any person may, after special notice, compel his neighbour to pull up Wild Mustard, even in a sown field, so soon as it flowers. Default renders the occupier liable to the above penalty. Such special notices must be given either in writing or before two witnesses.

In Saskatchewan the Noxious Weeds Ordinance of 1903 schedules nineteen species of plants as noxious weeds, including six species of Mustard and three of Thistles. Every occupier of land is required to use all reasonable means in his power to destroy all noxious weeds, and in default is liable to a penalty not exceeding 100 dollars and costs. Occupiers must clear the land between the centre of the road and their boundary. Inspectors are empowered on finding weeds in a grain crop to notify the owner to cut and burn, or plough under, the whole or part of the crop, or to fence and burn the straw from such crop within ten days of thrashing. Railway lands and lands of irrigation companies must also be cleared. No person is allowed to sell any grain, grass, clover, or other seed in which there are seeds of noxious weeds, and such seeds must not be removed from any premises until the power of germination of the noxious seeds is destroyed. Cleanings must not be placed outside a mill until the power of germination of any noxious weed seeds has been destroyed. Thrashing-machines must be thoroughly cleaned before removal, and this provision must be prominently displayed on each machine.

In Alberta the Noxious Weeds Act of 1907 (as amended in 1908) schedules twenty-two noxious weeds, and makes their destruction by all owners or occupiers of land compulsory. It further provides that all earthworks owned by railway or irrigation companies must be sown with White Clover, Timothy, or Western Ryegrass. Inspectors have power to order the partial or complete destruction of grain or hay crops containing noxious weeds. The sale of seed containing a greater proportion than 5 per 1000 of noxious weed seeds is prohibited, and the germinating power of all weed seeds must be destroyed before cleanings, &c., can be removed from any premises. Thrashing-machines must be thoroughly cleaned before removal to another place, and the thrasher must deliver the grain in such a condition that it contains not more than 10 per cent of noxious weed seeds other than Wild Oats.

In Prince Edward Island the Noxious Weeds Act of 1909 schedules seven weeds, and makes their destruction before the seed ripens compulsory. The provisions of the Act are in similar terms to those in force in the other Canadian provinces.

AUSTRALASIA

The Federal Quarantine Act, No. 3 of 1908, prohibits the importation into the Commonwealth of the seeds of no less than eighty-two species of weeds, among which may be mentioned Burdock, Charlock, all Thistles, Corn Marigold, Dodder, Fumitory, Poppies, Spurrey, Ragwort, Hemlock, Field Bindweed, Cleavers, Pepperwort (*L. Draba* and *L. campestre*), Black Bindweed, Sheep's Sorrel, and certain Docks. All seeds imported into the Commonwealth are required to be "sound, clean and new," and therefore tests of their viability are sometimes made, and they are cleared from bond only when the Commonwealth Inspectors are satisfied that seeds of the eighty-two species of weeds referred to are not present.

In Victoria, the Thistle Act of 1890 includes among other species *Cnicus lanceolatus*, *Onopordon Acanthium*, and *Cnicus arvensis* as noxious weeds; and the Act of 1891 empowers the Governor in Council to proclaim any plant to be a Thistle within the meaning of the Act of 1890. Occupiers of land are compelled to destroy all Thistles thereon, and upon half of any road

adjacent thereto, within fourteen days after any notice in writing signed by any Justice, subject to a penalty of from £5 to £20. After seven days' default the Justice may order destruction of the weeds, the cost to be recovered from the occupier. Duly authorised persons may enter upon land to search for Thistles, and on complaint being made of the suspected existence of Thistles, and the existence being confirmed, the Justice may make an order for eradication. Crown lands are also subject to the provisions of the Act.

New South Wales.—By the "Prickly Pear Destruction Act of 1901" provision is made for the compulsory destruction of the Prickly Pear.

In New Zealand, Act No. 10 of 1900, "To prevent the spread of noxious weeds and to enforce the trimming of hedges," provides that occupiers of land shall clear that part between the centre of the road and their boundary of all noxious weeds. No person is allowed to sow, sell, or offer for sale any noxious seeds (except gorse seed for fodder by permission), or any seed that has not been thoroughly dressed by a machine or other sufficient process to remove all noxious seeds. Thrashing-machines, clover-dressers, and chaff-cutters must be thoroughly cleaned immediately after use. Occupiers must take the necessary steps each year to clear noxious weeds from their land, and to clear at least a quarter of a chain each side of internal fences and watercourses. Powers of inspection and entry are given. Some thirty plants are scheduled as noxious weeds, and the Act empowers the Governor to extend the list on the advice of the Joint Agricultural, Pastoral, and Stock Committee.

In South Australia, Act No. 26 of 1862 provides that the occupier of land (including the adjacent half of any road) upon which Bathurst Burr (*Xanthium spinosum*), Scotch Thistle, or Variegated Thistle, shall be growing, shall, after due notice, effectually destroy such plants, or in default be liable to a penalty not exceeding £10. Powers of entry to inspect, and to destroy in default of the occupier, are given. Act 409 of 1887 extended the above Act to include the "Star Thistle" (*Centaurea calcitrapa*), but repealed its provisions as regards the Scotch and Variegated Thistles, the former of which was found to be eaten by cattle when in a dry state, and is therefore regarded as a fodder plant of some value in dry

seasons when grass is scarce. Further, powers were given by which any weed could be proclaimed a noxious weed which must be eradicated. Additional powers were given by Act No. 517 of 1891. At the present time some thirteen species of weeds are proscribed, having been declared to be "noxious weeds."

There is in South Australia no supervision over the sale of seeds, and no guarantee is given by seedsmen either as regards purity or germinating capacity.

In *Tasmania*, Act No. 17 of 1883 enforces the compulsory destruction of the Californian Thistle and Bathurst Burr before blooming, and gives powers of entry. Local authorities must destroy all Thistles growing on roads. It is provided by a later Act (No. 29 of 1887) that any person removing from land, or selling or offering for sale any hay, straw, or grass seed or grain containing Thistle seed, shall be liable to penalties. It is further enacted that an annual return shall be made to the Chief Inspector of Sheep, stating the estimated area of land infested with Thistles. A later Act empowers the Governor to proclaim any plant as a noxious weed, either generally or in a particular locality, and the Mona Vale White Weed or Pepperwort (*Lepidium Draba* L.) has been proclaimed accordingly, and the different municipal councils—fifty in number—take action for its destruction. No laws exist in the Island controlling the sale of seeds mixed with weed seeds.

In *Western Australia*, the Noxious Weeds Act of 1904 provides that such weeds as from time to time may be proclaimed by notice in the *Government Gazette* to be noxious weeds must be destroyed by occupiers of land after the Inspector has given notice. In default the occupier is liable to a penalty of £50. Powers of entry, and to destroy in default of the occupier, are given. Local authorities must clear all lands under their control.

Queensland.—Dodder was proclaimed a disease under the Diseases in Plants Act, 1876.

SOUTH AFRICA

In *Cape Colony*, Act 40 of 1889 provides that occupiers of land on which the Bathurst Burr (*Xanthium spinosum*) exists shall, after due notice, take steps to eradicate the weed, or in default be liable to a penalty. The Act empowers the Governor

to schedule any other weed as noxious, and to exempt any river bed should he see fit. Later Acts (1905 and 1907) give further powers for the compulsory destruction of noxious weeds. Act No. 20 of 1907 empowers the Governor to make regulations dealing with the furnishing of guarantees as to the purity and germination of any seed purchased, for preventing the sale of seeds not of the quality guaranteed, for preventing the sale of killed or dyed seeds, and for providing for the regular analysis of seeds intended for sale. It is not incumbent on the vendor to furnish a guarantee of purity and germination, but the absence of such guarantee does not exempt him from prosecution in the event of killed or dyed seeds being found in the seed sold by him. Other clauses deal with prosecutions under the Act, and with penalties in case of contravention of the Act or regulations made thereunder.

In *Natal*, Law No. 38 of 1874 renders occupiers of land upon which the Bathurst Burr (*Xanthium spinosum*) is found growing and bearing seed liable to a penalty of not more than £5. Powers of entry to destroy are given under the Act. Act No. 20 of 1901 includes two other weeds in the above Act.

In the *Orange River Colony*, Chapter cxxvi. of the Law Book orders that every owner, occupier, or user of a farm shall be bound to exterminate, bury, or burn the weed known as *Xanthium spinosum*. The Landdrost has power to do this in default, and to recover costs. Persons travelling with animals on which seed of this plant is found are liable to prosecution and penalties. The Law also applies to the Scotch Thistle, except that on representations from twenty-five landowners in a ward its operation may be withheld.

In the *Transvaal*, the Minister of Agriculture introduced a Bill, which received the royal assent on 30th June 1909, to make better provision for the eradication of noxious weeds. Under this term are included *Xanthium spinosum*, and any other plant which the Governor may proclaim by notice in the *Gazette*, to be a noxious weed either in the whole Colony or in specified parts. The Governor has power to make regulations compelling the destruction of noxious weeds, and prescribing the manner of destruction, and of empowering officers to inspect land and to serve notices on occupiers. In default of action by the occupier the destruction may be carried out,

and the cost thereof recovered from the occupier. The Governor may also make regulations prohibiting the introduction into the Colony or the sale of any plant, seed, or grain which is likely to propagate or to spread the seed of noxious weeds. Failure to comply with these regulations renders the offender liable to a fine not exceeding £50, or in default of payment to six months' imprisonment with or without hard labour. The Act came into operation on 2nd July 1909.

UNITED STATES OF AMERICA

There are no Federal laws requiring the destruction of weeds or the sale of pure seeds, but a number of States have passed laws requiring that certain noxious weeds shall not be allowed to seed. Various penalties are provided in case these laws are violated. In several States also there are laws governing the sale of seeds within the State.

The latest general information available is contained in a *Bulletin* (No. 17, Division of Botany) issued by the United States Department of Agriculture in 1896. At that date twenty-five States and Territories had made Laws for the suppression of weeds, and it may be mentioned that twenty-one of these States had proscribed the Creeping Thistle (*Cnicus arvensis* Hoffm.).

The various laws are set forth *in extenso* in the *Bulletin*, but they cannot be referred to individually here.

It will be of interest, however, to indicate by an example what laws exist as to the inspection of agricultural seeds. In the State of Iowa it is provided by Law (effective July 4, 1907) that no person shall sell agricultural seeds containing the seeds of Wild Mustard or Charlock, Quack Grass (Couch), Canada (or Creeping) Thistle, Wild Oats, Clover and Lucerne Dodder,¹ Field Dodder,² and Corn Cockle. The sale of seeds containing not more than 2 per cent by weight of the following (among other) weed seeds is not prohibited; but if more than 2 per cent be present the approximate percentage of each of such seeds must be stated: White Cockle (*Lychnis vespertina*), Curled Dock, Sheep's Sorrel, certain Plantains, Bindweed (*Convolvulus sepium*),

¹ *Cuscuta Epithimum*.

² *C. arvensis*.

Common Chickweed. Sand, dirt, chaff, foreign substances, and seed not capable of germinating are considered as impurities, and when present in quantity exceeding the standards of purity and viability mentioned below, the name and approximate percentage must be indicated:—

Standard of Purity and Viability of Agricultural Seeds

	Per Cent of Purity.	Per Cent of Germinable Seeds.
Alfalfa (<i>Medicago sativa</i>)	96	80
Barley	98	90
Bluegrass, Canadian (<i>Poa compressa</i>)	90	45
„ Kentucky (<i>P. pratensis</i>)	80	45
Brome, awnless (<i>Bromus inermis</i>)	90	75
Clover, Alsike (<i>Trifolium hybridum</i>)	90	75
Buckwheat	96	90
Clover, crimson (<i>T. incarnatum</i>)	98	85
„ red (<i>T. pratense</i>)	92	80
„ white (<i>T. repens</i>)	90	75
Fescue, Meadow (<i>Festuca pratensis</i>)	95	85
Flax (<i>Linum usitatissimum</i>)	96	89
Oats	98	90
Oat-grass, tall (<i>Arrhenatherum avenaceum</i>)	72	70
Orchard grass (<i>Dactylis glomerata</i>)	70	70
Rape (<i>Brassica rapa</i>)	99	90
Red top (<i>Agrostis alba</i>)	90	70
Rye	98	90
Ryegrass, perennial (<i>Lolium perenne</i>)	96	90
„ Italian (<i>L. italicum</i>)	95	80
Timothy (<i>Phleum pratense</i>)	96	85
Wheat	98	90

The United States Treasury Department periodically directs Customs Officers that, for specified periods, two-ounce samples of all importations of 100 pounds or more of grass, clover, and forage-plant seeds shall be forwarded to the Seed Laboratory, Department of Agriculture, Washington. The importation of the consignment, and its entry into commerce, is suspended until the result of the examination of the sample is made known.

ARGENTINA

The importation of seeds is regulated by Law No. 4084, whereby they are subjected to inspection, disinfection, or destruction, as the case requires. The Law has been amplified by decree of August 23, 1902, and it is stipulated that all live vegetable seeds, or part thereof, on importation into Argentina, are subject to the jurisdiction of the Department of Agronomy of the Ministry of Agriculture, and scrupulously examined with the view of preventing the importation of vegetable or animal plagues. Seeds in large or small quantities imported into Argentina are subject to inspection or analysis by the Department of Agronomy if necessary, and every effort is made to prevent the entry of Dodder. The importation of clover seeds, indeed, is prohibited unless these are certified as free from Dodder.

FRANCE

The Law of June 21, 1898, provides that the Prefects of Departments shall prescribe such measures as may be necessary to arrest or prevent damage to agriculture by Cryptogams and other harmful plants when such damage assumes, or may assume, an extensive or dangerous character. Regulations are not made by the Prefect without the sanction of the General Council of the Department, except in the case of urgent and temporary measures. He determines when the measures should be put into execution, the localities to which they shall apply, and the special means to be employed. The regulation is only to be carried into effect after the approval of the Minister for Agriculture has been received. The execution of the regulation is in the charge of the Mayors.

Regulations of the character outlined have been made by various Departments.

The repression of fraud in the sale of seeds is regulated by the Frauds Law of August 1, 1905, and experiment stations have been instituted to deal with samples of seeds submitted to them in conformity with that Law.

ITALY

There are no laws in force in Italy with regard to the destruction of weeds and the supply of pure seeds of a suitable germinating capacity.

BELGIUM

There are no laws in Belgium with respect to the provision of pure seeds of good germinating capacity, but the Burgomaster is required by Art. 50 of the "Code Rural" to see that the laws and regulations requiring the destruction of Thistles and other noxious plants are duly executed. A Royal Decree (May 2, 1887) lays down rules for the destruction of these plants, the measures for the destruction of Thistles being prescribed by the provincial Governors, and those for other weeds by the Minister for Agriculture. The destruction of male stalks of Hops is rendered compulsory by a Ministerial Decree dated May 3, 1887.

GERMANY

The Government of the German Empire have passed no laws in connection with the seed trade, neither is the destruction of weeds rendered compulsory by any Imperial law. Measures are, however, taken in most of the Federated States against the spread of certain weeds, *e.g.* Thistles (*Cnicus arvensis*), French Weed (*Galinsoga parviflora*), Wild Radish (*Raphanus*), Meadow Saffron (*Colchicum autumnale*), Butter-bur (*Petasites vulgaris*), Mistletoe (*Viscum album*), Dodder (*Cuscuta Trifolii* or *Epilinum*), Broom-rape (*Orobanche minor*), Wild Mustard (*Sinapis arvensis*), Wucherblume (? *Senecio vernalis*). These measures are carried out under police orders, and under penalty of a fine or imprisonment in default.

The examination of seeds in respect of purity and germinating capacity is carried out at experiment and control stations, which are partly State establishments and partly supported by the Chambers of Agriculture.

HUNGARY

The Rural Police Act xii. of 1894 imposes a penalty up to 200 crowns (£8, 6s. 8d.) on any person who offers for sale any clover or lucerne seed which is not absolutely free from Dodder. The result of the passing of this law is that seed merchants prefer to sell seeds which have been examined and bear the official seal. This seal is affixed to the package after examination at a Government Seed-testing Station, of which there are several in the country. The object of these stations is to exercise control over the trade in seeds and other vegetable products, and to protect the interests of farmers against fraud and adulteration; to make experiments as to germination, &c.; and to identify weeds and weed seeds submitted to them. An Act passed in 1895 imposes penalties to the extent of two months' imprisonment, or fines up to 600 crowns (£25), on any one who adulterates agricultural products, or advertises or sells material for adulterating purposes, or sells adulterated products, or who sells agricultural products under a false description. All seeds sold in quantities exceeding 10 kilograms (22 lb.) must be sold under a declaration by the seller as to their real name, variety, and origin, and as to the percentage of pure seeds and germinating power expressed by one definite figure. Various regulations govern the "control" or testing of seeds at the official seed-testing stations.

SWITZERLAND

The Government have established a system whereby firms of seed merchants, on payment of an annual subscription, can be registered as *maisons contrôlées*. Such firms contract to deliver to their customers a gratuitous certificate which gives them the right to have their purchases tested at one of the Government stations free of charge, and they undertake to indemnify the purchaser should the seeds fall short of their description. The guarantee furnished by the "controlled firms" includes the identity, purity, and germinating capacity of the seeds, together with absence of adulteration and of the seeds of noxious weeds. With regard to the latter, the firms especially guarantee a minimum proportion of authentic and pure seeds

having a minimum germinating capacity; the absence of Dodder from seeds of leguminous forage plants, and of Flax Dodder (*Cuscuta Epilinum*) from the seeds of flax; and by special arrangement between the parties the absence of the seeds of other noxious weeds can be guaranteed. The proportion of Burnet (*Poterium Sanguisorba*) in sainfoin seed is also guaranteed; such seed when sold as free from Burnet may be returned by the purchaser should it contain more than 10 grains of Burnet per kilogram (2.2 lb.), while the buyer of leguminous seeds which are found to contain more than 20 grains of Dodder per kilogram is entitled to an indemnity of 5 per cent on the price. Similar rules apply to seed found to be adulterated, or to contain seeds of other noxious weeds.

DENMARK

There appear to be no laws in Denmark requiring the destruction of weeds, but annual grants are made by the State to agricultural societies for the purpose of awarding prizes to members for weedless fields. Further, the municipal administrations and the railways are stated to be careful that the roadsides, ditches, and railway areas are kept free from weeds.

SWEDEN

There is no law in Sweden dealing with the destruction of weeds, but a Royal Ordinance, dated February 5, 1909, and taking effect from June 1, 1909, provides for the importation of foreign seeds under certain regulations. The chief point is that seeds shall, before they are allowed to be imported for sale, be treated with Eosin; by this means foreign seeds are dyed so as to be easily recognisable and distinguishable from Swedish seeds. (For further information on this Ordinance see *Jour. Bd. Agric.*, April 1909, p. 53.)

The Government allows an annual sum, for the purpose of seed inspection and for the supply of pure seeds, to establishments inaugurated and largely maintained by the local bodies. As long ago as 1876 the Swedish Parliament voted a sum of £550 for chemical agricultural stations and offices for the examination of seeds. At the present time there are some

twenty-five such offices. In 1887 a similar sum (£550) was contributed for seed offices established by local bodies, not more than £55 to be devoted to each office, and regulations were drawn up for the control of such State-aided stations. In the last Budget seed offices were granted a similar sum, while a subsidy of £1400 was granted to the Swedish Seed Association.

NORWAY

In Norway there appear to be no laws requiring the destruction of weeds.

NETHERLANDS

There are no laws in the Netherlands requiring the destruction of weeds. There is, however, a central Government Seed-testing Station at Wageningen.

SERVIA

Clover seed can only be imported when it has been shown by expert examination to be pure. Seed grain is inspected by market committees before sale.

PORTUGAL

No laws requiring the destruction of weeds or the supply of pure seeds of a suitable germinating capacity are in force in Portugal.

RUSSIA

There are no laws regarding the destruction of weeds. Seed, carefully cleaned and sorted, is supplied to agriculturists from State properties, farms, and institutions, and also from Government and "Zemstvo" agricultural stores.

JAPAN

No laws or regulations.

APPENDIX IV

THE VALUE OF BIRDS IN DESTROYING WEED SEEDS

“ You call them thieves and pillagers ; but know
They are the winged wardens of your farms,
Who from the cornfields drive the insidious foe,
And from your harvest keep a hundred harms.”

—LONGFELLOW.

THE part played in Nature's economy by “ the fowls of the air ” is of a manifold character, although as regards their effect on the agriculture of the country less is known than may be considered desirable. In general there are, from the point of view of the farmer and gardener, birds which are sometimes classed as wholly harmful, others as distinctly useful, and yet others which lie between these two extremes. In one way or another, however, the vast majority of birds may be considered useful, but their work in destroying weed seeds is the only point which can be touched on here.

We have already briefly noted the fact (see p. 20) that birds may be agencies in the distribution of weed seeds, but the harm done in this way must be inconsiderable when compared with the useful work done by birds which largely subsist on the seeds of wild plants. As an example of the aid farmers receive from birds in this connection, it will be of interest and value to mention briefly several birds which eat large quantities of weed seeds.

The Chaffinch (*Fringilla cœlebs* L.) devours innumerable seeds of weeds, such as Coltsfoot, Groundsel, Chickweed, Charlock, Wild Radish, Knotweed, Buttercup. Howard Saunders says, “ Both young and old feed largely on insects and the seeds of weeds, so that in spite of pilfering of fruit, vegetables, and newly-sown seeds, the Chaffinch may be considered as one of the gardener's best friends.”

The Greenfinch (*Ligurinus chloris* L.) is another seed-eater, taking large quantities of the seeds of Charlock, Dandelion, Dock, Corn Marigold, Plantain, Goose Grass, Corn Crowfoot, Knotweed.

The Bullfinch (*Pyrrhula europæa* Viel.) also takes the seeds of many weeds—Self-heal, Mouse-ear Hawkweed, Dock, Charlock, Great Stinging Nettle, Groundsel, Plantain, Meadow-sweet, Spear Thistle, Chickweed, Ragwort, Sow Thistle. Of 26 specimens examined by Newstead, "11 contained seeds of Sycamore; 3, Hawthorn kernels; 1, seeds of Elder; 9, seeds of Blackberry; 2, seeds of Self-heal; 11, seeds of Dock; 3, seeds of Charlock; 3, seeds of Nettle; 2, Hawkweed; 1, fruit buds." The same authority states that during the months of July, August, and September this bird subsists very largely on the seeds of Self-heal, and he has watched it for hours together feeding exclusively upon the seeds of this noxious weed.

The Linnet (*Linota cannabina* L.) is a seed-eating bird, and feeds freely on the seeds of Charlock and other weeds. It is known to eat the seeds of Self-heal, Dandelion, Dock, and Mouse-ear Hawkweed. Newstead records an enormous flock of Linnets feeding on the seeds of Charlock which had practically overgrown a field of potatoes.

The Goldfinch (*Carduelis elegans* Stephens) in the mature state feeds principally on seeds—Thistle, Knapweed, Groundsel, Dock, and others.

The Skylark (*Alauda arvensis* L.) eats the seeds of Annual Meadow Grass, *Lychnis* sp., *Polygonum* sp., Chickweed, Plantain, Charlock, and other weeds.

The House Sparrow (*Passer domesticus* L.) does good during several months of the year by eating weed seeds, as those of Charlock, Chickweed, Plantain, Buttercup, Knotgrass, Field Bindweed, Goosefoot, Dandelion, Dock.

The Yellow-Hammer (*Emberiza citrinella* L.) and other buntings appear to consume many weed seeds, including Knotgrass, Plantain, Groundsel, Chickweed, Thistle, Dock, and others.

The Wood Pigeon (*Columba palumbus* L.) does an immense amount of service by eating great quantities of weed seeds—Charlock, Shepherd's Purse, Corn Crowfoot, Docks, Goose Grass, Plantain, Knotgrass, Ragweed, Hemlock, and

others. It also eats the succulent roots of Silver-weed (see p. 79) and other weeds.

These few birds are merely quoted as examples of those which devour large quantities of weed seeds. The Pheasant, Partridge, Corn Crake, Siskin, Red-poll, and Brambling or Mountain Finch, also do much good in this way. (See also "The Food of some British Birds," R. Newstead, *Jour. Bd. Agric.*, Supplement to vol. xv., 1908-9; *The Farmer and the Birds*, Edith Carrington, 1898; *Manual of British Birds*, Howard Saunders, 1899; and other books on birds.)

APPENDIX V

THE following is a list of British seedsmen who submit samples to the Zürich Seed Control Station, and have made special arrangements for the testing of their seeds:—

George G. Bullmore, Newquay, Cornwall.
T. and R. Carlyle, Waterbeck, Ecclefechan.
Samuel MacCausland, Belfast.
McClinton & Co., Belfast.
Alex. Cross & Sons, Glasgow.
Dickson & Robinson, Manchester.
John Donaldson & Co., Edinburgh.
William Dods & Son, Haddington.
Durant & Sons, North-Tawton, Devon.
Robert Edgar & Co., Ltd., Edinburgh.
Farmer's Supply Association of Scotland, Leith.
Gordon Woodroffe & Co., London.
James Hunter, Chester.
Peter Lawson & Son, Edinburgh.
W. H. and H. Le May, London.
John Milne & Sons, Montrose.
John Picard & Co., London.
William Power & Co., Waterford.
Raynbird & Co., Basingstoke.
Roughead & Park, Ltd., Haddington.
Fred. Smith & Co., Woodbridge, Suffolk.
Tozer, Kemsley & Fisher, London.
William Watt, Cupar, Fife.
Edward Webb & Sons, Wordsley, Stourbridge.

This list is given solely as showing that many seedsmen recognise the great importance of seed testing in assisting their

endeavours to supply good, pure seed. Many of the great merchants are not on this list, for the reason that their seeds are tested elsewhere, or they are examined by trained men on the premises. The fact that this list is printed here is not to be taken to mean that the firms named are recommended before others, whose seeds may be equally good and have been tested and approved by competent authorities at other stations.

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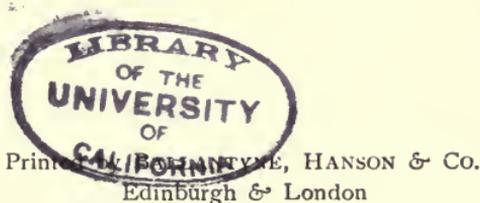
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