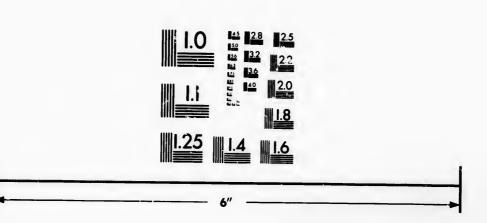


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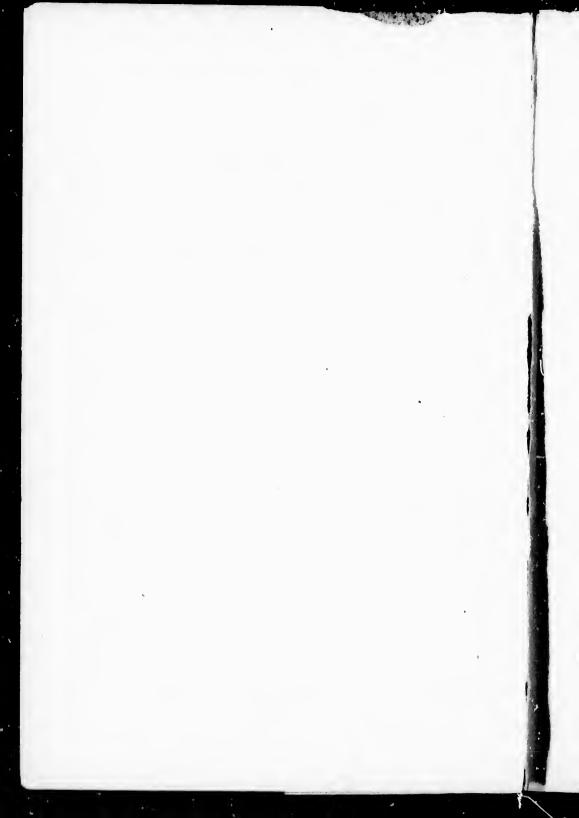
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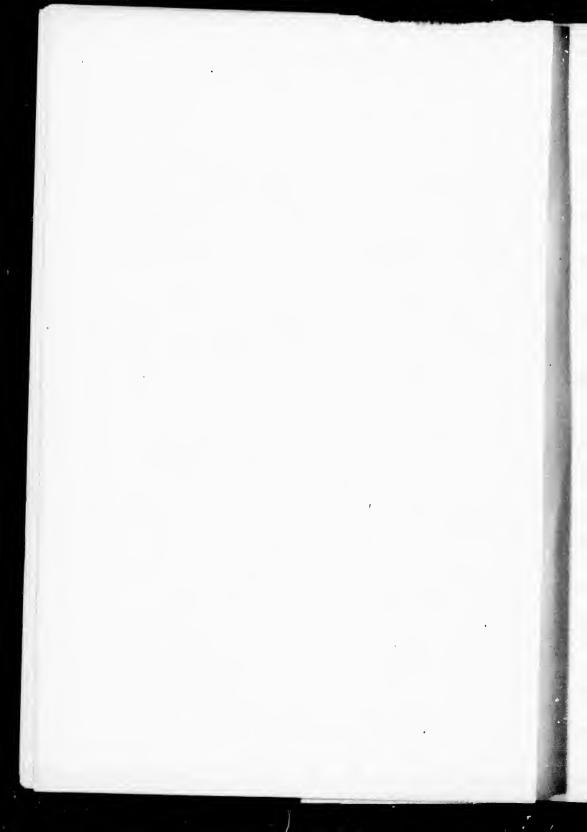
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WEEDS,

AND

HOW TO ERADICATE THEM.



WEEDS,

AND

HOW TO ERADICATE THEM.

BY

THOMAS SHAW,

Professor of Agriculture in the Ontario Agricultural College, Guelph, Ontario.

THE J. E. BRYANT COMPANY (LIMITED), 1893.

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PREFATORY NOTE.

This little work is offered to my fellow farmers in the sincere hope that it will do good. It is the outcome of much experience in dealing with weeds, and of much study and thought as to the best methods of eradicating them; and also of a profound conviction, based thereon, that no farmer need despair of having a perfectly clean farm if he have but the necessary determination and energy to put into practice the methods of weed eradication herein described.

THOMAS SHAW.

Ontario Agricultural College Experimental Farm, July, 1893.

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CHAPTER I.

THE PREVALENCE OF WEEDS.

"Cursed is the ground for thy sake; in sorrow shalt thou eat of it all the days of thy life; thorns also and thistles shall it bring forth to thee; and thou shalt eat the herb of the field." So reads the doom that was hurled adown the centuries from the flaming gates of Eden, when man was ejected from a paradise lost, to earn his bread by the sweat of his brow. From that day to the present weeds have followed in the footprints of man. He no sooner pitches his tent, or builds his more permanent home, than they entrench themselves around He no sooner commences to till the soil than they commence to dispute its possession with the plants that he sows, and thus they harass and perplex him, and complicate all his best devised methods for subduing the earth.

It is true, at the same time, that in lands that are as yet uninhabited, and which, therefore, were never tilled, we find some weeds; but they are indigenous, and the number of the

species is not only limited, but those which do exist seem unable to multiply to any great extent in the natural surroundings amid which they grow. On the other hand, in lands that have long been cultivated, we frequently find that foreign varieties of weeds are far more numerous and aggressive than the native species. Regions that have been settled with inhabitants drawn from different countries are peculiarly liable to be smitten with the various weeds which belong to the respective countries from which these inhabitants have come. The seeds of the weeds are imported along with the grain that is brought for sowing, and in various other ways are the foreign weed seeds introduced. Some of the varieties thus imported do not take kindly to the new conditions; but other sorts, like the people who have brought them, oftentimes find their new surroundings preëminently favorable to a greatly increased development.

The "prevalence of weeds" has respect (1) to the number of weed species found in any locality; and (2) to the extent to which these various species are allowed to multiply.

I. The number of weed species. With regard to the number of the various species of weed life which infest the several provinces

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and states of North America, we are as yet unable to speak with precision. The botany of not a few of these provinces and states is as yet unwritten. The story thereof, up to the present, has not half been told. It would therefore serve no good purpose, in the present condition of our knowledge, to enumerate the various species, or even to try to give an approximation thereto. Weeds are probably quite as numerous and varied now in the continent of America as in Europe, where it is well known that they have been continually increasing in number and variety with every passing century. But in addition to the noxious weeds of America that are indigenous to the continent, the major portion of those which have long harassed the inhabitants of Europe are now giving trouble to the inhabitants of America, and the weeds of the several provinces of the Dominion of Canada form no exception to this statement.

Our most troublesome and aggressive weeds are foreigners. The Canada thistle, which seems so completely at home in the central provinces of the Dominion, was imported from Europe. The same is true of some varieties of the sow thistle. The wild oat, the ox-eye daisy,

the ubiquitous burdock, the wild mustard, the wild flax, and indeed nearly all the various forms of weed life that are greatly troublesome to us, come from a foreign scurce. Foreign weeds in this country are far more numerous and characteristic than the people who brought them hither; and so they are likely to remain, for weeds, unlike nationalities, do not fuse and blend so as to lose their several individualities. For some of them, as, for instance, the Canada thistle, the new conditions have been found so favorable that they flourish to a greater extent than even in the lands whence they came.

Although the presence of weed life in any form is not desirable, some varieties, as, for instance, the dandelion, are not greatly harmful; while others, as the sow thistle, couch grass, and the Canada thistle, if given a chance, will soon render the growing of certain crops quite unprofitable. A large majority of the weeds found in this country may be kept in check by what may be termed good cultivation, that is to say, by such cultivation as is necessary to grow good crops; but, with reference to other varieties, some specific modes of treatment are required if, when the attempt is made to exterminate them, it is to prove successful. Happily the number

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of the varieties of weeds which are really seriously harmful to crops, and difficult to eradicate, is not very large. In the present state of our knowledge of the subject, it would not be safe to name a definite number which would cover the entire list, nor would it be judicious to do so, as new varieties are coming forward all the time. Notwithstanding, it would probably be not incorrect to say that, at the present time, the varieties of really noxious weeds in Canada do not number much more than a score; and it is greatly encouraging to reflect that we seldom find more than half a dozen kinds entrenched in any one locality.

2. The extent to which weeds have been allowed to multiply. The extent to which certain varieties of noxious weeds have been allowed to multiply is simply alarming. Some of them are, in a sense, taking possession of the land. Notably is this true of wild mustard, the Canada thistle, and the ragweed in Ontario, and of the penny cress and the Russian thistle in Manitoba. In several sections of Ontario, the seeds of wild mustard are so numerous in the soil that, though no more seeds were allowed to ripen during the present generation, there would probably still be a few left to grow plants for the next genera-

tion to destroy. The penny cress and the Russian thistle have so entrenched themselves in some parts of the Northwest that fears have been expressed that, in consequence, the cultivation of the land there may yet have to be abandoned on account of them. Other varieties than those named are increasing with alarming rapidity. So that, unless some heroic measures are taken to destroy them, they will increase more and more, to the great injury of our It is surely a stigma on the agriculture. agriculture of any country, and a withering criticism on the defectiveness of the modes of cultivation that are practised in it, when weeds increase rather than decrease. In the hope of doing something to stay the progress of the great tide of weed invasion and weed aggression, this book has been written. Hence the writer cherishes the hope that every interested reader will exert himself to the utmost to stay the progress of weed extension, by doing his best to utterly annihilate weeds in all their seriously noxious forms.

CHAPTER II.

THE EVILS WHICH ARISE FROM THE PRESENCE OF WEEDS.

The evils which arise from the presence of weeds are very many and very great; so many and so great that it would seem inconceivable that any one should be found willing to offer an excuse for weeds on the ground of their utility. Nevertheless, we sometimes find persons enlarging on their value for fertilizing purposes, and on their utility in arresting the escape of nitrates from the soil through leaching. It is true that weeds may sometimes be turned to good account in enriching the land, if they are plowed under as a green crop before their seeds mature; but more commonly it will be found far better to sow a crop properly suited to the purpose, and one that will at the same time afford pasture, if necessary. A green crop thus sown will also hinder the escape of nitrates more effectively than a crop of weeds, owing to its greater uniformity. Whenever weeds grow spontaneously in sufficient numbers to be of

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much service in either of the ways named above, they are sure to give trouble to whatever useful crop is grown upon the same land, much more than will offset any advantage to be gained from them.

In good farming weeds should not be tolerated at all, because (1) they rob the useful plants that are cultivated of their due share of nutriment; (2) they also injure them by crowding them and shading them; (3) they greatly add to the labor of cleaning grain for market and for seed; (4) they are usually not of much value for food; and (5) they frequently interfere with a regular rotation. To which may be added that the longer they are left to grow unchecked, the greater is the work required to completely subdue them.

of nutriment. Weeds feed upon precisely the same kinds of food as the useful plants amid which they grow, and they are nearly always much more capable of gathering food from the soil. When found growing in a crop, therefore, they deprive either that crop, or the crops that come after that one, of precisely that amount of sustenance which they consume during the period of their growth. The quantity of plant food, therefore, which weeds take from the crops

and the soil will be in proportion to the numbers in which they are found. Nor should it be forgotten that plant food externally applied, oftentimes at much cost, as in the case of commercial fertilizers, will be utilized by weeds quite as readily as the plant food naturally available in the soil itself.

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- 2. Weeds injure useful plants by crowding and shading them. When useful plants and weeds commence to grow at the same time, the weeds will nearly always, in the race, leave the useful plants behind. This is owing to the superior power of gathering plant food which weeds, in nearly all their varieties, possess. When present, therefore, in a crop, they grow, in most instances, more vigorously than the crop itself; and as the latter is intended to grow so thickly that it will require all the room that can be given to it to enable it to perfect its growth, it follows that the injury through crowding from weeds will be in proportion to the number and vigor of the weeds. Weeds also grow more quickly than useful plants; hence, by their shade, they hinder that perfect development of the useful plants which abundant sunlight is necessary to secure.
- 3. Weeds add much to the labor of cleaning grain for market and for seed. Were it not for

the presence of the seeds of weeds, it would not be necessary to spend much time in winnowing grain intended for sale. It is evident that grain entirely free from the seeds of weeds always commands, even in the ordinary market, a higher price than grain that is unclean. And when grain containing weed seeds is put on sale for sowing, the depreciation in value is much greater relatively. The seedsman cannot afford to pay good prices for seed grain of any kind if he must spend much time and labor upon it in removing the seeds of noxious weeds. times it is found impossible to completely separate weed seeds from the grain amid which they are found by any other process than that of hand-picking. With the farmer, in preparing a crop of any kind for market, this would be simply impossible. But all kinds of grain should be considered as unfit for seed so long as any seeds of noxious weeds are found in it.

The difficulty in removing the seeds of weeds from those of grasses and clovers is much greater than in removing them from the cereal grains, owing to the greater uniformity relatively in the size of the seeds of weeds and the seeds of grasses than that which exists in the case of the seeds of weeds and the seeds of cereal grains.

The labor of the cleaning process, therefore, is also relatively greater; and in very many instances the cleaning cannot be accomplished by any process. The only possible way, therefore, of preventing the presence of the seeds of certain noxious weeds in many kinds of seed grains, clovers, and grasses, is to prevent them from ripening in the crops which produce these seeds.

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4. Weeds are usually not of much value for food. If weeds were of much value as food either for man or beast, there would not be the same necessity for waging against them a war of extermination. But usually they are of no value. When live stock feed upon them, it is generally under the pressure of short supplies of their proper food, unless it be when the weeds are very young. Nearly all forms of weed life are possessed of acrid or bitter juices which render them distasteful to live stock, and many of them become so woody at a comparatively early stage of their growth that they are in consequence left undisturbed. Couch grass, it is true, forms an exception. But couch grass is not more valuable than many other kinds of grass; and when we consider the difficulty found in dislodging it from the soil, we cannot regard

it in any other light than that of a most mischievous weed. The value of weeds, therefore, for food is so trifling, compared with the mischief which arises from their prevalence, that we ought never to sow them, or, unconcernedly, to tolerate their presence for such a use.

5. Weeds frequently interfere with a regular rotation. Ordinarily, farming cannot be carried on successfully without a regular rotation. fact is admitted on every hand by the most successful agriculturists. The nature of the rotation will depend upon such considerations as relate to the capabilities and requirements of the soil, the markets, and the facilities for obtaining supplies of plant food. The fertility of the soil can always be sustained in more even balance when a suitable rotation has been found But when weeds become nuand is practised. merous in any of the crops of a rotation, they greatly hinder the profitable growth of these crops. In some instances, this hindrance may be so great as to render the growth of the crops of the regular rotation quite unprofitable until prompt measures have been taken to remove the weeds. The adoption of these measures may necessitate the growing of such crops for a time as may not be desired.

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Finally, the longer weeds are left to grow unchecked, the greater is the labor required to completely subdue them. Were it not for the presence of weeds, the art of tilling the soil would be very much simplified. They, more than anything else, are responsible for the introduction of the bare fallow, which is not only costly in respect of time, but also involves much Once get the mastery of the more noxious forms of weed life, and the bare fallow is no longer an absolute necessity on any farm. Weeds also add greatly to the cost of growing crops which require cultivation, such as corn and roots, as those engaged in raising these crops know very well. It would be impossible even to approximate to the cost of labor expended annually in the destruction of weeds, but it is a very large sum, and one that in many portions of this continent is continually increasing, since the cost of subduing weeds must always increase as the weeds themselves increase in number.

CHAPTER III.

THE POSSIBILITY OF DESTROYING WEEDS.

The prevalence of noxious weeds in the United States and Canada is simply alarming. They abound on every hand. In many sections, in one form or another, they flourish in every field, and luxuriate in every crop. Gardens, which, above all places on the farm, should be clean, are literally overrun with them. They occupy the sides of nearly every road throughout the whole continent. To so great an extent do they prevail everywhere that they form one great dark blot upon the boasted progress of the nineteenth century, and are a foul reproach upon its civilization.

The extent to which weeds prevail in nearly all parts of this continent would lead one to suppose that the farmers had abandoned all efforts to destroy them, and were content to gather from their fields, in the form of crops, merely what the weeds allowed to grow there. This apathy seems to arise, in part at least, from a disbelief in the possibility of destroying weeds

without incurring so much labor and expense in doing so as to make the work unprofitable. As the matter presents itself to the writer, there is not a shadow of a hope that the weeds of this continent will ever be destroyed by the farmers thereof, so long as their complete eradication is looked upon as impossible, or so long as the belief is harbored that the outlay of labor and expense in completely eradicating them will not be repaid by the greater gains that will be obtained when once their destruction is effected.

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m ds Four propositions are now submitted which bear upon the subject of the complete eradication of weeds. So confident is the writer of the soundness of these propositions that he makes them as strongly affirmative as possible. They are as follows:

- (1) The noxious forms of weed life can be completely eradicated on every farm throughout the whole continent if the farmers of these farms resolve that so it shall be.
- (2) Complete eradication can be effected without heavy outlay, if the work be done in the proper way.
- (3) When weeds are once eradicated, it will be easily possible, with but little outlay, to still keep them so.

(4) The profits of farming will be, relatively, much larger where farms are kept entirely free from noxious weeds.

The writer is by no means unconscious of the fact that the assertion of these propositions will bring cold scorn to the lips of some who read them; but he finds comfort in the reflection that they will be distasteful to no one whose heart is really set upon the complete eradication of the noxious weeds that may exist on his own farm.

I. The noxious forms of weed life can be completely eradicated on every farm. By the assertion that the more troublesome forms of weed life can be completely eradicated, it is meant that they can be so effectually exterminated that they will practically cease to interfere with any rotation that may be desired. Nay, more; it implies that they can be completely banished, root and branch, from every farm where the attempt is made, except in so far as their seeds are brought back again by natural or other agencies; and that with the necessary watchfulness the plants which grow from these can, in turn, be destroyed with but little difficulty. Many persons seem to hold the view that while weeds may be held at bay, and kept from

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seriously hindering the growth of crops, they cannot be wholly destroyed. They claim that while weeds may be thus far conquered, nevertheless they will come again, and therefore that the hope of eradicating them completely is not to be cherished. Those who hold this view shape their practice accordingly. They adopt some method of cleaning a field that proves fairly successful, and then during the years that immediately follow give the same field no further special attention. The consequence is that this field soon again requires to be put through some special cleaning process, owing to the increase of the weeds which were but partially eradicated by the previous cleaning process. If this practice were a good one, it would involve the correctness of the untenable theory that, in correcting error and uprooting evil, it is better to do it partially rather than wholly. So long as the belief is cherished by those who are most interested, that the complete eradication of noxious weeds is impossible, so long will weeds continue to prevail. To so great an extent is this belief indulged in that it would probably be found a greater task to correct it in the minds of many farmers than to uproot the weeds themselves from their fields. To banish weeds completely from any farm

will not only require the wise and diligent use of measures of a certain character, which will be described in succeeding chapters; but, when once they are gone, it will also require the most persistent watchfulness to still keep them away. With public sentiment on this subject as it is at present, it will be found impossible to get those who are most directly interested to act in concert in destroying weeds; hence the work of even materially reducing their numbers will necessarily be slow. The work of banishing weeds from any country would not of necessity extend over many years if all the farmers of the country would but act in concert. The spectacle would then be witnessed, for the first time since Edenic days, of an inhabited country without noxious weeds to harass and annoy the tiller of the soil. But because farmers, at present, cannot all be persuaded to put forth the effort to banish weeds, root and branch, from their premises, no one engaged in agriculture should refrain from doing all that he possibly can to bring about this Though our neighbors should not now believe in the possibility of being able to banish noxious weeds from their farms, if our own farms are made clean and kept clean, the evidence thus presented will in time have its due measure of influence.

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2. The complete eradication of noxious weeds can be effected without heavy outlay if the work be done in a proper way. To argue the truth of this proposition in an abstract, theoretical fashion would be to spend time to but little purpose. It would not succeed in winning many converts to the truth. Those who cherish the belief in reference'to weeds that "the thing that hath been is that which shall be" cannot be reached by any such line of reasoning. The evidence of actual accomplishment is the only testimony which they will not be inclined to reject. Evidence of this kind is not very plentiful, as pursuit of our theme, we have entered a domain with but few inhabitants. Therefore, because of the paucity of such evidence at the present time, and of the lack of the necessary data bearing upon the cost of cleaning farms from weeds, the writer, of necessity, must fall back upon his own experience, and use as evidence the work that has been accomplished at the Ontario Agricultural Experiment Station at Guelph since it came under his supervision in the autumn of 1888.

As was abundantly apparent in the season following his appointment, this farm at that time

was not in a clean condition. The Canada thistle prevailed to a greater or lesser extent over the whole of it. In some of the fields the spring cereal crops were so smitten with this pest that they had to be cut in the green stage to prevent the maturing of thistles in countless numbers. In several of the fields, during the balmy month of June, ox-eye daisies spangled meadows and pastures with a glory all their own. The yellow blossoms of the wild mustard plant lent variety to the foliage of every field, and in some fields their beauty was painfully profuse. Great fat burdocks revelled among the stones that were strewn along the numerous fence borders. Pigeon weed and wild flax were plentifully sprinkled in some localities, while in others the sow thistle had obtained a firm and menacing footing. Couch grass had laid claim to a monopoly of more than one field. Ragweed was plentifully strewn over one or two fields. Bindweed had taken possession of small areas here and there, and blueweed had fixed its firm grip on some of the pastures. Here, then, was a capital opportunity for experiment in the eradication of noxious weeds.

It would not be correct to say that any one of these varieties of weed life is now completely

gone. A few straggling survivors will yet be found from year to year; but these, in nearly all instances, come from the seeds which lie in the soil ready to spring into vigorous existence when favorable conditions occur for them. But it may be said, in all fairness, that none of these various forms of weed life are now present in sufficient numbers to cause serious annoyance to cultivation, or real injury to the crops that are desired to be grown.

To estimate with absolute precision the cost of bringing the aforementioned Station Farm into the condition of cleanliness indicated would probably be an impossible task, owing to the many complications that arise in fixing the proportion of the outlay that should be charged to the growing of the crops and to the eradication of the weeds respectively. The utmost that can be hoped for is an approximation to the real cost. Such an approximate estimate was made and published in the Annual Report of the Ontario Agricultural College and Experimental Farm for 1891, pp. 51 and 52. better course, probably, can be adopted here than to make a quotation from the Farm Department portion of this report, prepared by the writer. The subject in hand is therein discussed in the following language:

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"The question of the cost of cleaning this farm will doubtless be raised by the enquiring mind, and it is well that it should be. reference to this, I desire to say that I am satisfied that the only outlay for which there was no direct return was that paid for hand spudding. The hoed crops would certainly all pay for the cost of producing them. On much of the land, two crops were grown each year during the cleaning process. On the land gangplowed after harvest, compensation for the outlay was frequently obtained in the catch crops grown. I regret that no account was kept of the exact amount expended for hand spudding in 1889. In 1890 the time spent in spudding was 498½ hours by one person, which, at \$1.25 per day of ten hours, would amount to \$62.31 1/2. In 1891 the time thus spent upon the farm amounted to 489 hours, which would cost \$61.12½. For the two years, then, the outlay for spudding was \$123.44. This does not include spudding on the road. On the supposition that as much was expended in spudding in the year 1889 as in the two following years, and this estimate is certainly a liberal one, the whole outlay for spudding in the three years would not be more than \$250.00. Now, suppose the

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400 acres, or thereabouts, of arable and pasture land on this farm had been cleaned by the process of the bare fallow during these three years, that is to say, one-third of it each year, the cost of hired labor of man and team, with rental of land added, in the absence of crop, would have been from \$3,200 to \$4,000. This calculation is based on the assumption that the cost of the bare fallow, when all the labor is hired and the rental of the land included, would be fully \$8.00 to \$10.00 per acre."

When the work of the bare fallow is done by the farmer, it will not, of course, be nearly so costly to the person doing it as when the labor of man and team is hired; but in whatever way it may be done, it will cost several times more per acre than the sum actually paid per acre for spudding during the three years in which the Ontario Agricultural Experiment Station at Guelph was being freed from weeds.

3. When noxious weeds are once eradicated, it will be easily possible, with but little outlay, to still keep them so. This proposition is so reasonable that it should scarcely require any argument to demonstrate its correctness. Nevertheless, it is one which runs strangely counter to popular opinion. We find many ready to say that the

task is a hopeless one, that weeds will continue to come through all time, and that to keep them completely at bay will be found a process costly out of all proportion to the benefits accruing. That noxious weeds, even when once etadicated, will come again is certainly true; and that they will keep coming is equally true; but that it will cost more to keep them wholly banished than only partially banished is altogether illogical.

Such reasoning would involve the untenable assumption that when weeds are plentiful they are relatively easier to fight than when they are few; and that while it would be a wise and commendable course to reduce the number of weeds on a farm, there is a limit beyond which further reduction ought not to go.

If a farm that is very dirty can be made partially clean with advantage to the farmer, it seems reasonable to think that to go a step farther and to render it altogether clean would be a still greater advantage; and that if a farm can be partially cleaned and yield profit to the owner, this profit will not only be correspondingly greater if the farm be perfectly cleaned, but that the labor and cost of maintaining cleanliness will continually decrease with the increasing perfection of the cleanliness.

It may be well to state here that the term "clean," as applied to freedom from the presence of noxious weeds on farms, is used in this work. in a relative sense. Of necessity, it must be so; for so long as weed seeds are carried from place to place by means of such agencies as birds, waters, and winds, we shall never be able to say that a farm is absolutely clean. Though one year it were to be made perfectly free from noxious weeds, the following year a number of weeds would probably grow from seeds brought by some one or other of the various agencies concerned in weed distribution. When, therefore, a farm is spoken of as clean in this work, it is meant (1) that it is so free from noxious weeds that, practically, they do no injury to the crops that may be grown upon it; and (2) that such weeds as are found upon it are so few in number that one can remove by hand or with the spud, in one day of ten working hours, all of them found growing in, say, any ten consecutive square acres of the farm. definition may seem arbitrary; but since absolute freedom from noxious weeds is not, at any rate for the present, to be looked for, some definition seemed necessary to prevent misconception. A definition was chosen, therefore, within

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d, g reasonable reach of attainment, and such as would serve all practical purposes. The mode of securing and maintaining the above-defined degree of cleanliness will be described in subsequent chapters.

To show that the work of *maintaining* cleanliness is not necessarily expensive, it will be sufficient to quote again from the Report of the Ontario Agricultural College and Experimental Farm for 1891. On page 52, the following statements are made:

"It may not be amiss here to venture two or three remarks that are general in their nature in reference to cleaning farms. I desire to say, first, that it is my firm conviction that the farmers of this province may have clean farms if they so desire it; second, that farms may be cleaned without great outlay, and ordinarily without resorting to the bare fallow; and, third, that when farms are thus cleaned the work of keeping them clean will not be difficult, providing due vigilance is exercised. When a field is cleaned, it can easily be kept clean by the use of the spud and autumn cultivation, in addition to the cultivation necessary to the production of the crops grown. When thus cleaned, the hand spudding, essential in keeping fields clean of

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weeds, should not be more than \$25.00 per year for 100 acres. We expect to keep this farm clean henceforth at an outlay of not more than \$75.00 per annum, over and above the ordinary outlay required in good cultivation. This estimate includes private roads, fence borders, unbroken pastures, and by-places."

Some of the statements in the quotation just given may appear extravagant, even to practical men. The idea of bringing farms into a clean condition, and then keeping them so, seems to be entertained by so small a number that those who attempt to propagate such views will, by many, be looked upon as enthusiasts. The writer feels free to say, however, that this opinion is not the view of a mere enthusiast; and no man should regard it as such until he has first honestly made the attempt to clean his own farm on the lines laid down in this book, and found that he cannot profitably do so. This opinion, it may be added, is sustained by the experience of 1892 in the management of the Ontario Agricultural Experiment Station at Guelph.. An accurate account was kept of the time spent in hand spudding that year. amounted to 512 hours, which, at \$1.25 per day of ten hours, cost but \$64.00, a sum considerably less than \$25.00 per 100 acres. And this cost includes the entire work done in the way indicated on "private roads, fence borders, unbroken pastures, and by-places," in addition to that expended on the cultivable portions.

4. The profits of farming will be relatively much larger where farms are kept entirely free from noxious weeds. The correctness of the proposition here made will surely be apparent to the reflective mind; but if proof is wanted, it is easily found.

Since weeds feed upon identically the same food as useful plants, it follows that where the former take up a portion of the plant food there will be just that much less for the crops amid which the weeds grow. Where weeds are more numerous in a crop than the plants of the crop, much more of plant food is used by the weeds than by the crop; for weeds are more ravenous feeders than useful plants. Moreover, through the crowding and shading by weeds of the crop plants, crops are very much injured, as was stated in a previous chapter. Here, too, the injury will be in proportion to the number and strength of the weeds, and crop-yields will be correspondingly diminished. The view has been advanced that sometimes noxious weeds

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should not be cut down in pastures, for the reason that they encourage the growth of grasses, inasmuch as they furnish shade to them. This would be equivalent to saying that grasses robbed of nutriment by overshadowing weeds, and grown in the absence of sunlight, would be more abundant and nutritious than grasses occupying the ground alone. Such argument should be consigned to a deeper shade than the rankest weeds can possibly furnish.

Again, weeds growing in crops increase the labor of handling the crops, and to no useful purpose. Here, too, the increase in labor will be in proportion to the extent to which the weeds are present; and with all increase in labor that is not followed by a corresponding return, there must be a decrease in the profits. Weeds increase the labor of harvesting the crops amid which they grow, whether these are cereal or hoed crops. Grain crops are much more difficult to reap where weeds abound, since the latter are more branching in their habits of growth than cereal plants, are more woody in fibre, and are of greater height proportionately —the latter characteristic resulting from a tendency to a more prolonged state of greenness in some portions of the plants. And hoed weeds abound, since weeds frequently hinder freedom of locomotion on the part of the workmen, impede the working of the implements used, and increase the difficulty of handling the crop. Moreover, weeds materially increase the difficulty of curing both cereal and grass crops by prolonging the curing period; and in proportion as this period is prolonged, the liability to loss from adverse weather is increased.

When weeds become so numerous as to disturb the regular *rotation*, they necessarily interfere with the profits that would otherwise accrue. A disturbed rotation generally leads to the growing of some crop that is less desirable than that usually grown. This, in turn, may lead to disturbed market relations, a greater necessity for the purchase of artificial fertilizers, and even of certain farm foods that may be wanted, and to various other evils, some of which have been mentioned in Chapter II.

The *labor* required in cleaning the ground from weeds increases with the increase of the weeds, and the farm profits are therefore to that extent reduced. More particularly is this the case in growing hoed crops. With the multi-

here plication of weeds hand labor especially is nder increased, because more labor is required to remove weeds from the line of the rows; and the the plehand labor thus employed is always relatively ındmore expensive than horse labor. Because of inthis, the untenable conclusion has been reached and by some that, in America, it will not pay to grow od; crops which require hand labor to keep them ged, But the labor of cleaning by other modes, such as the bare fallow, is also increased r is as weeds multiply; and this increase of labor not only results from the greater frequency with diswhich the bare fallow would have to be resorted terue. to by those who practise it, but also from the the thoroughness with which the bare fallow would ble have to be managed to make it effective when weeds are plentiful; to say nothing of the loss nay that is occasioned by the greater frequency of ter the seasons when crops can not be grown because ers, be of the land lying idle in bare fallow. ich

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CHAPTER IV.

THE AGENCIES CONCERNED IN THE DISTRIBUTION AND PROPAGATION OF NOXIOUS WEEDS.

The means or agencies concerned in the distribution and propagation of noxious weeds are chiefly the following: seed grain, grass seed, clover seed, etc.; farm live stock; purchased feed stuffs: farmyard manures: packing-cases. crates, etc., that have been used for the carriage of goods; road and farm vehicles, etc.; implements of tillage; railways; threshing machines; birds; wild animals; waters; winds; and the inherent powers of the weeds themselves. Some of these means or agencies are entirely under the farmer's control, as, for instance, the last mentioned: some of them are but partially under his control—that is, as far as weed distribution is concerned—as, for example, the vehicles that pass along his roads or are used upon his farm; and some are entirely beyond his control, as, for example, waters and winds. These various means or agencies will now be considered in the order in which they have been mentioned. ION

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I. Seed grain, grass seed, clover seed, etc. no other agency, perhaps, are weeds so widely and so generally distributed as by the seed the farmer uses to produce his crops, as grain seed, grass seed, and clover seed, more especially the two latter. The carrying power of the world has become so great that seed intended for sowing can be brought from the farthest distances to be sold in any market where there is a demand for it. This is particularly true of the less bulky and lighter sorts of seeds. Owing to the ready facilities which are thus afforded for obtaining supplies of these seeds, there is a tendency in those districts where fair yields are not commonly obtained to purchase them from distant parts rather than to raise them at home. The demand thus begotten and sustained encourages the growth of the various sorts of seeds in those centres that are found most suitable for them. Unfortunately, those centres which are generally possessed of uncommon fertility oftentimes produce the seeds of hurtful weeds quite as freely as those of the useful clovers, grasses, and grains; and owing, in very many instances, to their similarity in size to the useful seeds in which they are found (especially if these are grass seeds or clover seeds), it is almost impossible, by any process of cleaning that may be adopted, to separate the seeds of weeds from the useful seeds which are intended for sowing. The distribution, therefore, of these weed seeds is as wide as that of the useful seeds in which they are found, and, it may be added, is as continuous. The seeds of millets are also a fruitful agency for the dissemination of weed seeds, though not perhaps to the same extent as are seeds that are smaller.

The renewing one's stock of cereal grains by the purchase of new seed, or by the exchange of one's own seed for other seed, is a common practice among farmers, and it has many things to commend it; but along with the new seed there too frequently comes an influx of the seeds of the most troublesome weeds. Although this is a less fruitful source of weed-seed dissemination than that which has just been spoken of, it furnishes the explanation of the arrival upon our farms of many forms of weeds, the presence of which we could not otherwise account for.

Moreover, the disposition is growing on the part of farmers, and happily so, to test by local trial the suitability of the various sorts of farm seeds that are to be obtained in foreign countries.

But this work has its dangers as well as benefits. In the old world, as in the new, it seems almost impossible to buy seed in the open market entirely free from the seeds of foul weeds. When, however, foreign seeds are distributed through the medium of our agricultural experiment stations, a considerable degree of assurance is furnished the farmer that he will get pure seed; but it would probably be claiming too much for those stations to say that, even when the farmer takes this precaution, there would be no danger. So long, therefore, as farm seeds are bought in the open market, so long will there be some danger that the seeds of noxious weeds will be brought to our farms by means of them.

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2. Farm live stock. Very frequently weed seeds are introduced upon a farm by being carried in the hair or wool of live stock brought from other centres. Sometimes the weed seeds cluster about the hair of the mane and tail. When the animals are given the freedom of a pasture, or, as is sometimes the case, the freedom of the farm, these seeds lose their hold, and, dropping to the ground in divers places, begin at once their mischievous work. If, for instance, a flock of sheep were bought in a locality where weeds abounded, and were brought to a clean

farm, and then hurdled, say, in a corner of a field of the same, while they were being subjected to the process of tagging, the number and variety of the weeds that would be found growing in that spot the next season would be surprising. The writer can testify to the correct ness of this statement from personal experience and observation.

Again, live stock distribute the seeds of various sorts of weeds in divers places by means of their droppings. This mode of weed distribution, though somewhat local, is very common, and should be borne in mind when removing cattle from fields infested with noxious weeds to other portions of the farm which, as yet, may not be infested with them.

3. Purchased feed stuffs. Weeds are very frequently introduced into new localities by being carried in the feed stuffs that are brought from distant places to supplement the food that is grown upon the farm when local supplies run short. More especially is this likely to be the case in those localities where dairying or the fattening of live stock is carried on extensively. In fact, weed seeds have long been thus distributed in both grains and fodders; but until recently in the latter only locally, owing to the

difficulty which has existed of transporting fodders long distances. But now, when fodders are baled for ease of transport, weed seeds are carried long distances in them as well as in grains. Indeed, fodders are now a more dangerous means of weed distribution even than grains, since fodders are usually fed without being subjected to steaming; whereas, when grains are purchased for feeding, they may, before they are fed, be steamed or ground for the purpose of destroying the vitality of such weed seeds as may be found in them. Persons who purchase mill screenings which have not first been ground or crushed, and who feed them without first subjecting them to a hot steaming, are certain to bring noxious weed seeds to their farms in countless numbers.

4. Farmyard manures. Weeds are distributed in countless numbers by the agency of barnyard manures, a fact which farmers generally know very well. And more especially are they distributed by means of the manures which are purchased in towns and cities, owing to the various sources from which the feed stuffs which are used in these places often come. The purchaser of feed stuffs in towns and cities has not the same interest in looking into the purity

of what he buys as the farmer; hence it would probably be exceptional to find the manure obtained from him entirely free from the seeds of foul weeds. But although manure is one of the most common agencies by which weeds are distributed, the weeds that are distributed by means of manure are likely to be local in character, rather than distant and foreign.

5. Packing-cases, crates, etc., that have been used for the carriage of goods. Noxious weed seeds are frequently introduced into new localities by means of the straw or chaff in which goods have been packed for carriage. packing-cases which have held the goods during transport, thus having served the end for which they were primarily made, are oftentimes purchased by farmers for certain uses. When these are brought home by the purchasers, the packing material which they contain is thoughtlessly emptied out upon the manure heap, or thrown aside in some undisturbed by-place; by which means the weed seeds which they contain are given opportunity to produce plants in centres perhaps hundreds or thousands of miles distant from the nearest point where any of the same species may be growing. In this fact we find an explanation of the sudden appearance

of weeds in new centres where their presence otherwise would be hard to account for; and this is more especially true of sections in proximity to cities.

As a similar method of weed distribution, it may be mentioned how, in the days of early settlement, travellers used to carry many weed seeds in the provender that they brought with them for their horses, and which the animals ate by the road sides, or wherever convenient; and the same remark is true of the present pioneer settlers of the Northwest, who thus often introduce weed seeds into their allotments before they have sown their first crop.

6. Road and farm vehicles. Noxious weed seeds are frequently brought to farms by the wheels of vehicles which have been driven along the highway. The spread of ragweed furnishes an ominous example of this sort of weed distribution. The seeds of this weed, and also of others that luxuriate along the public roads, are carried in the mud and dirt and dust that clings to the wheels of every passing vehicle, and in this way they are brought within the precincts of the farm. Sometimes they are thus conveyed for miles, not merely by the vehicles used by the farmer himself, but also by those belonging to

other parties; and from this sort of invasion the farmer is, in a sense, powerless to protect himself. In a similar manner, weed seeds are also conveyed from one part of the farm to another.

7. Implements of tillage. Weeds are, to a considerable extent, distributed by the ordinary implements of farm tillage, to which they cling during the various processes of cultivation. But while this is true, to some extent, of all kinds of weeds, it is more especially true of those weeds which multiply by means of creeping root-stocks. These root-stocks readily cling to the plow, harrow, or cultivator, and are thus carried from one portion of a field to another, or even from one field to another; and thus new centres of distribution are constantly being established. And more especially is this true when the ground is so damp that it tends to stick to the implements used. Seeds or root-stocks embedded in the earth that is thus carried from place to place are frequently deposited in new centres, where they spring up to carry on the work of further multiplication. The distributing power of the implements of tillage under favorable conditions furnishes us with one explanation of the rapid multiplication in our fields of such

weeds as couch grass and the Canada thistle, when once these pests have obtained a footing in them.

8. Railways. Railways seem to be a wonderfully effective agency in the distribution of weeds. While their influence in this respect is recognized on all hands, it is probably not so easy to account for it. We find one explanation, however, in the weed seeds that escape from the fodder supplies that are consumed by the horses and other beasts of burden used in constructing them; a second is found in the necessary work of cleaning cars in which live stock is carried. The litter with which these cars are supplied frequently contains noxious weed seeds; and, falling to the ground, these become rooted in the soil adjacent to the track, and commence to reproduce their kind. third explanation is found in the fact that oftentimes the weed seeds contained in the grain that is being carried along the railways escape through minute openings in the cars, and, being caught by the wind as they fall, are wafted to the sides of the track, and even beyond, where they lodge—it may be on soil in a condition of cultivation quite favorable to their germination. In these and other ways, the railways of the

country have become largely responsible for the introduction of new and troublesome weeds into localities where previously they were unknown.

- o. Threshing machines. Threshing machines, during that portion of the year in which they are used, are continually bearing the seeds of noxious weeds from farm to farm, and from district to district; for at every threshing, if weed seeds are present at all, some of them are sure to become lodged in the various parts of the machines, and to remain long enough to be carried away. In this mani from year to year, a very general local distribution is sure to be effected of every form of noxious weed which is able to mature its seeds in a grain crop. Farms that are managed in the most unexceptionable manner oftentimes thus become infected, for a time at least, with the taint of noxious weed life.
- 10. Birds. Birds carry weed seeds to great distances. A sprig of a plant, on which the seeds have not yet left the capsules in which they grew, is caught up by some feathered traveller of the air and carried to places far away where the food which the seeds afford can be enjoyed without molestation. Some of the

seeds thus carried off find their way to the ground below rather than into the maw of the bird, and in this way set into activity new centres of weed distribution. The instinct for nest-building not infrequently leads to similar results. In this fact we find an explanation of the unexpected appearance of weeds along the rims of forests, and in other localities where the soil has never been subjected to cultivation.

II. Wild animals. Certain wild animals are, in their innocency, the local distributors of weeds; for being, like human beings, fond of a varied diet, they do not hesitate to include the seeds of certain weeds in their list of desirable Sometimes they store away weed seeds in their winter treasure-house when laying up their winter's supply. They also find use for the foliage and stems of weeds in building their lairs or nests. When gathering these, they sometimes, like over-ambitious boys, attempt to carry loads which are more than they can manage, and so they leave a part upon the way. their forgetfulness, they may not return for the abandoned portion. The seeds that are thus distributed here and there on the soil, or are dropped at the mouth of the burrow, or are left unconsumed in the nest, spring at length into vigorous life, and commence again the work of weed distribution.

12. Waters. Few agencies are more potent in the distribution of the seeds of weeds, especially of such seeds as float readily, than water. When the valleys are deluged by heavy rains, or when they are turned into streams or rivers by the melting of the snows, such weed seeds are raised to the bosom of the floods and borne away in countless numbers to lower levels, on the soil of which they are deposited when the waters recede. A fresh seeding is in this way scattered, from year to year, over the surfaces that are thus exposed, to harass and perplex and annoy the husbandmen that till them. As things are at present, there is no effectual protection from this sort of invasion. So long as careless farmers on the higher grounds allow the seeds of noxious weeds to ripen annually on their fields, so long will the farmers on the lower levels have vagrant weed seeds strewn upon their fields in countless numbers. The only remedy is for the strong arm of the law in some way to intervene, and by the force of its authority compel the careless farmer to cease troubling, in this most reprehensible way, his unoffending neighbor.

13. Winds. Some forms of weed life are widely distributed through the agency of winds. This is especially true of those weeds the seeds of which have downy attachments that enable them to rise in the air when they are fully matured. Happily for the agriculturist, many of the seeds so endowed are impotent to grow for lack of proper fertilization; but, unfortunately, there are nevertheless too many of them that are fertilized. Hence many sorts of weeds are continually finding their way to new centres, to which they have a passage as silent as it is free. Some of these downy travellers are well able to sustain their flight to incredible distances; others, on account, in part, of their greater weight, are able to be carried but for short It should certainly fill us with some distances. concern to reflect that the winds of heaven, while engaged in the beneficent work of purifying the atmosphere, are also engaged, especially in certain seasons of the year, in scattering everywhere the seeds of many exceedingly troublesome weeds, which have been strangely endowed with singular powers of flight. While it is greatly important that no form of noxious weed should ever be allowed to mature its seed, it is at least doubly so in the case of weeds the seeds of which are able to rise in the air.

But winds distribute the seeds of weeds by their driving as well as by their carrying power. The seeds of some weeds remain in their capsules long after their season of growth is over; in some instances even until the approach of spring. These are often shaken out by the force of the winter winds, and are driven incredibly long distances; till at length, finding a resting place, they remain harmless till spring arrives, when they begin again their work of baneful reproduction.

In the carrying and driving power of the wind, we find an explanation of what would otherwise be difficult of solution, namely, the sudden appearance of weeds in countless numbers in areas which have been disturbed for the first time by the plow, or from which the forests have been but recently removed. In some instances, in such places, the weeds appear in numbers so great that, for a time, they form the principal product of the soil. It is this phenomenon which has given rise to the baseless opinion which is still cherished by many, namely, that weeds originate spontaneously, springing into life without a seed germ, or else that they grow from seed which has been for ages lying in the soil.

14. Inherent powers of the weeds themselves. Weeds also spread and distribute themselves by means of what may be termed their own inherent powers; that is to say, by ripening seeds which are shed on the ground around the parent stem, or by means of creeping root-stocks. By the former method, whole families are often reproduced around one parent stem in a single season; and, by the latter, many weeds are continually spreading and occupying wider and wider areas. These powers of reproduction enable weeds to multiply rapidly, without the aid of any of the agencies previously mentioned; that is to say, when once the weeds have been brought into new centres by one or other of these agencies.

With the agencies that have been mentioned continually engaged in the work of weed distribution, and also with others that have not been mentioned, the task of the eradication of weeds does, at first thought, seem appalling. But while the power of weeds to multiply and spread is very great, the power of man to banish and destroy them is greater; unless, like the waters of the mountain torrent which are left to idly play and gambol on their way to the plain, this limitless power is allowed to pass unutilized with the rush of crowding opportunities. While it is

true that there can be no discharge in this war, it is equally true that there can be no defeat for the resolute tiller of the soil who persistently and constantly strives to keep his farm clean.

It has already been mentioned that over some of these agencies of weed distribution we can exercise but little or no control. These are the untamable agencies of nature—as wind and water, and such other agencies as wild animals and birds. We must, so far as these are concerned, submit to the inevitable, and fight them, when we are subjected to their influence, as best we may. Our resource here is to slay the weeds as soon as possible after they rear their heads above the soil; and, in any event, at least before they mature their seeds.

Where the agencies are but partially under our control, as, for example, implements of tillage, or threshing machines, our duty is, by watchfulness, patience, and care, to control the agencies so far as we have power. The judicious exercise of this control will always be found easier than the eradication of the weeds which they have been allowed to bring to us.

When the agencies are practically completely under our control, as, for example, that of the inherent power of the weed plant to ripen its

own seeds, or to spread itself by means of creeping root-stocks, the measure of the persistency of our efforts to defeat this power will be the measure of the time required to effect complete extermination. If weeds multiply upon our farms by the shedding of their seeds, it is because we allow them to do so; and if they multiply by means of lateral root extension, it is because we do not use the resources which we have at command to prevent this extension; as will be shown later. The farmers who tolerate either of these methods of weed distribution will never have clean farms. We sympathize with the the man of scripture in whose fields, when he slept, the enemy sowed tares; but he deserves no sympathy who negligently allows weeds to ripen +1 eir seeds upon his farm, or to propagate themselves by means of root extension. a man should put a mark upon himself. should brand himself as one indifferent to his own true interests, who allows voracious intruders from year to year to prey upon the sources of his own prosperity.

CHAPTER V.

METHODS AND PRINCIPLES GENERALLY APPLICABLE IN THE DESTRUCTION OF WEEDS.

In the conflict with weeds, there are certain general methods and principles which are applicable in a greater or less degree for the destruction of all weeds; and there are also certain specific modes of treatment which apply only to the eradication of particular sorts of weeds. In the present chapter we shall consider the general methods and principles applicable in weed destruction, and shall in our next and concluding chapter treat of the specific modes which are applicable only in particular cases.

The general methods and principles applicable in weed destruction which, in the writer's opinion, are of the most consequence, may be described as follows:

(1) The persistent and careful study of the habits of growth of all the various sorts of weeds with which one's farm is infested, so as to be able to deal with them in the most rational way possible.

- (2) The modification (when necessary) of the scheme of rotation that has been adopted, so that such crops as allow the seeds of the weeds which infest them to ripen may, for a time, be omitted from the rotation.
- (3) When certain methods of eradication have been fixed upon, the careful and wise adaptation of these methods to such conditions of soil and climate as are found in the locality concerned.
- (4) The exercise of due care, when seeds are purchased, to see that they are perfectly pure, that is, perfectly free from the seeds of weeds; and also the exercise of due care with respect to such seeds as are grown at home to see that they, too, are perfectly free from weed seeds.
- (5) The exercise of due care to see that the threshing machine, especially when it comes directly from a farm infested with any form of noxious weed, is thoroughly cleaned before it is used.
- (6) The exercise of due care to see that the chaff from the fanning mill, when it is suspected of containing any weed seeds, is burnt or otherwise thoroughly dealt with, and that all screenings are also carefully looked after.
- (7) The growing of hoed crops upon the farm infested, to the largest extent that is practicable.

- (8) The growing of clover and lucerne, so far as this can be done with profit.
- (9) The growing of soiling crops, to the extent that may be found practicable, both because of the fact that they can be cut almost at any time that is desirable, and also because of their "smothering" properties.
- (10) The utilizing of sheep for the destruction of weeds in pastures.
- (11) The growing, as far as possible, at home, of the food required by the live stock of the farm, instead of purchasing it elsewhere.
- (12) The keeping of the land of the farm constantly at work, so far as this can possibly be effected.
- (13) The stimulation of the soil to a constantly vigorous production by means of thorough working and a large use of manure.
- (14) The practise of autumn cultivation to the largest extent that is possible.
- (15) The exercise of the utmost possible precaution that no weed seeds ripen upon the farm, if by any means whatever their ripening can be prevented.
- (16) The giving of due heed to all the agencies by which weeds are distributed and propagated, so as always to be able to counteract or defeat those agencies.

(17) When once the work of eradication has been undertaken, the making of it as thorougn as possible, and the accomplishment of it in the shortest possible time.

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nof (18) When once a state of cleanliness has been secured, the maintenance of it thereafter as perfectly as possible under all circumstances.

It is greatly important that these general principles and methods wiich appertain to weed destruction should be well understood and carefully observed; for, indeed, these are even more important than those specific modes of weed destruction which are described in the next chapter. In fact, unless in our management of the farm we pay the utmost heed to these general principles and methods of weed destruction, we can never hope, in our war with weeds, to be completely successful. As the writer has made it his habit for many years to test the value of the abovementioned general principles and methods by constantly putting them into practice, he will here set down in specific directions, for the benefit of his brother farmers in this most important question of weed destruction, such remarks as he thinks his experience entitles him to make.

I. Study their habits of growth. In the war with weeds we must study their habits of growth, and adapt our methods of fighting them to fit in with these habits. Weeds, like other plants, are classified as annuals, biennials, and perennials.

Annuals, as their name implies, complete, as a rule, the cycle of their existence in a single season; although, in some instances, they may, perhaps, spring into life during the previous year, as is the case sometimes with wild flax and pigeon weed. But more commonly they begin to grow toward the approach of spring. Of this class, a most common example is wild mustard. It follows, then, that as weeds of this class can live but for a single season, if the plants of any particular sort of weeds of this class are prevented, upon any farm, from ripening their seeds year by year through successive years, the time must come, sooner or later, when, on that farm, that sort of weed will be completely destroyed; and, of course, this is true whatever may be the means that may be adopted to prevent the seeds from ripening. In fact, the weeds would all be destroyed in a single year were it not that many seeds, because of the oily coating in which they are, as a rule, encased,

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have great power to resist decay, and may, therefore, remain in the soil for many years without their vitality being lost or even impaired. Some seeds of this class of weeds, as, for example, those of wild mustard, retain their vitality for an incredible length of time; so that, perhaps years and years after their formation, whenever they are brought sufficiently near the surface by cultivation, or by other means, at any time during the congenial season of growth, they at once spring into vigorous life. The means to be taken, then, in destroying weeds that are annuals, should be, first, to prevent them from maturing their seeds; and, second, to adopt such modes of cultivation as will most quickly force the seeds that are in the soil into germination, so that they may spring up, and, in turn, be The means best fitted to secure this quick germination of the buried seeds of annuals are the growing of root crops and "autumn cultivation." At all events, when, year by year, the seeds of annual weeds are kept from ripening, and when the agencies concerned in their dissemination are effectually looked after and checkmated, the time cannot fail to come when this class of weeds will all be destroyed.

Biennial weeds complete the cycle of their existence in two years. Many of them are characterized by a tap root, growing deep into the soil. During the first year large quantities of starch are stored up in this root, which, the next year, is utilized in producing an abundance of seeds. The burdock furnishes an excellent example of this sort of weed, being well known and common in many lands. As this class of weeds are reproduced from seed only, it is evident that any mode of destruction that will prevent them from producing seed will also in time effect their destruction. But it may take years to accomplish this, as the seeds of this class also have great vitality. Fortunately, however, biennial weeds cannot well resist the destructive effects upon their roots of thorough cultivation; hence we find this class of weeds more common in old meadows and pastures, along roadsides, and in by-places generally, than in fields that are cultivated. In areas which cannot be cultivated, therefore, their destruction is more difficult than elsewhere. To destroy them in these places persistent cutting with the mower, scythe, or spud is the only method that can be adopted; but it should be borne in mind that with many varieties of biennial weeds there is not

only a great persistency of growth, but also, during the second year, a great persistency of effort to produce their seeds, even though they may have been cut off several times previously during the season.

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Perennials, as their name implies, live from Of perennial weeds there are two year to year. classes, viz., the perennial with an ordinary root, and the perennial with a creeping root-stock. The perennial weed with an ordinary root-stock, or, as we may call it for our purpose, the ordinary perennial, is reproduced from seed only. The ox-eye daisy is a common example of this sort of weed, and the plantain is another. creeping perennial, as we may call it, is not only reproduced from seed, but is also propagated by means of its horizontal root-stocks, which run, or "creep," through the soil in various directions from the parent stem. These creeping root-stocks are furnished with many latent buds, each one of which, under certain conditions, is capable of sending up a fresh plant to the surface. The conditions necessary are those states of heat, moisture, etc., which are favorable to vigorous growth. It follows, then, that the cultivation which does not weaken and destroy creeping perennials necessarily favors their

increase, inasmuch as a soil that has been recently stirred is more easily penetrated by the creeping root-stocks than one that has not been so stirred, and, therefore, has become more impacted. Whenever any disturbing action is brought to bear upon these root-stocks, as, for example, the breaking them off from their parent stem by the implements of tillage, a fresh impulse is given to their growth. Each rootlet so severed attempts to develop into a complete plant. Hence it is that, in moist weather, ordinary cultivation is more likely to promote than hinder the growth of this class of weeds. influence of summer-fallows, and of hoed crops which are but ill cared for, is also in the same direction. Creeping perennials are also much prone to cling to the implements of tillage, and by them to be carried from one part of the field to another, and even to other fields. Canada thistle, the common sow thistle, and couch grass, furnish familiar examples of creeping perennials; and we are sure the experience of our readers will bear us out in what we have just said of the tendency of cultivation, in moist weather, to promote their increase.

To destroy creeping perennials, therefore, we must labor either to smother them, or else by

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cultivation to bring their roots to the surface, where they will perish by exposure to the air and sunshine. By "smothering" them is meant the keeping them constantly under ground. If creeping perennials are "smothered," that is, kept beneath the surface of the ground for some months during the early spring and summer, they will perish in a single season, and this result will be gained whatever may be the means made use of to effect it, whether spudding, plowing, or cultivating.

It is sometimes asserted, and the assertion is commonly accepted as true, that creeping perennials are more difficult to destroy than other classes of weeds. This assertion is supported by the specious argument, that whereas creeping perennials have two means of propagation, viz., (1) their seeds, and (2) their creeping root-stocks, which push their way through the soil in every direction, annual weeds and biennial weeds, and ordinary perennial weeds also, but one means of propagation, namely, their seeds alone. But it should be remembered that, in making this comparison, other things have to be considered. We must also take into account the number of seeds produced by each sort of weed, their vitality, and the modes by

which these seeds are distributed and fresh plants produced, the crops that are infested by each particular kind of weed, and the power which the various kinds possess of maintaining themselves in permanent pastures and byplaces.

Some annuals, as, for example, ragweed, bear seeds in almost countless numbers, whereas the number of seeds produced by creeping perennials is usually not very large. The diversion of the energies of creeping perennial weed plants from seed-bearing to increase by means of their root-stocks is, therefore, so far unfavorable to their reproduction that the excess of seed production in annuals not infrequently more than counterbalances the advantage gained by creeping perennials by reason of the dual powers of propagation which they possess. Moreover, the vitality of the seeds of some sorts of annual weeds, as, for instance, those of wild mustard, is so great that they seem to be able to retain their ability to grow for a much longer period than the seeds of creeping perennials are able to do. Again, when the seeds of an annual weed are transported from place to place by water, as, for example, those of the ragweed, and when the seeds of a biennial weed are transported by

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animals, as, for example, those of the burdock, they are given an advantage which goes far to match the more dangerous powers possessed by the seeds of some perennial weeds, as, for example, the thistle, in their ability to travel from place to place through the agency of winds. Weeds, too, which mature their seeds along with those of the clovers and grasses, as many ordinary perennial weeds do, are much more likely to be widely distributed than those which mature their seeds along with those of cereals, owing, of course, to the great difficulty that is experienced in separating, by any process of winnowing, the seeds of weeds from the seeds of clovers and grasses. Again, some forms of weed life, as, for example, some biennial weeds, find a congenial and permanent home in pastures and by-places, although in cultivated fields they might not prove very harmful. The labor required to remove these weeds from such places is very great, as it has generally to be done by hand; whereas in the same localities annuals and perennials may not be able to get a footing, because of the unfavorableness of the conditions. On account, therefore, of these considerations, and of others not named, as, for example, the congeniality or uncongeniality of soils, and so

on, it will be found that in some localities the weeds most difficult of eradication will be annuals, in others they will be biennials, in others they will be ordinary perennials, and in yet others, creeping perennials.

2. Modify the rotation. In the conflict with weeds, it is greatly advantageous to drop out of the rotation for a time such crops as allow the weeds which infest the soil where they grow to ripen their seeds. Some weeds, as, for example, pigeon weed and wild flax, ripen their seeds early in the season. The seeds, therefore, of these weeds mature in crops of winter wheat, rye, and hay, but ordinarily they do not mature in spring cereal crops, for the reason that, as a rule, these weeds begin their growth in the previous autumn. If, therefore, in the infested fields winter wheat, rye, and hay are dropped out of the rotation for a short time, and spring crops grown in their stead, the destruction of the weeds mentioned and of those of kindred habits, will be greatly facilitated. Other weeds ripen their seeds late Ragweed, for example, more commonly grows up after the early cereal crops and meadows have been cut, and, if undisturbed, it matures its seeds before the time of frost. Grass seed, therefore, in fields infested with this sort of weed, should

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not be sown for the purpose of producing meadow until the ragweed seeds have become greatly reduced in number through the growing of crops which require late cultivation. Other weeds, again, as, for example, the Canada thistle, grow in all kinds of crops, so that when a piece of ground is badly infested with them some kind of hoed crop should be grown upon it, such as field roots or corn, for which the constant cultivation required will tend to destroy them while the crop is growing.

Farmers are usually much averse to a modification of their fixed scheme of rotation, even for a limited time; and more especially so when the modification interferes with those crops which have been their chief source of cash revenue. Notwithstanding this, the truth remains that where the modification required for the destruction of any sort of weed is not made, the ultimate eradication of this weed will be found a very difficult matter.

3. Adapt methods to conditions. In our attempts to eradicate weeds, we should carefully adapt the methods that we follow to those conditions of soil, climate, cultivation, etc., which we find to exist. These conditions have, of course, an important bearing on the growth of

weeds, and, therefore, upon their destruction. In stiff clay soils with a hard subsoil, the Canada thistle, for instance, can be destroyed by simply turning the land into pasture, and mowing down the thistles that arise twice a year at suitable times, viz., once when in blossom, and again at a period considerably later. On other soils of more open texture this mode of destroying thistles would not succeed, at least for a long time, if, indeed, at all. In some climates a considerable proportion of the seeds of the Canada thistle are fertilized, and will therefore grow; while in other localities it does not seem very harmful to allow the thistle to be harvested along with the crops in which they ripen, because of the inability of their seeds to grow for lack of proper fertilization. Other kinds of weeds, as, for example, sheep sorrel, are almost harmless in certain sections; whereas in others they become great pests. Where winter wheat or rye is grown extensively, to destroy wild flax growing among it, specific measures would be necessary; whereas, if the wheat or the rye were not of much account in the rotation, it would be an easy matter to get rid of the flax by growing spring crops successively for a few years.

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If, therefore, we wish to destroy a particular sort of weed with the least possible expenditure of labor, we must study the habits of that weed as affected by the conditions under which it grows. Under some conditions, ordinary "good farming" will generally banish a weed; while under others "specific methods," energetically and persistently applied, will be absolutely necessary. It is apparent, therefore, that for the destruction of weeds hard and fast rules that will be equally applicable under all circumstances cannot be laid down; for what would be a proper course to pursue under some conditions may be wholly unfit under others.

4. Sow only clean seed. Where farms are to be made clean, and to be kept so, great care should be exercised in the purchase of seeds, and also in the preparation for sowing of those grown at home. The distribution of weeds is more widely effected through the agency of the seeds sown for useful crops than in any other way, as was shown in Chapter IV. It has, doubtless, been through this agency that nearly all our foreign weeds have been brought to our land to harass and annoy us. It is not enough for the seedsman to assure us that his seeds are clean, for he may be deceived himself. If his

small seeds have not been carefully hand-picked, he can have no certain assurance that they are clean; and in the preparation for sowing of necessarily great variety of seeds in which he deals hand-picking is out of the question. Purchased seeds, therefore, should not only be examined with the utmost care, and be cleaned again if weed seeds are discovered in them, but the crops that are raised from them should receive the most careful scrutiny while they are growing, so long as there is any ground for suspecting that weeds also are growing among them. As weed seeds are oftener carried in the seeds of clovers and grasses than in other ways, a particular care should be exercised in the purchase of any of these sorts of seeds.

It may, indeed, be wise to grow at home many sorts of seeds that are now commonly purchased, or else to buy them from a neighbor who has a reputation for growing pure seeds. It would be well, too, when attempting to raise one's own seed, to select but a small portion of the crop for this purpose, and to take special pains to prevent any noxious weeds from maturing their seeds in this portion; and this plan should be followed with all the crops grown for seed,

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especially grasses and clovers. It has already been mentioned that weed seeds frequently come to us in the seed grains brought to our farms for the purpose of effecting a change of The danger here, though not easily seed. altogether averted, may yet be lessened. If, for example, the seed of all cereal grains were carefully prepared by such a process of screening as would sift out all the smaller seeds from it, deterioration in the seed of this class of crops, at least, would be very much less rapid than it now is, and, therefore, a change of seed would much seldomer be required. The farmer who is so careless as to sow unclean seed of his own raising, or so foolish as to purchase unclean seed from the seedsman because it can be bought cheaply, is, however, not likely to be greatly concerned as to whether his farm is clean, or is not clean.

5. Thoroughly clean the threshing machine before using it. Threshing machines, especially if they come from a farm with a reputation for uncleanness, should be carefully swept before being set to work. If, in addition, they are made at the first to run empty for a short time, and the seeds that are caught in the grain box properly dealt with, the danger from them

is even more completely averted. Because of the fact that threshing machines are very instrumental in carrying weed seeds from one locality to another, it has often been found advisable for several farmers to club together and purchase a machine of their own. For the same reason, small machines run by tread power are sometimes used by individual farmers. But these methods of fighting weeds have obvious disadvantages which will prevent their general adoption.

6. Give attention to grain screening. The chaff and screenings from the fanning mill should receive the most careful attention. Whenever weed seeds are suspected, the chaff from the winnowed grain that is being prepared for market, or indeed for any other use, should be burned. That portion of the screenings which is too coarse for being ground should, before being fed, be boiled or steamed; or, if fed otherwise, it should be strewn on surfaces where the weed seeds contained in it are not likely to do any harm. The finer portions of the screenings should invariably be ground, boiled, or steamed before being fed. The proportion of the weed seeds grown in a crop which collect in the screenings obtained in cleaning it is

relatively very large; hence the opportunity to destroy these weed seeds, when they are thus collected, should by no means be neglected.

7. Grow hoed crops. Wherever it is desired to subdue noxious weeds wholly, hoed crops should be grown to the greatest extent that is practicable. The reasons are obvious. cultivation of these crops gives opportunity, at almost every period of the growing season, for the combating of almost every form of weed The working of the soil necessary for the production of good hoed crops not only destroys, from time to time, the weeds that are growing in them, but it also stimulates the germination of the weed seeds lying in the soil, so that they, too, grow up, and are, in turn, destroyed; and in this way it greatly reduces their numbers in a single season. Many farmers cling to the opinion that, in the fight with weeds, hoed crops are not very helpful. They point to the fact that, even in their own experience, they have grown these crops from year to year on the same fields; as, for example, when they have grown several crops of corn in succession upon the same plot of ground; and yet, notwithstanding this, the weeds in these very fields have increased. This may have been true, but when

it has been so the crops have certainly not been properly cared for; for otherwise the weeds would, without doubt, have gradually decreased, rather than increased. No other result could possibly follow where a succession of hoed crops had been raised, in which no weed had been allowed to ripen its seeds. Other farmers cling to the opinion that, whatever may be the value of hoed crops for destroying weeds in general, they are not helpful in the fight with creeping perennials; or, at least, that the hoed crop is not so effective as the bare fallow for the destruction of creeping perennials in a single This view is a mistaken one. season. arisen, doubtless, from the too common practice, in the cultivation of hoed crops, of staying the destructive processes too early in the season. Going over the crop with the hand hoe once, twice, or oftener, after horse cultivation ceases, and removing all stray weeds that may appear, will, as a rule, make a thorough job of the work of destroying creeping perennials, except so far as their seeds remain in the soil. The weather must, however, be fairly dry if success is to be complete.

It is, nevertheless, only too true that where hoed crops are grown, and sufficient attention is

not given to the work of keeping them quite clean, their growth only serves to encourage the increase of weeds in general, and of creeping perennials in particular. The cultivation given to the soil when hoed crops are grown furnishes conditions very favorable to the lateral extension of the root-stocks of creeping perennials. also equally favorable to the development in robust vigor of annuals; so that it not infrequently happens that where a hoed crop is grown, and sufficient care is not taken with it, these annual weeds perfect their seeds in great numbers; thus making the state of the field at the end of the season, so far as weed seeds are concerned, worse than it was at the beginning. Where, therefore, hoed crops cannot be grown successfully, that is, so far as weed destruction is concerned, a modified form of the bare fallow, as described farther on in this chapter, may take their place.

8. Grow clover and lucerne. Where the conditions are favorable to their growth, the raising of crops of clover and lucerne will be found helpful in the reduction of weeds; and more especially is this true of the common red clover. These crops are not only valuable in weed destruction because of the frequency with which,

as a rule, they are cut, but also because of their "smothering" tendencies, especially on good soil and in suitable seasons. Common red clover may generally be cut twice a year-a process which usually renders it impossible for perennial weeds growing in it to ripen their seeds the Lucerne may generally be cut same season. oftener than twice a year; and, when a luxuriant growth is obtained, both these crops tend to smother and weaken the perennial weeds growing among them. And when these crops are grown to be cut for fodder, the ripening of annual and biennial weeds growing among them is also pretty effectively hindered; but, if they are allowed to mature their seeds, some kinds of weeds will also ripen theirs along with them.

Although lucerne is even more valuable than common red clover for the purpose of checking the ripening of weed seeds, owing to the greater frequency with which it is cut, yet since lucerne can be grown only on certain kinds of soils its use as an aid in weed destruction is considerably circumscribed. But both crops are also very excellent for other purposes, as, for example, the bringing of nitrogen to the soil when they are plowed under, and so providing a more abundant store of this most necessary plant food;

hence much attention may consistently be given to growing them for other reasons than the service which they render in weed destruction. And it may also be mentioned that after the last cutting of these crops for the season the ground may, very profitably, be gone over with the spud for the purpose of destroying the creeping perennials which may then be growing. This last precaution will be found to be greatly helpful in speedily completing the work of extermination.

9. Grow soiling crops. In the work of eradicating weeds soiling crops will be found very helpful, especially where the other requirements of the farm render it advisable to grow them. This is owing, first, to their smothering tendencies; second, to the fact that they can be cut before certain weeds, which grow in them, have opportunity to mature; and, third, because, in many instances, two soiling crops can be grown in a single season: hence the benefits derived from their cultivation can, to some extent, be duplicated on the same soil in the same year. As these crops are not designed to mature their seeds, they may be sown more thickly than other crops; hence their smothering power is greater than if they were grown for

the grain to be obtained from them; and yet, if they are required for winter fodder, they may be allowed to become so nearly ripe before being cut that their grain becomes so mature as to possess considerable feeding value, and this, too, without allowing many of the sorts of weeds that grow among them to mature their seed. For example, they may be grown in this way and yet be cut before such mischievous weeds as the Canada thistle or the perennial sow thistle, growing among them, have opportunity to ripen their seeds; hence the cultivation of soiling crops has a tendency to weaken the vigor of these weeds, and to prevent their further Some of the most mischievous increase. annual weeds and biennial weeds may be prevented from ripening their seeds in these crops; in fact, many of these weeds cannot possibly ripen their seeds if the soiling crop amid which they grow is properly looked after. Because, too, of the further fact that frequently two soiling crops may be grown upon the same field during the same season, the cultivation of these crops becomes an excellent means for destroying a specially troublesome weed like the Canada thistle, whose habit leads it to grow throughout the whole season; as well, also, as such weeds as mature their seeds very early in the season, or such as mature their seeds very late; or, if it be desirable to take advantage of it, the growing of an early soiling crop gives opportunity for subjecting lands to the fallow process.

10. Call in the aid of sheep. Those who have had experience in keeping sheep do not require to be told that where sheep are numerously kept some mischievous forms of weed life soon entirely disappear; that other forms are much crippled in their powers of growth, and so gradually disappear; while still other forms are weakened and harassed, though they may not be entirely destroyed. On soils which lie upon stiff clay subsoils, where the land is devoted to pasture, sheep, unaided, will eventually prove more than a match for the Canada thistle, if the pasture is, at all times, kept closely eaten; but several seasons of such cropping may be required to effect this end. Nearly all biennial weeds, and some perennial weeds, as, for example, the ox-eye daisy, will be greatly harassed when thus pastured; and the same is true of some annuals, as, for example, ragweed and pigeon weed. If sheep are thus allowed to act as scavengers, they will render excellent service in the work of weed extermination, more especially in permanent pastures, on private roads, along fence borders, in the stubbles where a crop of grain has been reaped, and in corners and by-places generally. But, that this work may be done thoroughly, the pastures should be kept closely eaten from early spring. Many weeds are then so tender and succulent that the sheep will eat them; whereas, when the weeds are at a more advanced stage of growth, they will persistently reject them, unless they are impelled to feed upon them through the sheer force of hunger; and when weeds, in the places mentioned, are thus kept closely cropped, the hand cutting or hand spudding that may be required to complete their destruction is greatly reduced. There is, probably, no way in which weeds can so profitably be used as by turning them into mutton.

grow food supplies at home. To aim to grow food supplies at home, rather than to purchase them elsewhere, is a safe rule in farming, viewed from the standpoint of economy, even when the question of weeds is not taken into account at all. It is a rule, however, that is much affected by considerations of location, soil, climate, and other conditions, and is, therefore, not without its limitations; but so important

is it, notwithstanding all these considerations, that the aim should usually be to grow food supplies at home to the greatest possible extent. The effort thus made to increase production will, of itself, prove greatly advantageous in reducing weeds. For example, when corn is grown for the silo to be used as winter fodder, it gives ample opportunity for putting into tribulation those weeds which may attempt to grow in the corn; whereas if they grew among crops that were raised for the sake of the grain to be sold from them, they might not be equally effectually disturbed; and, looked at generally, it is evident that, where food supplies are grown at home, the farmer has power to prevent the weeds which grow in the crops producing them from ripening their seeds; a power which, of course, he cannot possess when the food supplies are purchased elsewhere. Of course, it is true that the purchase of food supplies on a more or less extensive scale is sometimes a necessity; as, for example, where dair ring and the keeping of live stock are largely engaged in. But all grains so purchased, when the presence of weed seeds in them is suspected, should be ground or steamed before being fed, as was mentioned in Chapter IV., when we were considering the purchasing of feed stuffs.

Even when such grains are fed to sheep, unless they are ground, a portion of the weed seeds contained in them is sure to find its way into the manure, and thus, finally, into the soil of the farm. So also, when fodders containing weed seeds are purchased, the seeds contained in them cannot be prevented from getting into the manure unless the fodder be cut and steamed; and to do this is, in practice, generally impossible.

12. Keep the land constantly at work. the conflict with weeds, the land should be kept constantly at work. Upon some kinds of soil we can easily get two crops a year; and where this can be done, the necessary cultivation will be found very helpful in the work of destroying The nature of the crops to be so raised weeds. will depend, of course, largely upon climate, soil, and the requirements of the farm. As was mentioned above in section 9, two soiling crops may sometimes be grown the same season. Again, an ordinary crop of grain, or of meadow, may generally be followed by a catch crop. many sections, rye may be sown in the autumn, and be followed in the next spring or summer by a crop of roots, or one of corn, or one of rape. When this is done, the rye may be cut

green, to be used as winter fodder, or to be cured in the silo; or it may, where necessary, be plowed under as a green crop. Such soiling crops as oats and peas may be grown, and be followed by a crop of rape, or one of soft When the soiling crop has grown turnips. vigorously, and is thus followed by one or other of the crops mentioned, grown in drills and cultivated, the effects, in the way of weed destruction, are very marked. As all these crops are of use only for feeding stock on the farm at home, the process of incessant cropping such as we have here described is, of course, helpful, rather than otherwise, to the fertility of the soil. And there is the further advantage in thus keeping arable soils at work, that the nitrates of the soil are, to a very considerable extent, prevented from being washed out by rains.

I3. Stimulate the land to produce plentifully. Weeds can be much more easily dealt with when the land is kept constantly stimulated to vigorous productivity than when the soil is left to run down and become infertile for lack of proper manuring. When crops are strong, weeds do but little harm in them, compared with the injury they work when they are allowed to grow amid crops that are thin and poor. When the

soil sustains a vigorous growth, the useful crops leave many forms of weeds behind in the race; and especially is this true in the early part of the season. And, too, where the growth is vigorous in the early stages of the crop, the weeds have much less opportunity of monopolizing the growing area. Growing good crops is synonymous with good farming; that is, the raising of good crops is in itself a great hindrance to the multiplication of weeds. agrees with the well-known fact that the spread of weeds is usually much more rapid and complete in impoverished farms than elsewhere; hence those who desire clean farms will have done much to secure the desired end when they adopt such measures as will also maintain them in a high state of fertility. Much may be done in the way of securing this fertility by growing catch crops for feeding off or plowing under after the earlier crops of the season have been removed. In all localities whose climate is similar to that of Ontario, peas, buckwheat, and rape may all be grown as catch crops. The cultivation requisite for preparing the ground for these crops is also good for the destruction of weeds. It may happen sometimes that the season will be so dry that the seeds sown for

catch crops will not germinate; when such is the case, the dry weather which produces this result will also be hurtful to the growth of weeds.

14. Practise autumn cultivation. In the war with weeds, one of the very best methods to be adopted is "autumn cultivation." So much is this the fact that it is at least questionable if any other means can be made use of that will so well repay the outlay. By autumn cultivation is meant the tilling of the soil after harvest with a view largely to weed destruction. As soon as the crops are removed, the land that is not sown to grass should be plowed—either with a gang plow, or with an ordinary plow. All weeds that are above the surface of the ground at that time are thus turned under; while the weed seeds lying in the soil are encouraged to germinate, so that the weeds that grow from these may, in turn, be destroyed by harrowing or by cultivating, or by the late autumn plowing that just precedes the advent of winter. In this way myriads of weed plants will be got rid of in a single season.

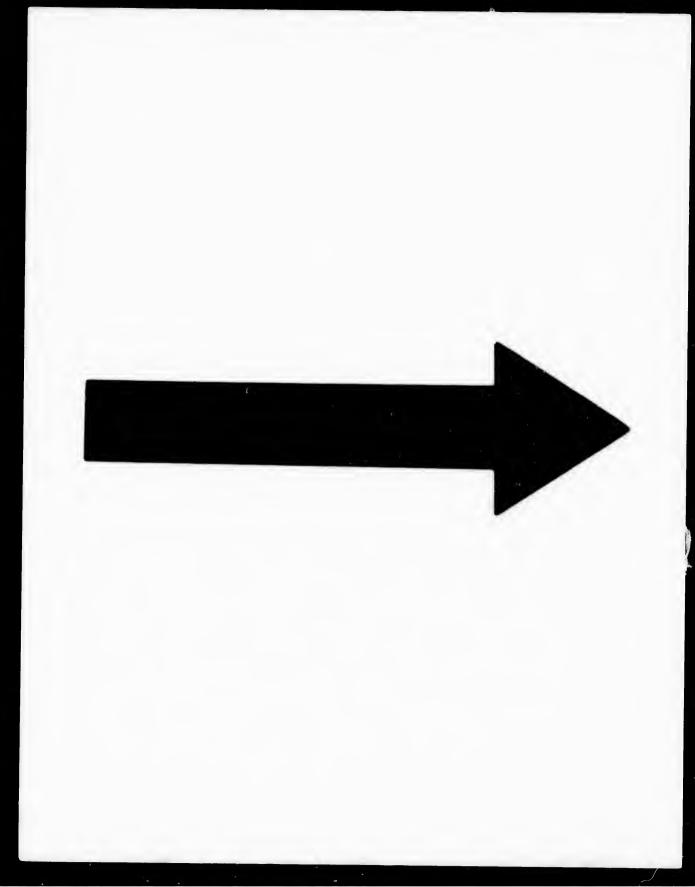
But there are two real difficulties which stand in the way: (1) The season at which this work is to be done is a busy one; and (2) there is frequently too little horse labor available for the purpose, for the reason that too little is kept on But the advantages of this method the farm. of destroying weeds are so very important that it is absolutely essential that much effort should be made to secure them. It may be remarked, too, that when eatch crops are grown for turning under as green manure, the plowing which is necessary therefor, after the harvest of the main crop, and the plowing that is necessary to turn the green crop under for manure, are much the same as would be required as autumn cultivation for the purpose mainly of destroying weeds; while if the catch crop has been successful, there is the additional advantage that the soil gains in having its fertility increased by the application of the green manure.

15. Allow no weed seeds to ripen. We should never, at any time, allow noxious weeds to ripen their seeds, if it is at all in our power to prevent their doing so. When the cleaning of a farm that is vile with weeds is first undertaken, it may not be possible, in all instances, to hinder the ripening of the seeds of the weeds that infest it: but, generally speaking, the ripening may be very largely prevented by merely, for a time, modifying the rotation. When once a farm

is fairly well cleaned, then it is simply inexcusable to allow noxious weeds—at least, those which are most troublesome—to mature their seeds. To allow them to do so is to show an indifference to one's best interests which cannot be defended.

The specific modes of hindering weeds from ripening their seeds will, of course, vary with the sort of the weeds, and also with the crop in which they grow. Several of these specific modes will be described with some precision in the next chapter.

As was said above, one of the best and most reasonable means that can be adopted for preventing weeds from ripening their seeds is by a modification of the rotation. The correctness of this opinion will at once be apparent when we think, first, of the unreasonableness of growing a crop, a very large portion of which consists of weeds, while we may just as well grow, instead of it, some other kind of crop that will mature at a different season, and be comparatively free from weeds; and, second, that, with respect to some kinds of crops, certain weeds cannot be prevented from ripening in them without the infliction of considerable injury to the crop amid which they grow. In any case,



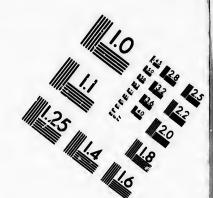
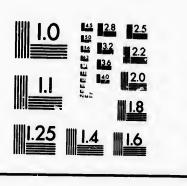


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however, the hope of having a clean farm is a vain one if noxious weeds are allowed to ripen upon it even in quantities ever so limited. If any weeds are allowed to ripen their seeds, the farm will never be wholly clean, notwithstanding the fact that the number of weeds may, on the whole, be very considerably reduced.

16. Give careful attention to all the modes of weed distribution and propagation. It was stated in Chapter IV. that, with respect to weeds, we cannot control some of the modes by which they are distributed, that some of them we can but partially control, and that yet others are completely under our control. So many and so varied are the agencies by which weeds come to us, and so many are the means by which they are then propagated, that we cannot afford to give small heed to any of these agencies and It will not suffice to concentrate our means. energies on keeping weeds at bay in one direction when, at the same time, they come to us in various other directions. Such a course would be about as wise as to try to keep out the waters of a rising tide by closing one breach in the embankment while several others are left open. When everything has been done that can be done in this direction, weeds will still come to

us. When this is so, there is only one resource left to us. This we will now describe.

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17. Make thorough work. When the eradication of weeds is undertaken, the work should be made as complete as possible, and be effected in the shortest possible time. The cheapness of the process is usually in direct proportion, first, to its completeness; and, second, to the brevity of the period occupied in completing it. It is quite possible to destroy creeping perennials in a single season, except only as to the seeds which remain in the soil. It is the lack of thoroughness in the modes usually adopted, rather than the modes themselves, that renders the destruction of this class of weeds so extremely difficult and so expensive. As a rule, creeping perennials are merely checked by the cleaning processes employed, and by no means destroyed by them. Hence the root-stocks left in the soil at once commence to grow. They push out in every direction. They are carried to and fro with the plow, and spring into life everywhere; so that in from two to four or five years they have so possessed the soil again that a similar process of reducing them will have to be undertaken. Whereas, had these weeds been completely destroyed in one season, and proper means been taken for removing those which afterwards came up from the seeds that remained in the soil when the cleaning process was being accomplished, then the cleanliness of the field would have been maintained, and at a cost that would have been merely nominal, as compared with the cost involved in cleaning the field anew. The greatest mistake that can be made in the war with weeds is to carry it on with a lack of thoroughness, when once the war has been undertaken. Men clean at fields rather than clean them. They reduce weeds, but do not subdue them. To make thorough work may seem costly at the time; but, let the farmer depend upon it, there is no way of getting rid of weeds so cheaply as when the work is done in a comparatively short time.

18. Maintain cleanliness. Where cleanliness has once been secured, it should be maintained from year to year at all hazards. To effect this, two things at least are required. First, the general management of the farm must be good, so that good crops may ordinarily be grown; and, second, every portion of the farm must be gone over once or twice a year with the spud, except that part which is devoted to hoed crops. The meadows should be gone over once or

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twice, according to the weeds that grow in them, and the time at which the hay is to be cut. thus gone over before the time of haymaking, such weeds as dock, wild flax, the ox-eye daisy, and pigeon weed, which would otherwise ripen their seeds, will be destroyed, and, in fact, any other weeds that may be there. Then, after harvest, they should, whenever it is necessary, be gone over again for the purpose of cutting off the stray thistles or ragweeds, or any other kind of weeds, that may be trying to retain a footing. In the same way, the grain crops should be gone over before they come into the ear. Where these have been sown with the drill, this may easily be done without injury to the crops. If the grain fields have also been sown with grass seeds, they should be gone over again after harvest; but this will not be necessary, of course, when autumn cultivation is to follow. Permanent and other pastures, fence borders, private roads, and by places should all be gone over twice a year with the spud.

Notwithstanding the great value of the spud in maintaining cleanliness on farms, it must, nevertheless, be used with discrimination. When the weeds are numerous, beyond a certain limit, it will not pay to use the spud. What that limit is will, in any particular case, depend somewhat upon the scarcity of labor, and the difficulty experienced in securing it and paying for it. It is not possible, therefore, to fix a limit that will apply equally well in every case; but, in the judgment of the writer, unless the spudder can get over from three to five acres a day, it is at least an open question whether some other mode of reducing weeds should not be resorted to instead. The spud is designed rather to maintain cleanliness than to secure it; although, to a considerable extent, it is helpful for the latter purpose also.

The method of procedure in cleaning a farm, where the work is to be economically done, will be somewhat as follows:

(1) The effort must be put forth to prevent any new seeds from maturing on the farm. It may not be possible, or even prudent, to go the length of securing this result, at the first, on all parts of the farm, owing to the costliness of the work, and to the amount of labor involved in it; in time, however, where judicious measures have been used, the end will be attained, and that without great difficulty.

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(2) One or two fields should be set aside each year to be cleaned, these being chosen with reference to the rotation, and to the resources of the farmer; and the work of cleaning these fields should be made as thorough as it would be reasonably possible to make it in one season. As each field is thus freed from noxious weeds, cleanliness should be maintained in that field by the use of the spud, until, in the order of the rotation, the field will have hoed crops grown upon it, by which means the cleaning process will be still further carried on.

(3) The pastures and by-places of the farm should, from the commencement of the cleaning process, be gone over twice a year with the spud. If it happens that in these places the weeds are too numerous to be dealt with by the spud, the scythe, or, where practicable, the field mower, should be used instead. In a few seasons, if thus dealt with, these places will be quite free from noxious weeds. The time occupied in cleaning the farm will depend upon the rotation. It should be practically free from weeds by the end of the first rotation, counting from the beginning of the undertaking.

Many farmers, however, look upon the use of the spud in any way as a chimerical idea. They

object to it on the score of the cost of the labor involved in its use; while the truth, in the mind of the writer at least, is beyond the shadow of a doubt that by no other conceivable means can freedom from noxious weed intrusion be maintained so cheaply, or, indeed, be maintained at The matter stands thus: In ordinary all. practice, the spud is *not* used. The farmer selects a field to be cleaned by the bare fallow or some other process. Fairly good work may be done; but some weeds are sure to be left in the soil, while also some seeds of weeds lie there which will germinate and reproduce their kind in abundance. Unless, therefore, the field be gone over with the spud after the manner we have here described, it is well nigh as certain as anything can be that, in from three to five years, the field will be as foul with weeds as when taken in hand at the first. On the other hand, if the spud is used in the manner that we have indicated, all stray weeds will be cut off before they can do any harm.

The cost of maintaining freedom from weed intrusion, where once a state of cleanliness has been attained, should not be more than \$25 a year for every one hundred acres of land. This

estimate is based on the supposition that all the methods of cultivating and managing the crops grown upon the hundred acres are as they ought to be.

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With respect to the cost of the weed-cleaning process, it may be mentioned here that, when once a state of cleanliness has been secured, the cost of maintaining this state of cleanliness by means of the spud is the only direct charge to be made; for the expense incurred in cleaning crops and in destroying weeds by all the other means described in these pages should be more than met by the increased returns which the crops will show by reason of the improved cultivation which the weed-cleaning process necessitates. And on the assumption that every part of a one hundred acre farm be gone over twice a year to keep it free from weeds, and on the further reasonable assumption that the cost of labor involved in doing this for a day of ten hours is \$1.25, the entire outlay for the whole work would not be more than the sum already named, viz., \$25 a year. When once a farm has become fairly clean, a workman should easily be able to go over it with a spud at the rate of ten acres a day. That this is possible has been demonstrated over and over again, in the experi-

ence of the writer, in the work of cleaning the Ontario Agricultural Experiment Station Farm at Guelph. Ten acres have been frequently gone over in half a day, and in one instance twenty acres were done; but these results grew out of more than ordinary effort, and are, therefore, to be regarded as exceptional. One person can, however, easily get over ten acres in a day, even when some hundreds, and even thousands, of weeds are to be slain. Twenty days thus employed should take the spudder over the farm twice; hence the cost would not be more than the sum named. But the whole farm would not require to be gone over thus twice a One field of the farm would probably be vear. devoted to a hoed crop, and would not require any spudding. Several fields which had produced grain would not require to be gone over more than once, for the reason that, soon after harvest, they would be plowed or cultivated as a part of the "autumn cultivation"; and pastures would soon become so clean that one spudding in a season would suffice for them also. Hence the outlay for spudding should be less than \$25 a year.

It is certainly unfortunate that the spud is so little known, and so little used in perfecting and

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maintaining cleanliness upon farms. It is even more unfortunate that, with many farmers, the prejudice against it is so deep-rooted that to suggest its use in the fight with weeds commonly results only in drawing forth an incredulous and scornful smile. But it is well to remember, first, that those who are most averse to using the spud are usually those who have never used it; and, second, that those who have once tried it fairly are always unwilling thenceforth to abandon its use.

A little judicious reflection will make it clear as noonday that the spud is of the greatest use in maintaining cleanliness on a farm. Suppose a ten-acre field in which a crop is growing has only a few thistles in it—so few, perhaps, that the farmer thinks it scarcely worth while to do anything with them. But it may, at the same time, have some dock plants in it, and some pigeon weeds, and a few stalks of mustard, a small number of ragweeds, and, perhaps, a few other noxious weeds; while in the fence corners there may be some burdocks, or some plants of the Now, in one day, one person can cockle bur. remove all these weeds—not only the thistles, but all the rest—with the spud. If this be done, the thousands and tens of thousands of seeds

which these plants would have produced never come into existence; not only so, but the future infinite multiplication of these weeds is also effectually checked. Moreover, a corresponding saving in the labor that would otherwise have been ultimately required in subduing these weeds is also effected.

Those, therefore, who refuse to use the spud under suitable conditions do not know how much they lose; nor can it ever be said of them that their farms are clean.

It may not be amiss here to describe that form of spud which, in the estimation of the writer, is best adapted to the uses of the farmer.

The chisel spud, as usually made, may be described as follows: It consists of a light round handle, resembling that of a broom; and of a blade which is shaped somewhat like a chisel, but more tapering from the end of the blade to the junction with the handle. Its length is about five feet from the upper end of the handle to the cutting end of the blade. The blade is about eight



THE CHISEL SPUD.

inches long from the cutting end to the shoulder, and about two and half inches broad at the cutting end, and five-eighths of an inch broad' at the shoulder. The blade should be thin, not necessarily more than a quarter of an inch at the shoulder, and still thinner as the cutting end is approached. The blade is fitted into the handle in the same way as a common hoe. The implement is very light, so that it is in no way burdensome to carry. But in few kinds of labor on the farm are quickness and sureness of movement more important than in the use of the With the expert spudder, every blow that spud. is aimed usually takes away a life. When using the spud in a grain crop, for instance, the spudder walks astride of a row of grain, the feet being placed between the drills, so that trampling is avoided. He walks straight ahead, without leaving the lines of the drill in which he first enters, and cuts below the surface of the ground all the noxious weeds that may be found within, say, six feet on either side of him. A strip is thus taken at one time of about twelve feet in On the return trip, he walks in the width. centre of an adjoining strip of equal width; and he proceeds in this manner until the whole field is gone over.

In pastures, and where grain has been sown broadcast, some difficulty may be found in following a straight line; but more commonly the furrows between the ridges are sufficiently marked to secure this end.

The spudder should always carry with him a short file, to be used for sharpening the spud whenever this may be necessary. The frequency of the sharpenings will depend on the nature of the soil; but it is greatly important that a good cutting edge be constantly kept. A hip pocket will form a convenient receptacle for the file when not in use; but the file should never be forgotten—more especially in stony soils, as the spudder never can know how soon he may want it.

Simple as the work may appear to be, yet, as previously mentioned, there is great opportunity, and even necessity, for the exercise of dexterity in using the spud. One person will so use it in a grain field, for example, that very little of the grain will be either trampled upon or cut off; whereas another would make constant havoc in both these respects. It is matter for surprise how large and strong a weed root can be severed by the spud when it is dexterously used. Burdock roots, two inches in diameter, may be easily

severed, without endangering the handle, when the spudder is well skilled in his work.

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Since this valuable little implement is so little known and used, it may be well to state here that it may now be purchased in the leading hardware stores of Ontario at a cost of twenty-five cents. So far as the writer can learn, it has, as yet, not been manufactured in the United States.

MODES OF DOUBTFUL ADVANTAGE.

Modes of destroying weeds are sometimes practised, and widely so in respect to which it may be said that, even when all things are considered, the benefits arising from them are, at most, of doubtful character. Two of these will now be dealt with, namely, (1) the bare fallow; and (2) the fermentation of farmyard or stable manure. Both of these may, perhaps, on occasion, be made very helpful in the work of eradicating weeds; but, in the opinion of the writer, they both are costly modes, and they both can be dispensed with.

1. The bare fallow. In destroying weeds, the bare fallow has rendered good service in the past; and, indeed, where it is properly managed, it is a very effective mode, even now—more especially for creeping perennials.

But since the bare fallow method, as usually practised, requires the land to lie unused during the whole season in "summer fallow," as it is called, so that a crop cannot be raised the same season, it is evident that the method is a very expensive one; in fact, far too expensive, when compared with some of the other modes of fighting weeds which have been previously treated of in this chapter. And it may be added that where these other and less expensive modes are faithfully practised, it will be unnecessary to resort to the bare fallow for the purposes of weed destruction.

It may be necessary sometimes to call in the aid of the bare fallow where the soils are so stiff that hoed crops grown upon them are not remunerative for the reason that they grow so shyly. But now that the growing of corn for the silo or for green fodder is becoming common, the areas where it may be wise to resort to the bare fallow are more circumscribed than ever; for corn will grow fairly well even on a stiff soil if care be taken to plant it early enough to secure proper germination; and as a means of weed destruction a corn crop is as useful as a root crop.

When, therefore, it is thought necessary to

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resort to the bare fallow, let it be in some modified form; that is to say, let some crop be grown the same season, before or after the fallowing is done. When a late crop is grown, as, for example, a crop of millet or of rape, then, during the portion of the season prior to the sowing of that crop, the ground may be fallowed with excellent results, both in the destruction of the weeds, and in the preparation of the soil for the crop that is to come after. Similarly, other crops which mature early in the season may be followed by the bare fallow for the rest of the season, and so secure nearly all the benefits of the ordinary bare fallow without the missing of These early-maturing crops include rye, winter wheat, and barley.

In the same way, pastures may be eaten off until some time in June, and then be plowed and worked on the surface, with great injury to the weeds, until it is time to sow winter wheat The same course may be adopted with early-cut meadows, with almost equally good results. Where winter wheat is not grown, the length of the season left for working this sort of fallow is, of course, much increased; and such a bare fallow, coming after any of the kinds of crop above mentioned, will be very effective in

destroying weeds. But it should be remarked that this mode of fallowing so nearly resembles what has been previously described as "autumn cultivation" that it may, perhaps with greater propriety, be referred to by that designation.

The costliness of the bare fallow does not all arise from the fact that a great amount of labor is expended without getting a crop the same season; more especially in seasons when much rain falls, there is also a serious loss incurred from nitrates leaching out of the soil—a loss which would be almost entirely prevented if a crop were grown upon the soil. too, inasmuch as the bare fallow reduces the humus in the soil, the soil becomes more impacted in consequence. The bare fallow entails, therefore, (1) the loss of a crop; (2) a certain loss of fertility by reason of the leaching out of nitrates; and (3) increased impaction of the soil. It is obvious, then, that, in our fight with weeds, we should resort to the bare fallow only in cases of extreme necessity.

Where the bare fallow is resorted to, as a means of destroying weeds, the work should be done most thoroughly, especially so far as creeping perennials are concerned. Where these are only partially destroyed, the residue remaining in the soil are given most favorable conditions for lateral root extension, and hence for future multiplication.

In the opinion of the writer, the fallowing process should, whenever possible, be accompanied by the growing of green crops for the purpose of enriching the soil while the process of fallowing is going on. For instance, a crop of rye may be sown in the autumn, and plowed under the following spring; this may at once be followed by a crop of peas, or buckwheat, or rape, which, in turn, may be plowed under; and various other crops may be thus utilized. The weeds, by this modification of the bare fallow, will be greatly reduced, and the land will, at the same time, be much improved in fertility, and in its mechanical texture.

2. Fermenting manure. Where farmyard or stable manure is fermented, the process may render substantial service in destroying the germinating powers of the weed seeds found in it. But the price paid is, probably, too costly. Manure cannot be sufficiently fermented to destroy the seeds of weeds present in it, except with the result of the removal of much of its most useful properties, more especially of the nitrogen, its most valuable constituent. The

reduction of manure in the soil where it is to remain is attended with so many advantages of a mechanical and chemical nature that, whenever practicable, the reducing process should always be effected in the soil, rather than in the farmyard, or in wasting heaps in the field.

Fermenting manure, therefore, with the object of destroying weeds, should never be resorted to unless the seeds of some especially pestiferous sorts are known to be present in it in unusually large quantities. And, as a rule, it is not necessary to resort to the process at all; for if the modes of fighting weeds that have been already pointed out are faithfully practised, the seeds that will at length be found in the manure will be reduced to an insignificant quantity. And, in this connection, it is well to remark that on account of the danger there is of bringing weed seeds to farms where purchased stable manure is used, it may be judicious, where increased fertility is desired, to purchase artificial fertilizers, rather than stable manure.

CHAPTER VI.

SPECIFIC MODES OF ERADICATING CERTAIN TROUBLESOME WEEDS.

This chapter will deal with specific modes of destroying certain kinds of weeds which peculiarly infest the soils of Canada and the northern parts of the United States. Some of these weeds are local and circumscribed in their distribution, while others are found in greater or less numbers from the Atlantic to the Pacific. While the general methods of weed destruction, described in the previous chapter, are, as a rule, equally applicable to all weeds, the specific modes described in this chapter are especially helpful when applied to the weeds for which they are intended.

It should be remembered, however, that the modes described here as especially applicable to certain weeds will also apply to all other weeds, not considered in this work, which may closely resemble these in their habits of growth.

Fourteen weeds are dealt with in this chapter,

and these include a majority of the most mischievous varieties which harass the agriculture of our northern latitudes. These fourteen weeds are: The Canada thistle, the corn sow thistle, couch grass, bindweed, the ox-eye daisy, the plantain, the burdock, blueweed, the wild carrot, wild mustard, wild flax pigeon weed, ragweed, and the wild oat. The specific modes, here described, of dealing with these fourteen weeds are nearly all based on the actual experience of the writer; hence they are submitted with a degree of confidence which could not be felt were they based merely on theories, however correct these theories might be. And it may be proper to mention here that, some time in the future, the author will probably extend this list, when the specific modes of dealing with other varieties of weeds are more thoroughly understood.

An outline sketch is given of each of the weeds dealt with. This sketch was in every case prepared from living specimens of the weed illustrated. The root development of each plant is shown, as well as that of the portion above ground. And it may be stated here that, in the work of exterminating weeds, a knowledge of their habits of root growth is frequently of quite

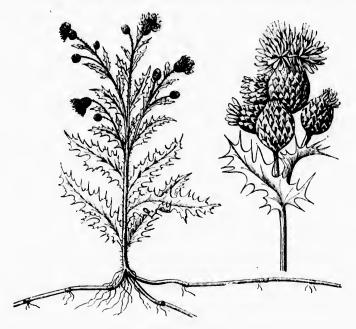
as much importance as a knowledge of the growth habits of the portions of the plant ordinarily visible to the eye.

(1) THE CANADA THISTLE.

The Canada thistle (Cirsium arvense) is a creeping perennial which grows from one to four feet high, according as soils and seasons vary. It is of an upright habit of growth, somewhat branched towards the top, especially when it is not much crowded; but when it is pressed for room, it has but a single stem. Its leaves are armed with sharp prickles, which, either when green or dry, but more especially when dry, are exceedingly unpleasant to handle. Its blossoms are of a beautiful crimson, and are endowed with a pleasing fragrance.

The Canada thistle comes up early in May, and continues to grow until the time of severe frost in autumn. It comes into blossom, as a rule, in July, but sometimes in August, and it matures its seeds principally in the latter month, but sometimes also in the former. When cut off above, or just a little below, the surface of the ground, it will at once put forth sprouts below the point of excision, several sprouts thus coming up around the parent stem.

The Canada thistle will grow in almost all kinds of soils; but in mucks with moist bottoms it does not find a congenial home. It grows in all kinds of crops that are produced in this country. Its seeds ripen with those of all the



THE CANADA THISTLE.

cereals, several of the clovers, and timothy and some other grasses.

The Canada thistie is propagated by means both of its seeds and of its creeping root-stocks, but more especially by means of the latter. Its root-stocks penetrate the soil in every direction, and in open soils to distances that are almost incredible. These are endowed with numerous latent buds, which, as soon as the root-stocks become broken, at once start to grow, even under the least favorable conditions. Its seeds are not only wafted incredible distances by the wind, but they are also distributed everywhere by means of the seeds of all kinds of cereal grains and of several of the clovers and grasses, among which, as said above, they ripen. They are also distributed by means of manure.

Modes of Eradication.

The following are some of the most effective modes of dealing with this most pernicious intruder:

- 1. Modifying the rotation. Until the fields infested with the thistle can be specifically dealt with by one of the modes described below, drop out of the rotation, so far as practicable, all crops which will allow the thistle seeds to ripen before they can be cut.
- 2. Autumn plowing and spring cultivation, followed by corn, roots, or rape. Plow the land immediately after harvest. Plow shallow with any kind of plow that will cut the thistles off clean without breaking up the creeping roct-

Keep the thistles from breathing above stocks. ground until the late autumn plowing, which, however, should be deep, for the sake of the crop that is to come after. In the spring, keep the thistles under by the use of a suitable cultivator until the time for planting a crop of corn, roots, or rape. Give this crop that amount of horse cultivation which it should have to insure a good yield, and take pains to keep the thistles that spring up in the line of the rows cut off by hand hoeing. Go over the crop with the hand hoe, if necessary, once or twice after the horse cultivation has ceased; and, if the work up to this point has been well done, there should not be one thistle left—that is, provided the season has been a dry one. The most effective part of the work, however, will have been done the preceding autumn.

3. August plowing, followed by winter rye cut early, and this again by rape. Plow the ground deeply in August, and, if practicable, in the early part of the month. Sow rye early in September at the rate of two and one-half to three bushels per acre. Cut the rye the following spring, as soon as it is headed out, for winter fodder. Cut it with the binder, and cure it in the shock. Or, cut it when in early blossom, and cure it

in the silo. Then plow the ground deeply with any kind of plow that will effectively bury the stubble. The jointer plow, with skimmer, will answer very well. Then roll at once, to conserve the moisture. Harrow once a week until it is time to drill the ground for rape. the drills about the end of June or early in July, using a double mould-board plow, with marker attached. The drills may be from twenty-two to twenty-six inches apart. Sow at once with rape seed while the drills are yet fresh and damp, and then cultivate and care for the rape as described in section 2 above. In the experience of the writer, this mode of destroying the Canada thistle has proved very effective. But it is not well suited to stiff soils which will not readily grow hoed crops.

Another way is to sow the rye in August, and then pasture it both autumn and spring, before the ground is plowed for rape; but this mode is not quite so effective as the one just described, inasmuch as the rye, when pastured, does not so effectually weaken the thistles by smothering them as when it is grown for fodder or for the silo.

On the Ontario Agricultural College Experiment Station farm at Guelph, thistle-infested

fields have been so effectively cleaned by the mode of treatment recommended here that in the following year one person could go over twenty acres in from ten to fifteen hours, spud in hand, and remove therefrom all the noxious weeds found in the grain crop which came next after the rape.

4. Breaking up pasture land or meadow and sowing to fall wheat and clover. Plow pasture land in June, or plow land from which a crop of hay has been removed, as soon as possible after the crop has been harvested. Work the plowed ground upon the surface, so that all thistles will be kept under until the time arrives for sowing winter wheat. In the spring, sow clover in the wheat crop, and after one, two, or three crops of clover have been grown repeat the same rotation. This method is applicable to stiff soils where winter wheat is a leading crop, and is especially successful where the land first broken up was clover sod. In localities where winter wheat will not grow, substitute for the winter wheat either spring wheat or barley, as may be desired. There will then be ample time for autumn cultivation after the sod land has been broken up; and, if this time is well employed, a great gain in the conflict with the thistles will have been effected.

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5. Smothering by a clover crop, with a hoed crop following. Where land has been sown to clover, cut the crop twice for hay, or once for hay and once for seed. Then follow with a hoed crop, properly cultivated. The smothering influence of the two growths of clover, combined with the effect of the two cuttings necessitated, will be found of much service in weakening the thistles.

6. Using the spud. When the thistles have been well brought under, they should be kept under by the use of the spud. The grain fields should be gone over before harvest to prevent the thistles from blossoming, and the meadows and fields sown with grasses should be similarly dealt with after harvest. To spud thistles before their blossoming season will not in itself be found of much service in destroying them; but when they are cut with the spud an inch or more below the surface of the soil at that stage of their development, and are again cut in the same way later on, the effects as regards their destruction are very beneficial. In the experience of the writer, when thistles have been thus cut two or three times a year, they have been found to disappear entirely from pastures, fence borders, lanes, and by-places generally.

7. Removing thistles from permanent pastures. In removing thistles from permanent pastures, we must be governed, as to our mode of procedure, largely by the character of the soil and subsoil. In stiff clays, two or three mowings a year for as many years will cause them to disappear; but on lands with open subsoils the spud will also have to be resorted to.

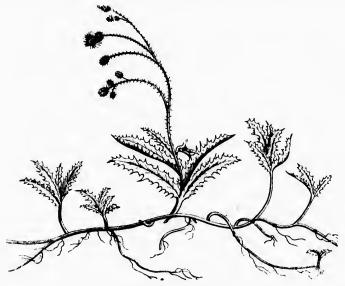
Observation. The facts relating to an experiment in removing Canada thistles and other noxious weeds from a permanent pasture in the Ontario Agricultural College Experiment Station farm at Guelph may prove interesting. field contained twenty acres, and had been for several years in permanent pasture, and was badly smitten. The experiment commenced in the summer of 1889, and the work was superintended by the writer, who also took part in it. The facts, as given in the annual report of the above-mentioned station for 1891, p. 50, are as follows: "The first spudding in 1889 took fully 100 hours of one person. The second spudding took 80 hours. In 1890 the first spudding was done on July 9th and 10th, and took 40 hours. The second spudding was done from August 26th to September 7th, and took 32 hours. In 1801 the first spudding was done on July 18th,

and took 7 hours. The second spudding was done on about the last day of September, and took 6 hours. The cost, therefore, of cleaning the field—for it is now clean—was \$22.50 in 1889, \$9.00 in 1890, and \$1.62½ in 1891; or a total, for the three years, of \$33.12½ for the 20 acres. The labor was valued at \$1.25 per day of 10 hours, without board." The annual cost of maintaining cleanliness in this field, so long as it remains a pasture, should not be more than \$2.50.

(2) THE SOW THISTLE.

There are several varieties of the sow thistle, but some of them do not give much trouble to the cultivator of the soil, and it will be sufficient for our purpose here to speak only of the variety known as the corn sow thistle (Sonchus arvensis), as it is the only form in which the sow thistle has been found, in Ontario, at least, which is very difficult to eradicate. The corn sow thistle is a creeping perennial, while nearly all the other varieties of the sow thistle found in Ontario are annuals. The plant has an upright habit of growth, and grows from one to three feet high; but when the soil is quite congenial it sometimes reaches a greater height. Like

the Canada thistle, the corn sow thistle is somewhat branched towards the top. Its stems are rather hairy, or bristly, especially its flower stems; they are also hollow, and, when wounded, a milky fluid exudes from them. The prickles upon its leaves are harmless. Its blossoms are



THE CORN SOW THISTLE.

yellow, and the plants are great producers of seed.

The corn sow thistle makes its appearance in May, and continues to grow until the autumn. It blossoms in July, and ripens its seeds in July and August. It will grow in any kind of soil,

but it is most at home in rich moist loams, and gives least trouble in stiff clays.

The corn sow thistle, like the Canada thistle, infests all kinds of crops, and it ripens its seeds somewhat earlier than, or simultaneously with, the crops amid which it grows; the only crops of which this statement is not true being, probably, red clover and lucerne.

It is propagated by means of its seeds, which are able to float about in the air by reason of the downy attachment which they possess; and, as its seeds are very numerous, its numbers increase very rapidly in the neighborhood of any place where once they are allowed to ripen. But it is at least an open question if they have the power of sustaining a long flight, like the seeds of the Canada thistle. The corn sow thisle is also propagated with much rapidity by means of its root-stocks, which it possesses numerously, and which, like those of the Canada thistle, are "creepers," and which also contain a very large number of latent buds, as is shown in the sketch. Moreover, its seeds, like those of the Canada thistle, are constantly being widely distributed by being carried about with the seeds of cereals, clovers, and grasses.

Modes of Eradication.

The means to be taken for destroying this intruder are essentially the same as those described for the eradication of the Canada thistle, and therefore need not be repeated here.

(3) COUCH GRASS.

Couch grass (Triticum repens) is known by a great variety of names, as scatch grass, quick grass, quitch grass, quack grass, and dog grass; but it is generally called by the name we have here given it. Couch grass is a creeping perennial, the root-stocks of which are so numerous that they soon fill the soil. They resemble considerably the roots of Canadian blue grass (Poa pratensis), but they are much larger and stronger and more vigorous in every way, and they are very much more tenacious of life. The root-stocks of couch grass are so strong and unyielding that they have been known to push their way through the tuber of the The stems grow to the height of potato. one to three feet, according to soil and season, and each of them is terminated by a slender spike from two to several inches in length. The leaves bear much resemblance to those of timothy, but are somewhat larger, and are characterized by a deeper shade of green.

Couch grass makes a good growth early in the season. Its seeds usually mature in August, about the same time as those of timothy. It will grow in almost any kind of soil, but is most

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COUCH GRASS.

partial to loams and soils of a decidedly open texture. It is least at home in stiff clays, and in these it is much more easily destroyed than elsewhere. Couch grass grows in all kinds of crops from early spring until late autumn, and during this entire period the work of propagation goes constantly on by means of its creeping root-stocks. When once it gets a footing, its power of crowding out other crops is very great. Like the Canada thistle and the corn sow thistle, couch grass also is easily distributed by means of the seeds of the useful grains and grasses, for its seeds ripen at the same time as those of the cereals, and those of some of the clovers—as, for example, alsike, and the mammoth—and those of timothy. It is also distributed through the agency of farmyard manure, both home-made and purchased.

As was said above, the power of this plant to multiply by means of its creeping root-stocks is very great. When it grows among other grasses, it usually so crowds upon them that they can make but little headway in its presence.

Couch grass has some redeeming qualities. It furnishes a considerable amount of food of a nutritious character, both as pasture and as hay; and, when cut as hay, it affords a considerable aftermath. It is so hardy that the cold of winter and the heat of summer cannot destroy it. Hence it has been deliberately

bought and sowed to provide permanent pasture. But after a few years its roots become so matted that the plants fail to produce a vigorous growth. When this is so, the pasture may easily be renovated by simply plowing it, and levelling it down again with the harrow. Couch grass, however, is generally looked upon as a great pest, owing to the difficulty of getting rid of it when its absence is desired; and this view is doubtless the correct one to take of it.

Modes of Eradication.

When the attempt is made to destroy couch grass, effective work should be made of it, and this in a single season. The following mode of dealing with it will be found successful, except in seasons that are unduly moist:

After-harvest and autumn cultivation, followed by spring cultivation and a hoed crop. After harvest, plow the infested fields lightly, and then harrow with the ordinary harrow—if necessary, using also the spring-tooth cultivator to shake the roots of the grass free from the soil. Then draw the roots into light windrows with the horse rake, and, when they are dry enough, burn them. If the weather should not be dry enough for burning them, the root-stocks may be carted into a compost heap. Repeat the operation a

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second time, and even a third time, the same autumn, if the weather will admit of it, plowing the ground, however, more deeply every succeeding time in order to bring up fresh rootstocks. But in no case should the disturbing work go on in wet weather. When the late autumn arrives, rib the land by turning two furrows together from opposite directions, or plow the land so that the largest possible amount of surface shall be exposed to the action of the frost in winter. The frost has the effect (1) of killing the roots that are exposed by the plowing, and (2) of freeing them from the soil. In the spring, use the harrow and cultivator occasionally in time of dry weather, and, in case of need, also the horse rake, until it is time to plant corn, roots, or rape. Then cultivate this hoed crop properly, giving it such hand work as may be deemed necessary along the line of the rows.

Observations. If this method is thoroughly followed out, then by autumn the couch grass will be completely destroyed. An infested field was very thoroughly cleaned by this method in one season at the Ontario Experiment Station farm at Guelph in 1891, the hoed crop used being a crop of corn. But it should be re-

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marked that more constant and careful cultivation was given to this crop than a corn crop usually receives, and this is true in respect to both the horse labor and the hand labor. In a wet season, however, it would be scarcely possible to eradicate couch grass without an expenditure of labor too costly for such a result. Indeed, couch grass should never be disturbed when the ground is wet, for at such a time the growth of the grass would, in some respects, be encouraged by stirring the soil.

In fence borders it will usually be found very difficult to dislodge couch grass without first removing the fence for a time, and then cleaning the ground as described above. However, another mode would be to smother the weed by piling litter or manure upon it; but this mode would only be applicable in the case of small patches. But it must not be forgotten that the weed should be destroyed in such places; otherwise it will be continually pushing out into the field and giving trouble.

(4) BINDWEED.

Bindweed (*Convolvulus arvensis*) is a creeping perennial with a trailing habit of growth. It usually grows to the length of two to three feet, but on some soils it attains a much greater

length. This weed bears a close resemblance to the morning glory. Its leaves are cordate or heart-shaped, and its blossoms are sometimes white, but more commonly they are of a pinkish-



BINDWEED.

white, which may be tinged with veins of blue. Its roots are larger than its vines. They form a network in the soil, and also go down deeply into it.

Bindweed begins to grow usually in the month of May, and maintains its greenness until the time of early frost, although its growth is most vigorous during the early months of It commences to blossom early in summer. the season, and continues to bloom for a long Bindweed grows in various crops, but it is most troublesome in grain crops; yet, when it is found in hoed crops, it greatly adds to the trouble of keeping them clean. Its climbing habit leads it to run up the stalks of the grain amid which it grows, and, after twining around them, it gradually draws them down toward the ground. So completely intertwined and entangled are the vines within themselves that they sometimes greatly hinder the progress of the mower or reaper. This weed will grow in various soils, but is most at home in soils which contain a large amount of humus.

Bindweed is generally distributed by means of the seeds of cereal grains, but it is also carried from place to place by the agency of water. In this last fact lies one explanation of the extent to which it is sometimes found in bottom lands. It is also distributed by means of manure, and it is propagated quickly by means of the root-stocks which it so numerously possesses.

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Modes of Eradication.

The following are the modes of eradication that have been found most successful in dealing with bindweed:

- I. Modifying the rotation. In the infested fields drop grain crops out of the rotation until the fields have been subjected to a cleaning process.
- 2. After-harvest and autumn cultivation, followed by spring cultivation and a hoed crop. Plow the infested fields immediately after harvest, and cultivate or plow them sufficiently often thereafter to keep the plants from breathing until the period of growth ceases. The plowing should be shallow, but at the same time thorough. The last plowing, however, should be deep, to prepare the soil for the next crop. In the spring proceed in the same way as in the autumn cultivation; that is, keep constantly stirring the soil near the surface until it is time to plant a hoed crop, as corn, roots, or rape. Then give this crop careful culture throughout the remaining part of the season.

It may here be remarked that, as this weed is usually a singularly persistent grower, it requires much labor and constant watchfulness in order to eradicate it completely in one season. 3. Calling in the aid of sheep. When bind-weed grows in pastures and by-places, its growth may be checked by allowing sheep to have access to the places where it grows, inasmuch as sheep are not disinclined to feed upon this weed, especially early in the season, while yet the plant is tender.

(5) THE OX-EYE DAISY.

The ox-eye daisy (Leucanthemum vulgare) is a simple perennial with a branching habit of growth. It grows from one to two feet high, according to soil and crop conditions, but usually it does not grow much more than one foot in height. It produces large flowers, consisting of a yellow disc bordered with white rays. The fancied resemblance of the disc in the centre to the eye of an ox has probably given rise to the name. The flowers, sometimes called "Marguerites," have been much in favor for bouquets during recent years. The plant, however, is none the less a pestilent weed. It is a great producer of seed.

The ox-eye daisy is very hardy. It can resist in a marked degree the influences of both heat and cold, and also of drought. It commences to blossom early in June, and under some con-

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ditions it will continue to blossom as late as September. The seeds have, in an uncommon degree, the power of maturing on the stalk, even



THE OX-EYE DAISY.

when the stalks have been pulled out of the ground or cut off from their roots before the seeds are quite ripe, and, moreover, they possess

great vitality. Although the plants may appear but singly at first, yet, if they are allowed to ripen their seeds, these fall to the ground and grow up again so thickly that to eradicate the weed by spudding is almost impossible. Hence, in pastures and by-places where cultivation cannot be introduced, the ox-eye daisy is an extremely difficult weed to deal with. It is not relished by live stock, owing, in part, to the woody nature of its growth; but they will, to some extent, browse on it when it is young.

The ox-eye daisy grows in all soils, but is most vigorous and troublesome in those of loose texture. It infests all kinds of crops, and it also grows where the land is not cultivated, as in permanent pastures, and in by places generally. It is, however, most difficult of eradication in permanent pastures and meadows, more especially so as these grow older, since the roots of the daisies then become much interlaced with those of the crops amid which they grow. It is least troublesome in hoed crops, and these, too, are very effective in destroying it.

This weed is distributed entirely by means of its seed. It is most commonly carried about in the seeds of timothy and some kinds of clover, but it is also distributed through the

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agency of the cereal grains. It is often taken from field to field on the farm in the manure, and is also carried about to some extent by birds.

Modes of Eradication.

The following are the modes of eradication that have been found most successful in dealing with the ox-eye daisy:

- 1. Modifying the rotation. Drop meadow out of the rotation until the infested fields have been dealt with.
- 2. August plowing, followed by winter rye cut early, and this again by rape. Grow a crop of rye followed by rape, as described in section 3 above, where we treated of the methods of destroying the Canada thistle. The plowing for the rape in June will turn under the daisies that may have been in the rye, and the stirring of the soil necessary to the cultivation of the rape will be favorable to the germination of the seeds of the weed that may be lying in the soil dormant.
- 3. Plowing up meadow land and sowing to rape. In the case of meadow land which is infested with the weed, pasture it until the middle of June; then plow it deeply and sow it with rape in drills, taking pains to cultivate the rape with sufficient care. The daisies are thus

turned under before they have had opportunity to ripen their seeds. It may be necessary to follow the rape crop with a crop of corn or of roots.

- 4. After-harvest and autumn cultivation, followed by spring cultivation and a hoed crop. Plow the infested field lightly after harvest, and then again deeply just before winter. In the interval give the soil one or more harrowings to induce the daisy seeds to germinate. In the spring, follow this preparation with a hoed crop, and this, if necessary, next year, by another hoed crop.
- 5. Sowing to rye for pasture or hay, following by millet, or bare fallow and winter wheat. Sow the infested field with rye, and pasture the rye until June, or cut it for hay. Follow the rye with a crop of millet; or, if thought best, work the ground on the bare fallow system until winter wheat may be sown in September. Where it may not be desired to grow winter wheat, the occasional stirring of the soil should be continued until the close of the season, that the weed seeds lying in the soil may be made to germinate. Then next season some kind of spring cereal may be grown.
 - 6. Cultivating a hoed crop and following by a

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grain crop sown to meadow. If a hoed crop is grown with a view to the destruction of the weed, then it should be followed by a grain crop, which should also be sown with clover, or clover and grass. The grain crop should then be gone over with the spud, and any daisies found in it be cut off. Spudding will probably be necessary in the meadow which follows the grain crop, more especially during the first year of its growth. The best time for spudding the ox-eye daisy is when it is in blossom, as at that time the weeds are very easily seen.

When spudding the ox-eye daisy, it may sometimes be necessary to catch the plant with the hand and strike it over the spud handle to free the adherent earth from the fibrous roots of the weed which have been cut off with it.

7. In permanent pastures, etc. Wherever practicable pasture-lands that are infested with ox-eye daisy should be broken up and dealt with in one or other of the methods described above. But in pasture-lands which cannot be cultivated, and which therefore must remain permanent, and along fence borders, or on the sides of roads, and in by-places generally, it is difficult indeed to deal with this pest. Any plan that will prevent

it from maturing its seeds will in time, no doubt, prove effectual, but several years will probably elapse before the weed will be finally banished from such places.

(6) THE PLANTAIN.

The two most important varieties of the plantain are known as the common plantain (*Plantago major*) and the English plantain (*Plantago lanceolata*).

The common plantain, which seems to follow everywhere in the wake of civilization, is not a very troublesome weed. It grows about dwellings, and in paths where the grass has been much trodden, and in by-places generally where the soil is rich. Good cultivation, in nearly all cases, will suffice to keep it at bay.

The English plantain, sometimes called rib grass, is, however, a much more troublesome weed, and has, in consequence, become a source of great annoyance in the many sections of our continent into which it has been introduced from Europe. It is a simple perennial. Its leaves are long, ribbed, hairy, and narrowed at the base. The stems which support its seed-spikes are usually about a foot high, though they sometimes attain a height considerably greater. Several spikes are commonly borne by

each plant. These spikes are usually from one to two inches long, being, however, much shorter relatively than those of the common plantain.



THE ENGLISH PLANTAIN.

The English plantain continues to grow throughout the greater part of the growing period of the year. If it be cut off above ground, as with the scythe, after the spikes begin to appear, other spikes will at once commence to grow in their place. Its effort to produce seed is thus sustained until late in the season. It comes into flower in June, and seems capable, under certain conditions, of maturing seeds during all the months following until cold weather is near.

The English plantain is most troublesome in meadows and pastures, more especially in the latter. It also infests lanes, roadsides, and byplaces; but it is not specially troublesome in tilled fields, as it does not seem to have much power to withstand good cultivation. Its favorite soils are those which may be termed sandy loams, or loams of mild constitution.

This weed is most commonly distributed by means of the seeds of grasses and clovers, but it is also distributed, to some extent, in the seeds of cereal grains which have not been carefully cleaned. It is also distributed in manure, and by means of other agencies. Its seeds are about the same size as those of red clover, and are much the same in color. In shape each seed is slightly elongated, and furrowed on one side.

Modes of Eradication.

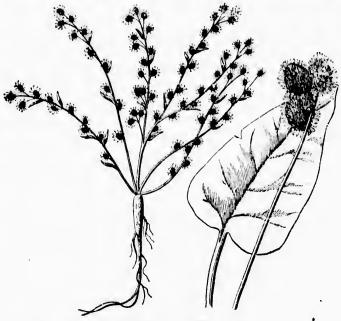
The following are the modes of eradication that have been found most successful in dealing with the English plantain:

- 1. Breaking up meadow-land and following it with a hoed crop. In the case of meadows, plow them just after they have been cut, and cultivate on the surface until the late autumn. Grow a hoed crop the following season.
- 2. After-harvest and autumn cultivation, followed, next season, by a soiling crop, and this by rape. In the case of tilled fields that are infested, plow just after harvest, and thereafter give due attention to surface cultivation. Next season grow a soiling crop, and follow that with a crop of rape, grown as described in section 3 of our treatment of the Canada thistle.
- 3. Using the mower, or scythe. In places where cultivation cannot be introduced, persistently use the mower or scythe to keep the plants from maturing their seeds; or, if practicable, use the spud to cut off the plants below the surface of the ground.

(7) THE BURDOCK.

The burdock (*Lappa major*) is so well known, and also so easily managed, if the work of destroying it is gone about properly, that it would seem almost superfluous to write about the modes that will prove effective for its extermina-

tion; and yet there is no denying the fact that the burdock is one of the most general of the weed abominations which disgrace the farms of to-day. It is a biennial, the leaves of which are very large even in the early stages of the



THE BURDOCK.

The large plant in the sketch represents the burdock in the dead state, after it has perfected its growth.

growth of the plant. Its seed is borne on a branched stem, which pushes up from amid the centre of the leaves to a height of from two to five feet. Sometimes this stem is very much

branched. The first year of its growth, the burdock, being a biennial, does not produce any seeds, but in the second year it produces them in immense numbers. The seeds are matured in enclosures at the end of the branches of the stems. The seed sacs, circular in shape, are so armed with hooks that they adhere to almost everything they come in contact with. Hence we find them clinging in large numbers to the hair of horses and cattle that pasture where they grow, and also to the wool of sheep, which, indeed, they oftentimes render practically valueless.

The burdock sends a strong tap root down into the soil wherever the natural or artificial drainage is good; hence it does not suffer readily from dry weather. The root as shown in the sketch is broken off. The burdock comes out into flower chiefly in the months of June and July, but more especially in the latter month. If cut off above the crown, even after the seed pods are formed, young shoots will be thrown up around the parent stem, and seed be matured sometimes within a few inches of the surface of the ground, and even many weeks after the harvest season is over. It is forgetfulness of this fact, more, perhaps, than anything

else, which allows this plant so long to retain its hold upon the agriculture which it degrades.

The burdock will grow in nearly all soils that are free from ground water. No other weed, perhaps, is found in so many of the provinces and states of our continent. It is pre-eminently the weed of the outlying and neglected portions of cities, towns, and villages, and it is much prone to intrench itself along the fence borders and in the by-places of the farm, but it does not give much trouble where the soil is well cultivated.

The burdock is propagated solely by means of its seed, which is possessed of much vitality. It is very generally distributed through the agency of domestic animals, to the hair and wool of which its seeds most readily adhere. If a burdock plant is left undisturbed, so that its seeds ripen upon its stems, it sheds them upon the ground about it, and there they will continue to give trouble for years after.

Modes of Eradication.

The following are the modes of eradication that have been found most successful in dealing with the burdock:

I. In cultivated fields. Where the burdock is found in cultivated fields, it will, of course, be

cut off with the hay or grain amid which it grows. When thus cut during the first year of its growth, the plant is but little injured; and, when mowed off during the second year, it at once pushes up fresh stems and ripens its seeds in great numbers, as already mentioned. Although the farmer may not notice this, the ripened burs will not fail to find lodgment in the hair and wool of his cattle and sheep when they feed upon the aftermath or gleanings. The only way to prevent this late ripening of the seeds is to go over the fields once or twice after the harvest is over, and cut off with the spud all plants that seem likely to produce seed that season.

2. In permanent pastures, by-places, lanes, etc. In permanent pastures, and in by-places, as along fence sides, in lanes, and around the corners of farm buildings, and in the borders of woodlands, the plants must be destroyed by the use of the spud. In cutting them, however, great care must be taken to strike them below the crown. If this be done the plants will die, no matter what their previous growth may have been. The spudding may be done at any time of the year when the ground is not frozen; but during the second

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year the cutting must, of course, take place before the plants form their seeds. A few years of this persistent spudding will soon get to the last of them. Farmers who go over their fields twice a year with the spud will not long be troubled with burdocks.

(8) BLUEWEED.

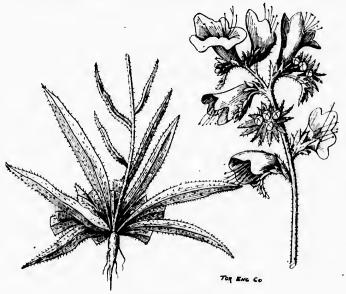
Blueweed (*Echium vulgare*) is a biennial. It is sometimes known as viper's bugloss, but the more common name for it is blueweed. In the Southern States it is sometimes called the Canada thistle, although it bears but little resemblance to that weed. It is now found in several localities in Ontario, both in the east and in the west.

Blueweed is both upright and spreading in its habits of growth, each plant having several branches springing from a single stock. It grows to the height of from one to three feet, according to the character of the soil which it infests. Its leaves are rather large, and those which grow nearest the crown spread out so that they lie near the surface of the ground. Both leaves and stems are covered with numerous hairs, which stiffen with the advancing growth of the plant, and this is, perhaps, the reason

why blueweed is not relished by live stock. These hairs are also far from agreeable to the touch when one tries to pull the plant. Its flowers are large, and of a deep, rich blue color, thus giving the fields where blueweed grows a very beautiful appearance at the season of the year when it is in bloom.

Blueweed is a biennial. During the first season of its growth, it sends a strong tap root down deep into the ground, and from this several smaller roots branch off. Blueweed does not blossom in its first year, but in the second year the stronger plants begin to come into bloom in the month of June, and the weaker ones later on, so that the period of bloom usually extends over several months. The blooming season is also extended by efforts made to eradicate the weed; for when it is cut off above the surface of the earth, as with the scythe, horizontal branches at once start out from the crown, and these soon begin to bloom and bear seed. Some of these newly formed horizontal branches hug the ground so closely that, when the field is gone over again with the scythe, it is not at all easy to cut them off; and, as the same thing occurs with each cutting, as long as the growing period continues, and as the weed is a very prolific seed producer—its seed, moreover, being very tenacious of life—it follows that, in places where cultivation is impossible, this pest is not a very easy one to deal with.

Blueweed grows in various kinds of soil, but



BLUEWEED.

its favorite feeding grounds are those soils which contain much lime. It grows vigorously, too, in gravelly soils, even in those which are suitable for being used in road-making; hence, on highways, we frequently find this plant growing right up to the travelled portions of the road.

As is the case with all or nearly all biennials blueweed is not very difficult to keep out of the cultivated portions of the farm; but, as was said above, it is a very different matter when we come to deal with it in fence borders, in permanent pastures, on road sides, and in by-places generally. In all these places blueweed soon finds a congenial home, from which it cannot be easily dislodged.

As regards the distribution of blueweed, it is probable that the wind is the chief agency employed in effecting its spreading from place to place. The seeds of blueweed cling long to the receptacles in which they grow; but in winter, or toward spring, the wind shakes many of them out of their receptacles and drives them for miles over the encrusted snows. This fact, no doubt, will generally account for the sudden appearance of blueweed in new centres, where previously it had not been known to exist. Blueweed is also probably distributed to some extent by means of clover seed, where careless methods of farming allow it to mature its seeds while growing in meadows.

Modes of Eradication.

The following are the modes of eradication that have been found most successful in dealing with blueweed:

- In cultivated fields. Really good cultivation will keep blueweed from getting much of a footing in the cultivated portions of the farm. When stray plants put in an appearance in a field that is not desired to be broken up that same season, the spud is the most effective means for removing them. But the spud should in all cases be made to go below the crown; for when the plant is cut off below the crown at any stage of its growth, it will surely die, but not otherwise.
- 2. In permanent pastures, by-places, lanes, etc. In permanent pastures, and in by-places generally, if the plant has got a strong foothold in them, it will be found that any plan that will keep it from maturing its seed will soon prove effective in destroying it. Whether the spud or the scythe be used must be determined by the number of the plants to be destroyed; but in either case the work will have to be done more than once in a season, and also for several seasons. It will have to be done more than once in a season because, when cut with a scythe, the plants, as described above, at once spring up again and begin to blossom, and, when the spud is used, some weaker ones are, in the first cutting, certain to be overlooked, but these also

will blossom and bear seed later on; and it will have to be done for several seasons, inasmuch as the seeds lying in the soil, being possessed of considerable vitality, will continue to germinate for years.

Observations. When fields containing blueweed are pastured closely early in the season, the production of the seeds will be very much hindered. But this method will not alone be sufficient to eradicate the weed, for some of the plants will be sure to ripen their seeds unless some other method of eradication be resorted to.

(9) THE WILD CARROT.

The wild carrot (*Daucus carota*) is a biennial. It bears a close resemblance to the cultivated variety, more especially in the portions above ground. It has a tap root, which is more or less branched.

The wild carrot comes up early in the season-It sends up long flower stems, which terminate in an umbel or flower cluster. It thus produces seeds very numerously; and when cut off by the scythe, or otherwise, it sends up other stems, and thus continues to put forth the effort to produce seeds until late in the season. Owing to its acrid juices, live stock do not care to feed upon it.

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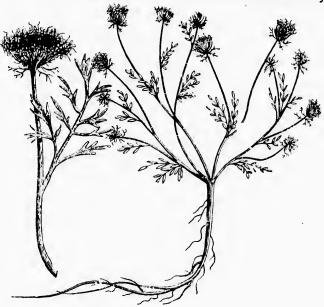
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h e of The wild carrot is not greatly troublesome to crops where the usual cultivation is good. Like blueweed, it is more commonly found in pastures, along roads and railroads, and in by



THE WILD CARROT.

places generally, and to a less extent in meadows. It grows most readily in vegetable soils, but it also flourishes in mild loams.

The wild carrot is brought to new centres through the agency of railways, and to some

extent by birds. But wind and water are the great agencies for carrying and scattering its seeds.

Modes of Eradication.

The following are the modes of eradication that have been found most successful in dealing with the wild carrot:

- I. In cultivated fields. Give the arable portions of the farm good cultivation. If this be done, the wild carrot will soon cease to appear in them.
- 2. In permanent pastures, lanes, by-places, etc. In pastures and by-places keep the plants cut down during the second year of their growth, cutting them off with the scythe as often as they attempt to mature their seeds. If this be done thoroughly, at the end of two years all the plants will be destroyed.
- 3. Using the spud. Where the plants are not too numerous, they may be destroyed with the spud by cutting them off below the crown at any stage of their growth.

(10) WILD MUSTARD.

Wild mustard (Sinapis arvensis) is one of the most difficult weeds to dislodge found on this continent, when once it gets a strong foothold

in the soil. Owing to the extraordinary vitality of its seeds, a very long time is required to completely effect its removal from any soil infested by it, for the reason that for years and years the seeds lying in the soil continue to germinate with each successive cultivation that may happen to bring them near the surface.

Wild mustard is an annual plant which, in the earlier stages of its growth, bears some resemblance to the radish, and to the yellow-fleshed varieties of the turnip. It has a spreading, fibrous root, as shown in the sketch. Its stem is more or less branched, according as it is crowded or not when growing, and it bears a bright yellow blossom, which can be seen at a considerable distance. Its seeds resemble those of the turnip so closely that they cannot easily be distinguished from them, and they also closely resemble the seeds of some varieties of rape.

Wild mustard comes up in spring as soon as the weather gets really warm, but seeds that come sufficiently near the surface will germinate as long as the season of growth lasts. It grows very rapidly, and matures an immense number of seeds. It sometimes grows to the height of more than two feet, but when it ripens amid

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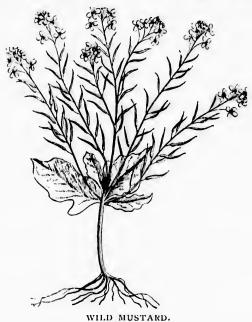
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he iis ld grain crops it is about eighteen inches in height. Its seed pods are usually about an inch in length. The first flowers, or those borne by the earlier developed plants, appear early in June, but the late plants will produce seeds on



into the month of September, or even later. Fortunately, it is not a plant that can withstand severe frost; hence it is not found to any considerable extent in meadows or pastures, or in fields of winter wheat or rye. It is not positively known how long its seeds will retain the

power of germination when lying in the soil; but it has been claimed that they may lie buried for at least fifty years and yet immediately spring into vigorous life when brought to the surface of the soil under favorable conditions.

Wild mustard will grow in all kinds of soils, but not equally well. It is most at home in friable limestone soils that possess good drainage, but it will also grow in great luxuriance on humous prairie soils. On stiff clays it does not grow so readily; but it will make fair headway even in these when given the opportunity.

Wild mustard grows in all kinds of grain crops that are sown in the spring, and usually it matures its seeds before the grain in which it grows is ripe. It is manifest, therefore, that where spring grains are chiefly grown the contest with this weed will be a difficult one. It has been argued by some persons that wild mustard does not interfere, to any serious extent, with the yields of the crops amid which it grows; but it must be evident to any one who understands the way in which plants feed that a soil cannot produce a crop of mustard and one of grain at the same time, with the result that the grain will yield as well as if the mustard had not been there.

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Wild mustard is distributed by means of various agencies. Some seeds are carried from place to place by birds, but usually this weed finds its way to new centres by the seed being carried in the seed of grain. The threshing machine is also a potent means of carrying it from farm to farm. It is further distributed over farms on which it grows by means of the droppings of the cattle, and by the manure. It is also very frequently distributed by spring floods; and, when this is the case, the farmer has great difficulty in dealing with it.

Modes of Eradication.

The following are the modes of eradication that have been found most successful in dealing with wild mustard:

- I. Modifying the rotation. Until the infested fields can be subjected to a cleaning process, drop out of the rotation, as far as possible, the spring crops amid which the mustard grows and ripens. Grow hoed crops, at the same time, to the greatest extent possible, as the cultivation which these require first encourages the germination of the mustard seeds in the soil, and then effects their destruction.
- 2. Growing winter rye for pasture, hay, or ensilage: and following it by rape, barley sown to

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meadow or pasture, and corn. Plow the ground deeply after the preceding grain crop has been removed, and sow with rye. The rye may be pastured in autumn or spring, if sown sufficiently early; or, if desired, it can be cut for hay or ensilage, as described in section 3 where we treated of the modes of destroying the Canada thistle. Follow the rye with a crop of rape, as described in the section just referred to. While the rape crop is growing, it may be necessary to go along the rows of the rape at least once in the season to remove the mustard plants that may appear; otherwise they might mature seeds. Follow the rape with a crop of barley sown to meadow, or for pasture. the mustard plants in the barley are not too numerous, remove them by hand, or with the spud; otherwise cut the barley before the mustard seeds ripen, and use it for fodder. Pull out any stray plants that may from year to year appear in the meadow or pasture; but of these there will not be many. If, by this time, a suspicion still exists that the mustard plants are still numerous in the soil, follow the meadow—or pasture, as the case may be—with a crop of corn managed as described in section 3 given below. Barley, or spring wheat, may follow the corn; after which careful spudding or pulling should be quite sufficient to keep the fields clean for the crops that follow.

3. Autumn cultivation, followed by corn, and this by spring wheat, barley, or oats, sown to Immediately after harvest, plow the land, if it be in stubble, with the gang plow. Then stir the ground once, or oftener, with the harrow or cultivator. This is to be done with the twofold object of destroying the plants that may be growing and of encouraging dormant seeds to grow. Then, in the late autumn, plow the soil deeply, both for the sake of the corn crop that is to come after, and also to bring up another stratum of earth, so that, by the cultivation that will follow, the seeds of the mustard which lie in it will be encouraged to germinate. In the spring cultivate the soil once, twice, or oftener, and then plant with corn. Give the corn as much cultivation as possible until the season for cultivation is over, and allow no seeds to ripen in the lines of the drills. Follow the corn with a crop of spring wheat, barley, or oats, sown to grass, as described in section 2 above. But, if the mustard seeds are very numerous, and the land will bear it, it may be advisable to grow another root crop before laying the land down to grass.

4. Autumn cultivation, spring cultivation, and a rape crop. Plow the land after harvest, and proceed with the subsequent cultivation until winter, as described in section 3 above. In the spring, cultivate as frequently as may be necessary until the latter part of June. Then sow with rape, managed as described in section 2 above. A crop of corn or field roots may come after the rape, if it is feared that the mustard seeds are still numerous in the soil; otherwise the rape may be followed by barley, which, however, should be sown to grass.

5. Winter rye, sown for hay, ensilage, or green manure, followed by winter wheat or rye, sown for a crop. Sow with rye in autumn, as described in section 2. Cut the rye for hay or ensilage, or plow it under as a green manure. Then cultivate the ground occasionally after it has been plowed until it is time to sow winter wheat; that is, in localities where winter wheat can be grown. Where it cannot be grown, a crop of rye may be made to take the place of the wheat. Grass seed should be sown the following spring upon the land where the wheat or rye has been sown. The few plants which may grow in the wheat or rye may be removed by hand.

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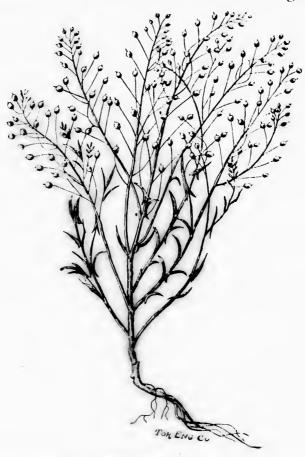
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It will be noticed that any one Observations. of these methods may be followed by either of the others when the meadow land is again broken, thus forming a sort of rotation for the time being. The weak point in each of these methods is found in the fact that they all preclude the growing of spring cereal grains for a time at least. Generally speaking, any one of the methods given above will so far reduce the prevalence of the mustard that the twice-a-year hand spudding, so frequently spoken of in this chapter, will be found sufficient to effect, eventually, a complete extermination of the weed. the case of mustard, however, hand pulling may be preferable to spudding, for the reason that when they are pulled by hand the plants may be taken entirely off the field, and burnt; whereas otherwise, from the more mature plants, seeds sufficiently ripe to germinate may possibly be left upon the soil.

(11) WILD FLAX.

Wild flax (*Camelina sativa*), sometimes known as false flax, has probably gained its name from the prevalent, but mistaken, notion that it has originated in the degeneracy of cultivated flax, whereas cultivated flax is a plant of another

order. Wild flax usually grows to the height of about eighteen inches, but sometimes it grows



WILD FLAX.

considerably higher. Where the seeds have been shed numerously the previous year around

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some parent stem, it frequently comes up so thickly that some of the plants cannot grow more than a few inches above the ground. In the earlier stages of its growth wild flax is somewhat leafy, but after its blossoming stage is past the upper portions of the plant consist mainly of stems and seed pods, as shown in the sketch. The blossoms are small, and of a pale yellow color.

Ordinarily, wild flax is classed as an annual, although it usually commences to grow in the later portions of the year previous to that in which the seeds are matured. Wild flax is very hardy, and can well withstand the influences of frost. Its seeds, which are very numerous, are easily shed; hence, when the ripe plants are disturbed by the jar of the machines used in cutting the crops amid which they grow, many of their seeds are shed upon the ground. The seeds of wild flax have some resemblance to the seeds of common flax, but they are much smaller.

Wild flax is a weed that will grow in any kind of soil adapted to winter wheat or meadow; hence it will flourish on a wide range of soils. It seems equally at home in the stiffest clays and in the mild, humous loams of the prairie.

Wild flax peculiarly infests winter wheat, rye, meadows, and pastures. It does not usually grow to any considerable extent in spring crops, but sometimes stray plants will be found in these crops. These stray plants, however, usually have sprung up in the preceding fall, and have survived the cultivation involved in preparing the ground for being sown in the spring.

This plant is distributed by means of the seeds of the crops amid which it grows, by farmyard manure, and also, probably, by the droppings of cattle; but it is more widely distributed by being carried in the seed of timothy than in any other way. In this fact we find a chief explanation of the sudden appearance of wild flax in new centres where formerly it was not known.

Modes of Eradication.

The following are the modes of eradication that have been found most successful in dealing with wild flax:

1. Modifying the rotation. Modify the rotation by dropping out of it such crops as winter wheat, winter rye, hay, or pasture. Instead of these crops grow spring crops. Where the ground is suitable, one of these may be a hoed crop. When the land is again sown with

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lays irie. grasses, stray plants in the meadows will probably be found, and, if so, they should be removed with the spud, or by hand pulling.

- 2. Growing hoed crops. Grow two hoed crops in succession where the conditions will admit of this being done. The seeds of the weed lying dormant in the soil will in this way be greatly reduced in number, owing to the encouragement given them to germinate during so long a period of cultivation. But the most effective part of this mode of combating the weed is the cultivation given to the soil in the latter part of the season, since that is the time when the seeds of the plant germinate most readily.
- 3. Growing rye and following it with a hoed crop. Grow rye, and follow it by a hoed crop. The rye must not be allowed to ripen; but it can be pastured, or else cut green for fodder, as may be desired.
- 4. Hand pulling. When the plants are not numerous, pull them out by hand. When the wild flax first makes its appearance, or when it is still confined to limited areas, this mode of dealing with the weed will probably be the cheapest.

Observations. In the conflict with wild flax

it will be well to bear in mind the following: (1) That grass seeds should invariably be sown along with spring grain, as wheat or barley; (2) that autumn cultivation is always the most important thing to be attended to, owing to the natural tendency of the weed to germinate from seed in the fall of the year; (3) that when wild flax is found in meadows merely in detached patches, the infested parts may be cut and used for soiling purposes, while the remainder of the crop may be harvested in the usual way; (4) that where lucerne can be substituted for the ordinary meadow crops it is well to make the change, inasmuch as in that case the first cutting of the lucerne would take place before the wild flax would be ripe.

(12) PIGEON WEED.

Pigeon weed (Lithospermum arvense) is sometimes known as gromwell, and wheat-thief, and oftener red-root. It usually grows from eight to sixteen inches high, but sometimes in rich soils it becomes considerably taller. It is more or less branched in its habits of growth. Its leaves are narrow and about an inch long, and are noticeable from the fact that they are of a lighter tinge of green than those of the cereals and

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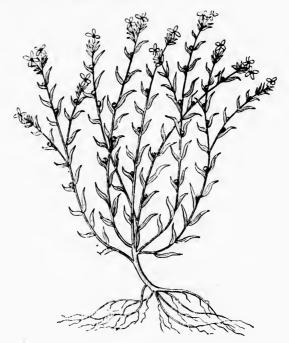
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grasses. Its flowers are small, and of a pale white color. Its seeds cluster along its stems, and are produced abundantly. They are endowed with much vitality.



PIGEON WEED.

Pigeon weed is an annual, but, like wild flax, it usually comes up in the fall of the year previous to that in which it matures its seeds. Its blossoms appear during the latter part of May, or early in June; hence its seeds ripen

before our meadows are ready for harvesting, or before our crops of winter cereals can be cut. It is so hardy a plant that frosts do not destroy it. It usually grows a little in advance of the crop in which it is found; hence its presence may most readily be detected just when it is coming into blossom. The lighter shade which its leaves possess also enables it to be somewhat easily distinguished. It will grow in any kind of soil free from stagnant water, but is most partial to sandy loams.

Pigeon weed is most troublesome in crops which mature early, and have been sown the previous season. These crops comprise, principally, winter wheat, rye, and meadows. It is also found in pastures; but it seldom infests spring crops to any considerable extent, although some plants may survive the early cultivation necessary for the preparation of the ground for these crops.

Pigeon weed is most commonly distributed through the agency of the seeds of the winter cereals—namely, winter wheat and rye—and of the seeds of timothy, mammoth clover, and alsike clover. It is not carried in the seed of common red clover. It is further distributed by the droppings of cattle, by the manure of the

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farmyard, by threshing machines, and by birds. It has probably derived its name from the belief that wild pigeons were fond of it, and were therefore an active agency in its distribution.

Modes of Eradication.

The following are the modes of eradication that have been found most successful in dealing with pigeon weed:

- r. Modifying the rotation. Drop out of the rotation winter wheat, winter rye, and meadow crops, but not necessarily pastures, if these are kept eaten bore. The omission of these crops from the rotation need not continue for more than two or three seasons if due attention be given to autumn cultivation, as described in the next section. In respect to pastures that are infested, it will generally be sufficient to deal with them by means of hand pulling.
- 2. Autumn cultivation. Give careful attention to autumn cultivation, for it is in the autumn that the seeds of pigeon weed germinate most freely. The first plowing after harvest may be either shallow or deep, as may be desired. But if the seeds of the pigeon weed have fallen numerously during the harvesting of the immediately preceding crop, cultivating the surface soil will be preferable to plowing it.

3. Growing hoed crops. Where the land is suitable, grow hoed crops; or else grow rye and follow it by a hoed crop. Where hoed crops are grown alone, give careful attention to the autumn cultivation which precedes their sowing.

4. Hand pulling and spudding. Where the weeds are not numerous, resort to hand pulling or spudding. This work, to be easily done, and to fully accomplish the end intended, should be undertaken while the plants are still in bloom.

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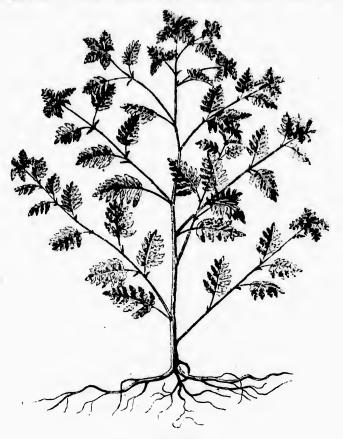
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Observation. Whenever it may be necessary to sow to grass, then, as in the case of wild flax, it should only be done with such crops as spring wheat, barley, and oats.

(14) RAGWEED.

Ragweed (Ambrosia artemisiæfolia) is an annual plant, with a slender and much-branched stem. There are several varieties of ragweed, but the variety represented in the sketch is by far the most troublesome one. Ragweed more commonly grows to the height of from fifteen to twenty-one inches, though in some soils it will, under favorable conditions, grow to the height of four feet. Its leaves are much jagged in their outer edges; hence its name. The blos-

soms have a yellowish tinge, but the contrast in color between them and the leaves is not marked. The seeds are small and helmet-



RAGWEED.

shaped, and when ripe are of a dark hue. They are produced on the lower portions of the flower-bearing parts of the branches, and are very numerous. They are so light that they float readily in water, and they are possessed of great vitality.

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As this weed is in no hurry to awaken from the sleep of winter, its development is somewhat late in the season; so much so that it does not usually ripen its seeds in cereal crops before these are reaped, or, in meadows, before the time of cutting. But in the stubbles of these crops, if not disturbed, it continues to grow until late in the season. It blossoms and produces seeds from July onward until the time of frost, the precise time of its blossoming varying with the attendant conditions of growth.

Ragweed will grow in all soils that are free from stagnant water, but it very much prefers friable and loamy soils that contain a large proportion of humus. It revels in black loams and muck soils that have been well drained; but it does not make much headway in stiff clays, except in depressions and valleys, or along water furrows and watercourses.

While ragweed will grow in all kinds of crops, it does not mature its seeds in grain crops, nor does it mature them in the first cutting for the season of a clover meadow. But in all kinds of

stubbles it pushes on rapidly after the crop has been removed, and, if it be not disturbed, produces an enormous crop of seeds before the season closes; and in hoed crops, as corn or roots, it will also produce seed abundantly if due attention is not given to their cultivation late in the season.

Ragweed is distributed in the seeds of all the late-maturing cereals, and in the seed of mammoth and alsike clover, and of timothy. But it is most commonly distributed in the seed of common red clover; for the reason that, by the time the clover crop is harvested for threshing, a large proportion of the seeds of the ragweed growing in it have also ripened. It is, indeed, in the seed of common red clover that ragweed is usually carried to new centres. Its seeds are also distributed by the excrement of animals, by clover threshing machines, and by birds. But, in localities where it once gets a foothold, no agent is so potent in effecting the distribution of ragweed as water. In low-lying, level lands, its distribution soon becomes as wide as the range of the water which overflows them. water, in its subsidence, leaves the seeds of ragweed scattered everywhere over the soil. It is very difficult, therefore, to keep entirely free

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from ragweed those parts of a farm which are subjected to a periodical overflow of water coming down from lands where the weed abounds. Indeed, it is impossible to do so. The most that can be done, under such circumstances, is to keep the ragweed, as from time to time it springs up, cut down, so that it cannot mature any of its seeds.

Modes of Eradication.

The following are the modes of eradication that have been found most successful in dealing with ragweed:

I. Modifying the rotation and autumn cultiva-Modify the rotation, and give special tion. attention, at the same time, to autumn cultiva-Happily, the rotation will not require serious modification where careful attention is given to the working of the soil in autumn; but late-ripening cereals should not be grown in the meantime; nor should timothy nor any of the forms of clover be allowed to produce a seed crop in the infested fields until the ragweed is much reduced. As soon as the cereal crops are reaped, the ground should be gang-plowed, or plowed in any way that may be desired. may then be occasionally stirred until the late plowing that is given on the approach of winter.

Autumn cultivation is peculiarly helpful in destroying ragweed, for the reason that the plants grow late, rather than early, in the season.

2. Growing hoed crops. Grow hoed crops as described in section 3 in the treatment respecting pigeon weed.

.3. Using the mower. When fields are newly sown to grass, the use of the mower in the autumn will be found very effective. The mowing should be done as close to the surface of the ground as possible, for the reason that the seeds of the ragweed are often formed low down on its stem; and, of course, it should be done before any of the seeds ripen. Pastures and meadows may be treated in the same way.

Observations. (1) When infested meadows or pastures are to be broken up, the work should be done, wherever practicable, before any of the seeds of the weed have had opportunity to ripen. (2) When the plants are well reduced, hand spudding will soon effect the extermination of this weed; but if its seeds have been allowed to become numerous in the soil, several years will necessarily elapse before the work of eradication can be completely effected. (3) Sheep may be made to render substantial service in reducing the prevalence

of this weed, more especially if they be allowed to feed upon it during the earlier stages of its growth.

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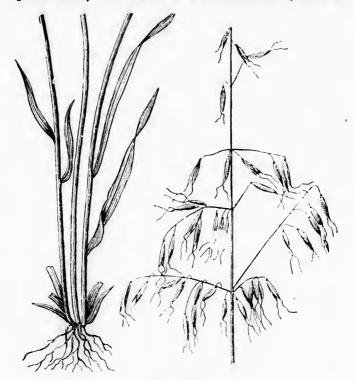
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(15) THE WILD OAT.

The wild oat (Avena fatua) is an annual that is rapidly becoming one of our most pernicious and troublesome weeds. There are several varieties of it, but the points of difference between these varieties do not appear to be well understood as yet. In fact, the attention has never been given to this pest that its banefulness merits; but we would advise all farmers to spare no pains to exterminate it utterly from their land. The wild oat will grow readily at different seasons of the year, but it makes its most vigorous growth in the warm, moist weather of spring, though not in early spring. It bears considerable resemblance to the common oat, but there are some distinctive points of difference. In the wild oat the chaff scales which adhere to the grain are thick and hairy, while in the cultivated varieties these scales are not so coarse, and are hairless. The wild oat has a long, stiff awn, which is usually twisted near its base; in the cultivated varieties, the awn is either entirely wanting, or, if present, is not so stiff, and is seldom bent. When the awn of the wild oat is dry, it is generally twisted closely upon itself; but when it is moistened by dew or



WILD OATS.

rain, it slowly uncoils. This uncoiling of the twisted awn causes the seed to sprawl and spring about upon the ground. The grain of the wild oat is light, being composed chiefly of

hull, and it is therefore of but little value as a food.

The resemblance of the wild oat to other cereals, before the shooting of the ear, is so close that when it grows along with them it is impossible to detect its presence without very careful scrutiny. It matures it seeds earlier than nearly all the varieties of the useful cereals, but, of course, not so much so in the case of fall wheat as of the spring cereals; hence it is oftentimes peculiarly troublesome in the localities where cereal crops are much grown. It is very troublesome, too, from the fact that, as soon as ripe, it begins to shed its seeds upon the ground; and the operation of harvesting the crops amid which it grows greatly helps it to shed its seeds. It is a very hardy plant, and will endure adverse conditions of soil and weather in a remarkable degree; but its seeds will not germinate very early in the spring; nor in the autumn, unless the weather be warm and moist. It luxuriates in soils that are well adapted to the growth of cereals, but it will also grow in various other soils. seeds are possessed of great vitality, and will spring into life when brought under suitable conditions, although they may have been buried

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sely w or in the ground or in unrotted manure for years and years.

From what has been said above, it will be seen that the wild oat is specially troublesome in cereals, more particularly in the spring varieties; but it is not troublesome to any great extent in meadows, or in pastures, or along fence sides, or in by-places.

It is distributed most freely by means of the seeds of the cereal grains; for the reason that, if left to grow among these crops, it is sure, as was said above, to ripen before them, and therefore to have a portion of its seed mixed with the grain that is threshed out from them. But it is also very largely distributed by manure, since its seed is so light that there is no means of preventing it, at threshing time, from being very freely mixed with the straw of the crops amid which it has grown; and, when once among the straw of the manure heap, its seeds will maintain their vitality for years, unless the utmost pains be taken to thoroughly rot the manure—this, indeed, should always be done before the manure is placed on the land if wild oat seeds are suspected of being present in it. The watercourses also carry down the seeds of wild oats from higher levels, and some seeds

are brought into new localities by threshing machines. On the farm it is also further distributed by being carried in the droppings of animals.

Modes of Eradication.

The following are the modes of eradication that have been found most successful in dealing with wild oats:

I. Breaking up sod land and sowing it to winter wheat and meadow. Where the wild oat is found on sod land, the best way to get rid of it is to break up the sod by plowing, either in the month of June or early in July; but it must be remembered that, to get the best results, the plowing must be done as early as possible, so as to give the utmost possible opportunity for the cultivation of the surface soil during the summer months, since the germination of all the wild oat seeds will not take place that season except they are especially encouraged. Continue the cultivation, as in the case of a bare fallow, until the time for sowing winter wheat. Then, when the proper season arrives, sow to winter wheat, and seed to grass. After a crop—or, at most, two crops—of hay, break up the meadow again, and repeat the process as before. At the end of the

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second of these rotations, the wild oats should be subdued; that is, if the work has been thoroughly done. In localities where winter wheat cannot be grown, rye may be substituted instead.

2. After-harvest and autumn cultivation, followed by a hoed crop. In fields which have borne grain crops, gang-plow the land just as soon as this can be done, starting the process even before the shocks of grain have been removed from the fields—the reason for this early plowing being that many of the wild oat seeds which have been recently shed upon the ground may at this time be induced to germinate, whereas they could not easily be induced to germinate later on. Gang-plow a second time, and then cultivate or harrow the land occasionally, until the time of late plowing in the fall. Other wild oat seeds lying in the upper portions of the soil may thus be encouraged to germinate. It will be an additional encouragement if the land be rolled once or twice during the process, especially if the season be dry; for the rolling tends to retain the moisture of the soil, and when the soil is not moist the oats do not germinate readily. In any case, it must be remembered that they do

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not germinate so readily in the autumn as in the warm and moist days of spring. When the late autumn has come, plow deeply, so that the lower section of the cultivated portion of the soil will be brought to the surface. Then, in the spring, let the surface soil be stirred occasionally, until it is time to plant corn, or to sow turnips, mangels, or rape.

3. Growing two hoed crops. Grow two hoed crops in succession upon the land, giving careful attention to the previous autumn cultivation and to the subsequent preparations of the soil for seed, and to the cultivation of the crops while they are growing.

Observations. (1) In all districts infested with wild oats, the greatest care should be taken to get pure seed for sowing, especially of spring wheat, oats, and barley, for the wild oats will, in many places, ripen earlier than any of these. (2) Owing to its lightness, if wild oats exist on any farm, the seed of the weed is sure to get mixed with the straw of the threshed grain, and thus get into the manure. Owing, therefore, to the remarkable vitality of the seed, whenever there is a suspicion that the manure contains wild oat seed, it should be thoroughly rotted before being used. (3) Owing to its

reluctance to germinate in the fall, autumn cultivation does not do as much for the eradication of this weed as for many others. The greatest pains, therefore, must be taken to induce its seeds to germinate by the earliest possible cultivation after harvest. From the fact that its seeds will not germinate in autumn unless the weather is warm and moist, the wild oat is very hard to deal with in the Canadian Northwest, where the autumn days are never warm enough to secure the germination of the seeds. And the soil there is so suitable to the weed that it grows with great vigor, even to a height of six feet.

CHAPTER VII.

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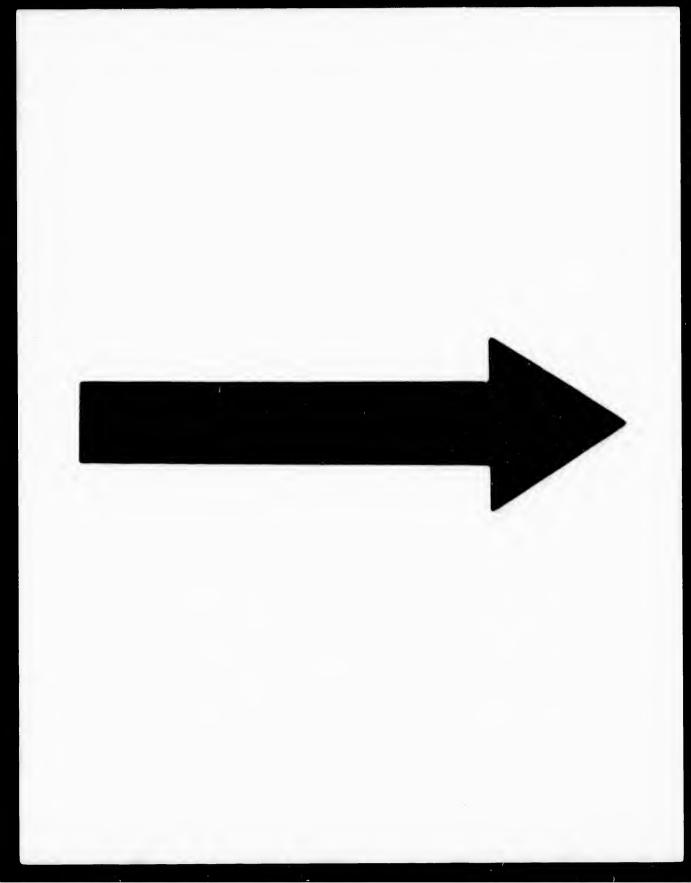
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SPECIFIC MODES OF ERADICATING CERTAIN WEEDS SPECIALLY TROUBLESOME ON THE WESTERN PRAIRIES.

This chapter will discuss some of the specific modes of eradicating certain noxious weeds, which have been found peculiarly troublesome on the soils of the great prairies in the western part of the continent.

Six weeds will be considered, viz:—The Russian thistle, Hungarian mustard, the penny cress or French weed, wild prickly lettuce, foxtail and wild buckwheat. All of these will grow and flourish on other than prairie soils, and in other than prairie countries, but nowhere else will they grow so luxuriantly or distribute and increase so readily.

Weed distribution on the prairies is facilitated, first, by the strength and continuity of the winds; second, by the absence of fences and other obstacles, such as hinder weeds from travelling; third, by



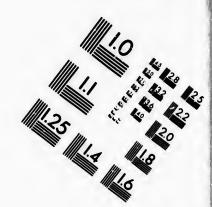
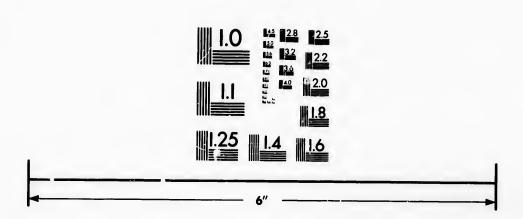


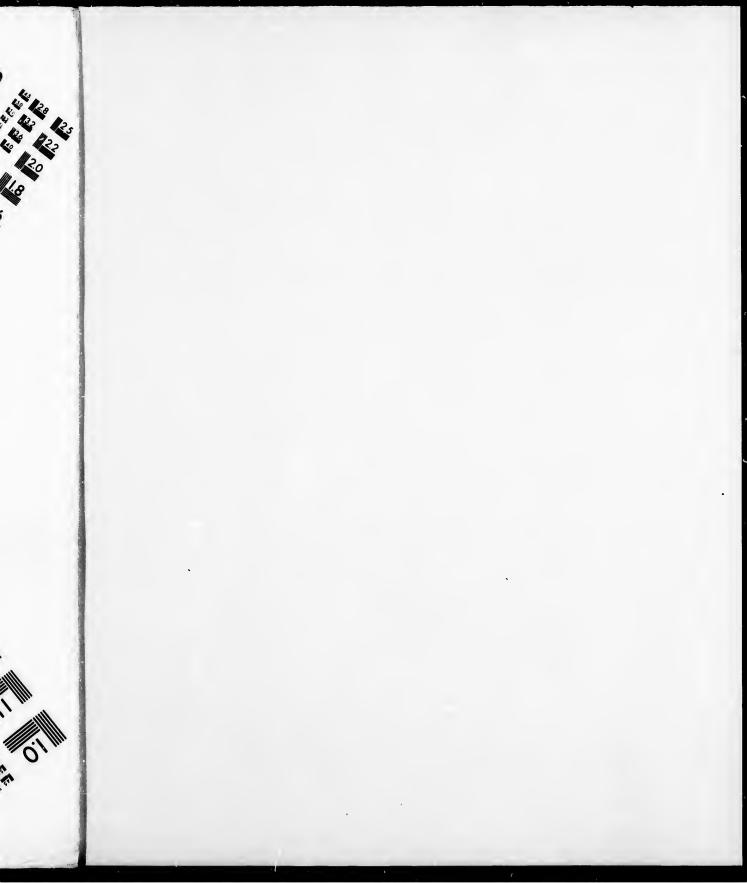
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the greater extent to which the more level of the prairie surfaces are covered with water at certain seasons of the year; fourth, by the dearth of winnowing mills to enable the farmer to save his own seed and to clean it properly; fifth, by the extent to which the same crop, as wheat for instance, is grown successively on the same soils; and sixth, by the limited extent to which live stock is kept. Various other agencies are also active, but they do not exercise so great an influence on weed distribution in prairie countries as the agencies named.

Since then agencies concerned in weed distribution on the prairies differ in degree, if not in kind, from those in other localities, so the specific modes of preventing such distribution must also differ in degree, if not in kind, from those practised in these localities. On the prairies, therefore, in the conflict with weeds, special attention will have to be given to the planting of windbreaks, and the erection of fences, to the draining of the land, to the cleaning of the seed, to diversifying

e levthe rotation, and to increasing the numl with ber of the domestic animals kept on each farm, and more especially the number of year; mills sheep kept, since sheep are great weed n seed scavengers. And as weeds grow rapidly he exin prairie countries, and mature their eat for seeds quickly, the necessity arises for prolonging the season of cultivating hoed n the ed excrops, and for ploughing with much arious promptness that portion of the land to be hey do sown with cereals the following spring, as n weed soon as the harvest has been reaped. as the

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(I) THE RUSSIAN THISTLE.

The Russian thistle (Salsoli kali var traqus) is one of the most aggressive and formidable weed pests that has ever come to the prairies of the west. It is frequently called the Russian cactus, but strictly speaking it is neither a thistle nor a cactus. It belongs to the saltwort family.

This plant, it is claimed, first obtained a foothold in the United States in Bon Homme county, South Dakota, about the year 1873. It is supposed to have been brought in flax-seed from the plains of

Russia where it has been growing increasingly formidable for at least two centuries. So rapidly has the Russian thistle spread in the United States that it is now a serious menace to successful agriculture



THE RUSSIAN THISTLE.

in several of the prairie states bordering on the Mississippi and Missouri rivers. And it has also made its appearance in states farther to the east. In 1894 an unsuccessful appeal was made to the Congress of the United States to enact such legislation as would be likely to ensure its complete eradication within the borders of the Republic.

The Russian thistle is an annual. The

The Russian thistle is an annual. early leaves of the young plants are smooth and slender, about two inches long, and each is tipped with a spine. Above the early leaves branches grow out which produce many spines, and the number and length of the branches vary much with the attendant conditions of growth. The spines grow in clusters of three, and as the plants near maturity they become so rigid that the legs of horses require protection when they have to travel among the mature weeds. When near maturity the plant appears to be almost leafless. Specimens of the plant have been found with a diameter not less than five feet.

The Russian thistle does not begin to grow very early in the season, hence if grain crops are given an early start in the spring the thistle which infests them will be so far kept in check that it may not seriously injure the crops. It fre-

dering rivers. nce in an un-

quently continues to grow and mature seeds until the frosts become severe enough to destroy its vitality. The earlier plants mature much of the seed in the latter part of August, and in September, hence all plants cut off or pulled up after that time should be burned. It is claimed that an average sized plant is capable of maturing from 20,000 to 30,000 seeds.

This weed is specially troublesome in grain crops, the later the crops and the more weakly they are the greater will be the injury done. It grows with sufficient vigor under some conditions to prevent the harvesting of the grain by the ordinary binder. It infests all kinds of crops that are being tilled, but is easily destroyed in such as are cultivated. This weed grows to some extent on the native prairie, but not so much where grasses are well established in the soil, as where prairie fires and also the industrious little gophers have prepared a seed bed for it.

The Russian thistle is propagated solely by means of its seed and its marvellous

power of propagation is attributable to the ease with which the winds send it tumbling over the prairie for miles in succession, the number of seeds which it produces, and the readiness with which the seeds germinate under favorable condisions. Railways are largely responsible for the conveyance of the seed to new centers; and it has also been carried in flaxseed and in the seed of cereals.

Modes of Eradication.

The Russian thistle is not difficult of eradication. Its great weakness lies in the inability of the seeds to maintain vitality under normal conditions for a longer period than two years. Under a good system of farming, therefore, it may be eradicated without great difficulty. Any system of farming that will prevent the plants from maturing their seeds for two successive years will accomplish this end.

The following are the modes of eradication which have been found most success ful in dealing with the Russian thistle:

1. Modifying the rotation.—Cereal crops and other crops which favor the maturing

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solellous of the seeds, may be omitted for two successive years, and other crops grown in their stead, such as hoed crops or the cultivated grasses.

- 2. Spudding.—When the weed plants are not numerous they may be destroyed by cutting them off with the spud below the crown any time before the seeds are matured; but the work will be much more easily done at an early rather than at a late stage of growth. Along fence borders and in by-places they may also be thus destroyed.
- 3. Growing two hoed crops.—If two hoed crops are grown in succession on the same land, and if at the same time proper cultivation is given to them, the weeds will be all destroyed.
- 4. Growing forage crops and pasturing them with sheep.—The Russian thistle may be easily destroyed by growing certain forage crops and pasturing them with sheep for two years in succession. Winter rye should be given a prominent place among these crops where it can be successfully grown. The rye may be follow-

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ed about the end of May with corn, sorghum, millet or rape. Sheep seem to relish the thistles when young and tender.

5. Autumn cultivation.—Autumn cultivation will be found very helpful in destroying the Russian thistle, and also in preventing its further increase. It is efficacious in proportion to the early date at which the ploughing is done.

6. Legislative enactments.—When vacant lands have become infested, stringent legislation will probably be found necessary to properly keep the weeds in check.

Observations.—From what has been said it will be apparent that in waging war against the Russian thistle, preventive measures are even more important than those which relate to eradication. Prominent among the former are the following:

1. To plant windbreaks of such quick growing trees as the white willow.

2. To erect high wire fences around the farm.

3. In the absence of fences, to plant several rows of sunflowers around the borders of the fields on the entire farm. The plants should be near to each other in the

line of the row. The seed of the sunflowers will go far to defray the cost of the work. 4. Sow only pure seed. 5. In the work of eradication seek the co-operation of the entire neighborhood, of the state, and of the whole realm.

(2) HUNGARIAN MUSTARD.

Hungarian mustard (Sisymbrium sinapistrum) is of the Brassica family. some localities it is known simply "Tumble weed," but in Central Europe it is called Hungarian mustard. It is thought that it was brought to this continent by certain Austrians employed in the construction of the Canadian Pacific railway. About the year 1880, it began to arrest the attention of the farmers around Indian Head in the Canadian Northwest. Since that date it has spread so rapidly that it may be said to have infested the whole country around Indian Head, within a radius of from ten to twenty miles. In the summer of 1892 the writer was driven into a field of 250 acres of Hungarian mustard, so completely overgrown with it that nothing else could be seen. The

whole field which was not far from Indian Head was covered with one dense mass of weeds from two to three feet high, and they grew so thickly that when a conveyance was driven into them, it caused them to sway to and fro even several rods distant. In this one field there were probably seeds enough to infest a whole state if properly distributed. This weed is already in Northern Minnesota, and it may be in North Dakota also.

Hungarian mustard is an annual, although in some localities it would not be incorrect to call it a biennial. When it grows amid cereal grain crops, its branches are not numerous, but they are long and slender. When it has room to grow the branches are quite numerous and they bear an enormous number of seed pods. The seeds are small and in color they are a dark, reddish brown. The plants commonly grow about two feet high but the height varies with the soil and season. The flowers are a pale yellow and the plant bears a close resemblance to common wild mustard.

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HUNGARIAN MUSTARD (MATURED PLANT).

branches, and also a young plant in an early stage of growth.

Hungarian mustard will grow at all seasons between the time of the spring and autumn frosts. The seeds naturally mature at the same time as those of the cereal grains or even a little earlier, but under certain conditions they will continue to ripen until the arrival of the autumn frosts. If cut off before the blos-

soming stage, the effect is that more branches will be produced.

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While Hungarian mustard infests all kinds of crops, it is peculiarly trouble-some in cereals. Where these get an early and vigorous start in the spring, they will keep the weeds in check for that season. But when from any cause the crops are weakly, the weeds will soon



HUNGARIAN MUSTARD (YOUNG PLANT).

overshadow them. It does not give serious trouble in pastures or in meadows. This plant will grow in various classes of soils, but it thrives most vigorously on those essentially humus in their composition.

Hungarian mustard is propagated chiefly by such agencies as wind, water, birds and the seeds of cereals and millet, but of these the first mentioned is by far the most potent and dangerous.

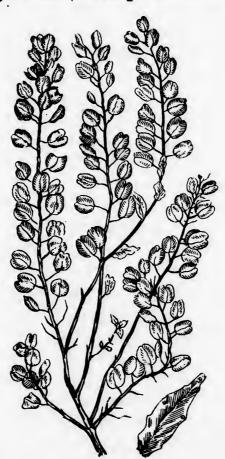
Modes of Eradication.

The methods adopted for destroying Hungarian mustard are essentially the same as those given for the eradication of the Russian thistle.

Observations. 1. The winds have even greater power to carry Hungarian mustard than they have to carry the Russian thistle as the former is much lighter when it is dry. 2. The former also produces seeds more numerously than the latter, as a fairly well developed Hungarian mustard plant will produce 75,000 seeds.

3. The seeds of the former like those of the common wild mustard have great vitality, hence the inference is legitimate that Hungarian mustard is in some respects a more dangerous weed than the Russian thistle.

(3) PENNY CRESS.
Penny cress (Thalaspi arvense), more



PENNY CRESS.

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rethe annual, but when it has not yet produced seeds in the autumn, it will live through the winter and mature them the following spring and summer. It is sometimes called stink weed, owing to the offensive odor which it possesses, and which it imparts to the beef and milk of animals which feed upon it. It is of the same family as mustard, and, like all weeds of that family, it is difficult to eradicate. In certain sections of the western prairies it is giving very much trouble, more especially in Manitoba, Dakota and Minnesota.

Penny cress is usually about a foot high, but under favorable circumstances it will reach the height of two feet, and the plants are capable of bearing seeds, though not more than 2 inches high. The branches are numerous. The leaves are oblong in shape and of a deep green shade. The flowers are very small and white in color. The seed pods or sacs are elliptical and flat, and from one fourth of an inch to half an inch in diameter. They are very numerous and each pod contains several seeds. The seeds are small.

The penny cress will ripen its seeds at any season of the year from June until the arrival of the autumn frosts. The season of maturity is dependent chiefly on the time of the year at which the plants commence to grow. Those which get a start in the autumn blossom in May, and by the arrival of the harvest season the seeds will nearly all be shed on the ground. It is claimed that plants from seeds which have fallen early in the season will in turn mature before the coming of winter.

Penny cress will grow least vigorously on stiff clays, and most luxuriantly on the vegetable soils of the prairies. It harms grain crops much more than pasture or meadow or cultivated crops, and it does more injury to grain crops which ripen early than to those which ripen late.

Penny cress is distributed through the medium of the seeds. They are carried along with the seeds of cereals amid which they have grown. They may also be distributed in manure and in the droppings of cattle, and to some extent they are conveyed by water and carried by

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wind. The seeds are possessed of great vitality, but they will not germinate unless when near the surface of the soil.

Modes of Eradication.

The following are the modes of eradication that have been found most successful in dealing with this weed:

- 1. Modifying the rotation. Cease to grow spring cereals, except barley, for a time, and keep the infested fields under meadow or pasture until they can be dealt with properly, with a view to destroy the weeds which will appear when they are again cultivated.
- 2. Growing barley. Sow barley late rath er than early, on ground that was cultivated the previous season, and carefully ploughed just before the barley is sown upon it. But few of the plants will ripen their seeds in the barley. Repeat this process where the land is good.
- 3. Growing hoed crops. Grow two hoed crops successively on the infested fields, and care for them so that none of the plants of the penny cress will mature their seeds.

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hoed fields, f the ature 4. Growing rye and rape. Grow winter rye and pasture it, and follow it with a crop of rape sown in drills and properly cared for. When necessary repeat the process, and where rape may not be desired, substitute corn grown in drills, and used as fodder or ensilage.

Observations. The following methods of reducing the numbers of this weed will be found easily applicable and very helpful:

- (1) Cultivate the land from which cereal crops have been removed as soon as possible after harvest, to encourage the germination of weed seeds, and harrow over once or oftener subsequently, to destroy the seeds that have germinated.
- (2) Harrow spring cereals with a light harrow, after the grain has made a good, vigorous start.
 - (4) WILD PRICKLY LETTUCE.

Wild prickly lettuce (Scariola L) is a biennial. It appears first to have obtained a foothold on this continent in the Atlantic states, and it is traveling westward at a rapid rate. It is already troublesome

in states bordering on the Mississippi The term prickly is derived river. from the short prickles or spurs found growing on the underside of the ribs of the leaves. The plant bears considerable resemblance to the garden lettuce, and may be easily mistaken for other species of lettuce which grow wild.— The branches are numerous, and on good soils strong plants will attain the height of from 5 to 6 feet, but on ordinary soils the average height will not be more probably than 3 feet. The blossoms are a pale yel low, and a vigorous plant is capable of bearing from 8,000 to 10,000 seeds. seeds are provided with a downy attachment which enables them to float in the air, hence they may be carried by the winds to almost any distance.

Wild lettuce comes up early rather than late in the season. It matures its seeds in midsummer. If the plants are cut out before they have reached the blooming stage they will at once send up other branches which, in turn, will produce seeds. Horses and cattle will crop it off

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WILD PRICKLY LETTUCE.

to some extent in pasture, but they are not fond of it.

Wild lettuce will grow on various soils, but rich loams sustain it in best form. It does not give much trouble in grain crops or hoed crops, but grows freely in meadows and pastures, on road sides, along fence borders and in by-places.

Wind is the principal agent in distributing the seeds of wild lettuce. It is therefore likely to spread very rapidly when it reaches the prairies of the west. But the seeds may also be distributed along with those of clover and some of the grasses.

Modes of Eradication.

The following are the modes of eradication that have been found most successful in dealing with wild lettuce:

- 1. Modifying the rotation. Drop meadow and pasture out of the rotation for a time and grow spring cereals and hoed crops. This will only be necessary with fields infested with the weed.
- 2. Mowing and spudding. Cut the plants off with the scythe or mower with sufficient frequency to prevent them from ma-

turing seeds. When they are not numerous they may be easily destroyed by cutting them off with the spud an inch or two below the surface of the earth.

Observations. (1) Wild lettuce is not difficult of eradication where care is taken to prevent the maturing of the seeds. But (2) farms cannot be kept free from it in an infested neighborhood, without concentrated action on the part of the farmers.

(5) FOXTAIL.

Foxtail (Setaria glauca) is better known in the Northwestern states as summer grass or pigeon grass. It grows to a greater or lesser extent in nearly every section of the continent where the land has been tilled, though only for a few years. But it gives greater trouble in prairie countries where one kind of cereal is so frequently grown for many years in succession on the same lands.

Foxtail is so well known that it is hardly necessary to describe it at length. It may be mentioned, however, that it is a grass of the same family as the millets,

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FOXTAIL

and that it usually grows to the height of about one foot when matured, although the height varies much with the richness of the soil. It is capable of maturing seeds even when but a few inches high. The leaves bear a very close resemblance to those of millet, but they are much smaller. The head is covered with fine, soft hairs, and it produces many seeds.

Foxtail commences to grow as soon as the soil gets warm, and the seeds, which have great vitality, will germinate under favorable conditions, until the arrival of cold weather in autumn. After the cultivation of hoed crops has ceased, as corn for instance, the seeds which lie in the soil will grow when it is sufficiently moist. The plants produced under these conditions grow very rapidly and mature seeds in an incredibly short space of time.

Foxtail will grow on almost every class of soils. But on rich prairie soils it luxuriates. It infests almost every form of crop grown, but does not give much trouble in rye, winter wheat, or on cultivated meadow, owing to the early

period at which these crops mature. It is specially troublesome in cereals sown in the spring, as in these the plants frequently grow in such numbers as to greatly hinder the growth of the crops.

Foxtail is distributed through the agency of birds, wind and water, and to a still greater extent probably through that of seed grain, manure and droppings of animals.

Modes of Eradication.

The following are the modes of eradication that have been found most successful in dealing with foxtail:

- 1. Modifying the rotation. Increase the acreage of rye, winter wheat, cultivated grasses and permanent pastures.
- 2. Autumn cultivation. Practice autumn cultivation to the greatest possible extent. If the fields which have grown cereals are at once ploughed, as soon as the grain is removed, the maturing of many of the seeds will be prevented, but not of all of them.
- 3. Growing hoed crops. Grow hoed crops so far as practicable, more especially crops

of corn. In these the cultivation should be continued as late in the season as possible.

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- 4. Harrowing the grain. Harrow the grain in the spring with a light harrow, with many teeth in it, just after the foxtail plants have appeared in large numbers above the surface of the ground. But this should never be attempted when the ground or the grain is wet. When the work of harrowing is judiciously done it will also prove helpful to the crops which are thus dealt with.
- 5. Pasturing with sheep. Utilize sheep in pasturing off the stray plants in pastures and in the aftermath of meadows, and in eating off the myriads of plants which frequently grow among the stubbles of cereal crops, in corn crops and in by-places generally. A flock of sheep will soon clean out all the plants growing in a crop of corn, and without injury to the corn, when the sheep are turned in to feed amid the corn at the proper season.

Observations. (1) In fighting this weed the aim should be to give prominence to

those methods which will most effective ly secure the quick germination of the weed seeds in the soil. Until these germinate they cannot be removed. (2) To get the complete mastery of the weed it will probably be found necessary to cease to grow ccreals which are sown in the spring from year to year upon the same lands.

(6) WILD BUCKWHEAT.

Wild buckwheat (Polygnonum convolvulus), sometimes improperly called bindweed, is a plant possessed of a creeping, and also a twining and clinging habit of growth. In some aspects it resembles bindweed previously described, but the roots grow very differently, and there is no resemblance between the blossoms or the seeds of the two plants.

The plants grow singly, but oftentimes in great numbers. The tendrils spread abroad in different directions, and cling to the vegetation amid which the weeds grow. They will then clamber up to the very top of the stalks of matured grain, and will oftentimes cause it to lean to-



WILD BUCKWHEAT.

ward the earth in consequence of their weight. The seeds resemble those of cultivated buckwheat, both in shape and col-

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in, toor, but they are not quite so large. They are possessed of a considerable degree of vitality.

Wild buckwheat begins to grow almost as soon as the cereal grains, and it continues to grow and mature seeds until the time of severe frosts.

In spring cereals many of the seeds are matured before the grain can be harvested. It infests all kinds of crops, but like foxtail, is more troublesome in cereals than in other crops. It gives but little trouble in pastures and meadows.

Wild buckwheat will grow in various soils, but it grows much more vigorously in rich vegetable loams than in soil stiff and heavy or deficient in vegetable matter. It has come to be a grievous pest on prairie soils in localities where cereals are grown on the same lands from year to year.

Wild buckwheat is distributed by means of birds, wind and water, and to a greater extent probably through the agency of manure, the droppings of cattle and the seeds of cereals

Modes of Eradication.

The following are the modes of eradication that have been found most successful in dealing with wild buckwheat:

- I. Varying the rotation. Vary the rotation so that but little prominence will be given for a time to meadow and pasture and to hoed crops. And it may be mentioned here that in the judgment of the writer, too little attention, by far, is given to the growth of hoed crops in nearly all parts of the Northwest. If these were more extensively grown and suitably cared for, noxious weeds would soon be materially lessened.
- 2. Growing hoed crops. Grow hoed crops and clean them so effectively that none of the seeds of the wild buckwheat plants will mature.
- 3. Sowing clean seed. Make sure that only clean seed is sown, and use special care in preparing the seed of cereals for sowing, or in purchasing the same for seed.
- 4. Autumn cultivation. Plough the land immediately after harvest when possible,

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5. Harrowing cereal crops. Draw a light harrow possessed of many short teeth over the cereal crops when the plants of the wild buckwheat have appeared numerously above the surface of the ground. When the work is judiciously done it will be found very effective in relation to the labor expended.



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