On flax, and the practicability of extending its cultivation in Ireland : together with directions for the proper management of that crop / by Edmund W. Davy.

ON FLAX,

AND THE

PRACTICABILITY OF EXTENDING ITS CULTIVATION IN IRELAND.

(18.)

ON FLAX,

AND

THE PRACTICABILITY OF EXTENDING ITS CULTIVATION IN IRELAND:

TOGETHER WITH

DIRECTIONS FOR THE PROPER MANAGEMENT OF THAT CROP.

BY

EDMUND W. DAVY, A.B., M.B., M.R.I.A.,

PROFESSOR OF AGRICULTURE AND AGRICULTURAL CHEMISTRY TO THE ROYAL DUBLIN SOCIETY.

Read before the Royal Dublin Society, February 15, 1864.

DUBLIN:

M'GLASHAN & GILL, 50, UPPER SACKVILLE-STREET.

LONDON: SIMPKIN, MARSHALL, & CO.

1865.

DUBLIN:
Printed at the University Press,
BY M. H. GILL.

ON FLAX,

AND THE

PRACTICABILITY OF EXTENDING ITS CULTIVATION IN IRELAND;

TOGETHER WITH DIRECTIONS FOR THE PROPER MANAGEMENT OF THAT CROP.

BY EDMUND W. DAVY, M. B., M. R. I. A., &c.,

PROFESSOR OF AGRICULTURE AND AGRICULTURAL CHEMISTRY TO THE ROYAL DUBLIN SOCIETY.

[Read before the Royal Dublin Society, February 15, 1864.]

Notwithstanding that the extension of the cultivation of Flax in this country has from time to time been strongly advocated, it is much to be regretted that till recently its culture has been almost entirely confined to the North of Ireland, where, as is well known, that plant has been successfully cultivated for a long period.

Several circumstances, however, occurring recently—such as the failure in the supply of cotton, owing to the protracted war in America; the low prices and unremunerative returns from our cereal and other usual farm crops, consequent in a great measure on a succession of bad seasons; and the great emigration which has recently taken place from our shores—have united in a remarkable manner to force on us the importance of extending the growth of a crop like Flax, which is a plant that is not injured to the same extent by excessive rains, and different atmospheric influences as our cereal and other ordinary crops; gives much agricultural and industrial employment; and, above all, the cultivation of which, and the subsequent manufacture of its fibre, have conduced so much to the prosperity of the North of Ireland, and of those districts in other countries where it has been extensively grown and manufactured. Consequently, were this plant in more extensive cultivation in all parts of our island, we might reasonably hope in some degree to arrest the tide of emigration now taking place from this country,

by being able to give our poorer fellow-countrymen more constant employment, and offer them a more adequate remuneration for their labour than they now obtain in so many instances,—thus enabling them to support their families in some degree of comfort at home. So general is this feeling just now, and so much has the attention of the public been of late engaged with this subject, that we can scarcely take up a number of any of our agricultural, or even daily papers, for some months back, without meeting either an article on this subject, or an account of a meeting held somewhere, for the purpose of promoting the growth of Flax in Ireland.

As this subject appears to be now engaging so much public attention, the present Paper, containing the history of Flax from the earliest times down to the present day, and the most important points to be known as to the character and proper cultivation of that plant, and its subsequent treatment for the production of fibre, as well as different facts which show the practicability and advantages of extending the growth of Flax in this country, will not, I trust, be unacceptable to those intending themselves to introduce that plant amongst their other agricultural crops, or who wish to encourage others in doing so; in addition to which, considerable interest is attached to the Flax plant, whether we regard the antiquity and extent of its cultivation, or the many important purposes to which mankind have applied its fibre, from a very remote period, as well as the number of useful applications made of different portions and products of this plant in more recent times.

THE EARLY HISTORY OF FLAX.

In point of antiquity, there are few plants, and those only used for food, that can take precedence of Flax; for we find frequent allusion made to it both in its growing and manufactured state as linen, in the early Books of the Old Testament, which are, as is well known, amongst the most ancient records in existence.

It seems probable that Egypt was the native country of the Flax plant, or at least that there its cultivation first attained a degree of perfection for which it has been celebrated from the remotest periods down even to the present time; and the extent to which it was cultivated in that country from the earliest periods may be inferred from the Book of Exodus, where the mention made of it would appear to show that it was then one of the most important crops of the Egyptians; and, consequently, when the Almighty inflicted the plagues on the land of Egypt, this crop was one of those injured or destroyed by the hail; for we read in the ninth chapter and thirty-first verse, that "the Flax and barley were smitten,"—showing, by its being mentioned along with that important cereal, the value which was attached at that time to the Flax crop by the Egyptians.

It would appear also, from the First Book of Kings, tenth chapter and twenty-eighth verse, where we are told that Solomon brought out

of Egypt *linen yarn*, that they had considerable traffic with the people of other countries in that article.

From Herodotus also, the oldest of profane historians, we learn that Egypt was the great emporium or market for the Flax trade; and the high estimation in which the Flax plant was held by the people of Egypt may also be inferred from the fact that we find the plant itself, or the preparation of its fibre, represented on many of their monuments; and in their mummies the microscope has shown that the clothes in which they rolled or enveloped their embalmed dead some 1200 years before the Christian era were made of the fibre of the Flax plant.

The Greeks appear to have been well acquainted with Flax and the preparation of its fibre; for we find *linen* mentioned by Homer and other early Greek writers. And as to the Romans, we have abundant evidence in the works of their different historians, and writers on rural economy, that this plant was extensively cultivated by that people.

Though Flax and its cultivation are referred to by the several Roman writers on agriculture, Pliny seems to be the only one of them that enters minutely into detail as to the growth and subsequent treatment of that crop, which appear to have been conducted pretty much in the same manner as at the present time. Amongst other interesting observations which he makes in reference to this plant, he states that the Flax of Cumæ, in Campania (which was much esteemed on account of the fineness and toughness of its fibre for the manufacture of nets used in fishing and fowling), was employed in the making of toils or hunting nets for catching wild boars, and that* he has seen some of these nets of such a degree of fineness as to allow of their being passed, together with their ropes, through the ring of a man's finger,—a single individual being able to carry as many of such nets as would surround the hunting ground; this, he further observes, is not so very surprising as that each of the cords of such nets should be composed of 150 threads.

Such network appears to have been used in the manufacture of armour long before that time by the Egyptians; for Herodotus speaks of a curiously made *linen corslet*, preserved in the Temple of Minerva at Lindus, in the Isle of Rhodes, which originally belonged to Amassis, one of the kings of Egypt, 600 years B. C. Curious enough, in Pliny's time, a portion of this same corslet, which was made of a sort of network, each thread or strand of which consisted of the enormous number of 365 fine threads, was exhibited in Rome at the time he wrote, as a specimen of strength and fineness of fibre, as well as of skill in the preparation and spinning of thread.

Much as we may have improved in different mechanical appliances for the separation and manufacture of Flax fibre, there appears to be

---

* Plin. Nat. Hist., lib. xix., cap. 1.

nothing in modern times that can be compared with the fineness, strength, and complexity of the thread used in the making of the nets and corslet just referred to.

During the dark or middle ages which succeeded the fall of the Roman Empire, the absence of all agricultural records leaves a blank in the history of Flax till about the end of the twelfth century, when we learn from different documents relating to that period, that Flax was grown to a considerable extent in England; being, as it is supposed, introduced into Britain some time after the Norman Conquest, as it is not enumerated amongst the titheable articles of that period; and it was not till the year 1175 that Flax and hemp were included, by the Council of Westminster, amongst those productions from which the clergy were to receive their dues.

As the country became less disturbed by civil wars, more attention was devoted to agriculture and the useful arts; and with the consequent advance of civilization, the manufacture and employment of linen became more general. The importance which was subsequently attached to the growth of Flax in England is shown by the different Acts of Parliament which were passed enforcing its cultivation: thus, in 1532, during the reign of Henry VIII., an Act was passed obliging each person occupying land fit for tillage to sow at least one rood of Flax for every sixty acres of such land in his possession. This quantity was subsequently increased to one acre in 1562, during the reign of Elizabeth, and the provisions of the Act enforced under a severe penalty.

With a view of encouraging the growth of Flax in England as much as possible, we find that in the year 1691, during the reign of William and Mary, an Act was passed, fixing the tithe on Flax as low as four shillings per acre; and later, in the reign of Queen Anne (1713), a bounty of one penny per ell on home-made sailcloth was given, as an encouragement to that manufacture.

THE INTRODUCTION AND CULTIVATION OF FLAX IN IRELAND.

We now pass to our own country, with which we are more particularly interested, and proceed to very briefly trace the history of the Flax plant from the earliest records we have of its being cultivated there down to the present time.

At what period Flax was first grown in Ireland there is no means of determining; it appears, however, that it must have been known in that country from a very remote period; for in an ancient Irish manuscript, written 200 years before the Christian era, the shield of a great warrior mentioned in it is described as being made of alternate layers of linen and leather; and in the thirteenth century we read of the Irish chieftains and their soldiers wearing saffron-coloured garments, which are supposed to have been made of linen; and it is therefore probable that Flax was cultivated, and linen manufactured from it to some extent in Ireland, from the earliest times.

But, though the growth of Flax gradually extended in this country, as well as in England, from the great encouragements given to it by the State, it did not acquire any degree of national importance till the close of the seventeenth century, when the linen trade received a great impulse by the revocation of the Edict of Nantes, by which act, in 1685, Louis XIV. drove out of France more than 50,000 of the most industrious and intelligent of his subjects, many of whom, well skilled in the manufacture of linen, settled in this country, as well as in England, where they introduced many improvements in that branch of industry from France and the Low Countries, where at this time the making of linen had been brought to considerable perfection.

This was more especially the case with M. Louis Crommelin, who after the repeal of that edict fled from France (in 1699), accompanied by a number of refugees, who, coming to this country, settled in the neighbourhood of Lisburn, near Belfast; and being acquainted with the best methods then known in France of growing and manufacturing Flax, imparted that knowledge to the people of the district in which they came to reside, and this information was afterwards extended to other parts of the country; and to that circumstance we may fairly attribute the reason why Flax has been grown to a greater extent and with more success in the province of Ulster than in any other part of Ireland.

Shortly after the period just referred to, the Irish Parliament confirmed the establishment of the linen trade in Ulster; and a board of trustees was appointed in 1711 to encourage and extend this rising manufacture; and with a view to increase the demand for, and consumption of, linen, the Duke of Ormonde, whilst holding here the office of Lord Lieutenant, directed that linen scarfs and hatbands should be worn at funerals—a custom, as is well known, still prevailing.

Soon after this period, the manufacture of linen seems to have steadily progressed, and different improvements were made by the application of new mechanical contrivances, as well as by the use of various chemical agents in the preparation and bleaching of the fibre and the manufactured linen. Thus, Dr. James Fergusson, of Belfast, was awarded in 1764 a sum of £300 by the Linen Board, for the successful application of lime in the bleaching of linen, as a substitute for the excreta of animals, which, as an alkaline reagent, was commonly employed in that process; and the same gentleman subsequently, in 1770, introduced the use of sulphuric acid instead of buttermilk, which was previously in general use, as an acid, in the bleaching process.

Various other improvements were rapidly introduced after this time, amongst which were the employment of potash in the alkaline ley used for boiling the yarns and cloth; and the still greater improvement in the application of chloride of lime as a bleaching agent, which has done so much in facilitating the bleaching of linen, as well as of many other useful substances.

It would be tedious to trace still further the advancement of this manufacture in Ireland, and to show how, step by step, this country

became celebrated for its linens: suffice it to say, that the Linen Hall in Dublin soon became the great depôt to which linens were sent by the different manufacturers of this country, and that there merchants and traders from various parts repaired for the purchase of such manufactures.

The means of transport, however, becoming more easy by the construction of new roads throughout the country, and still more so by the application of steam to locomotive and marine travelling, the manufacturers in the North of Ireland soon found it more to their advantage to send their goods direct from Belfast across the Channel to Liverpool, Manchester, or London, where they had agents to dispose of them, than to send them up to Dublin; and thus the Linen Hall, which was in former days a place of much commercial importance, has sunk into its present deserted condition; and a considerable portion of it has been converted into a barrack, or devoted to other purposes very foreign to those for which it was originally intended.

In 1828, the Government, considering that the linen trade in Ireland was sufficiently established to be independent of public support, dissolved, by the consent of Parliament, the Linen Board; and all further grants for the promotion of the linen manufacture were suspended. After this for a time the cultivation of Flax in Ireland seems to have declined, no doubt from the want of some society like the Linen Board to watch over and encourage the linen manufacture. In 1841, however, the Belfast Flax Improvement Society was formed, which gave new impulse to the cultivation and manufacture of Flax, and originated many improvements. Amongst other means that were taken for the carrying out of the objects of their Society, they brought over from Belgium persons skilled in the culture of Flax, to instruct our people; and finding afterwards that this was not sufficient for the purpose intended, they selected a number of intelligent young men, who were sent to Belgium to be instructed in the Flemish mode of cultivating and preparing Flax; and the result of this excellent proceeding was soon apparent in the increased quantity and improved quality of the Flax produced in the North of Ireland. The Royal Dublin Society, too, which has always been ready to encourage any project having for its object the promotion of the agricultural and industrial prosperity of this country, by its offering prizes at its triennial and other exhibitions, for the best Irish linens, has aided in no small degree to advance this important manufacture.

The formation of the Belfast Flax Improvement Society was soon followed by others, which gave increased stimulus to Flax culture, especially the North-Eastern Agricultural Association for Promoting the Growth of Irish Flax, which took the place of the former society, and is now actively promoting the objects of that association.

But, though the growing of Flax and the manufacture of linen have (owing to the encouragement of those Societies and other circumstances) been flourishing in the North of Ireland, the culture of that plant in other parts of this country has been hitherto either very limited or

entirely neglected; and little or no attempt, except in a few instances, has been made to introduce Flax as a regular crop amongst our agricultural rotations. Such a desirable end, it is scarcely necessary to say, is the object of the present great Flax movement, which, if carried out, as there is no doubt it will be, is calculated to effect much good for our people and country.

THE BOTANICAL RELATIONS AND THE GENERAL CHARACTERS OF THE FLAX PLANT.

The common Flax plant (the *Linum usitatissimum*) is a delicate-looking plant, which usually attains a height of about two feet, but may, under very favourable circumstances, grow much higher. It has a slender rounded stem, which is but slightly branched, and is thinly covered with narrow glaucous three-ribbed leaves, and bears at its summit a few elegant pale-blue shining flowers.

The fruit is a globular cartilaginous capsule, splitting when fully ripe into ten boot-shaped valves, each containing a single seed; these seeds which are brown, shining and oval, constitute the well-known linseed.

This plant, which is the most characteristic and important species of the genus *Linum*, belongs to the Natural Order of *Lineæ*, or *Linaceæ* (the Flaxworts) which are remarkable for the tenacity of their fibre, the mucilaginous character of their seed, and, as a general rule, the beauty of their flowers. This Family, according to Dr. Lindley, contains three genera, and about ninety species, which are irregularly distributed over the greater part of our globe.

The principal stations of this Order of plants are—Europe, North Africa, and North and South America; though individual species are to be met with in India, New Zealand, Australia, and other countries. As to the Flax plant itself, it is remarkable for the great range of climate in which it may be grown. Thus, in Europe, we find it cultivated in Norway, Sweden, and Russia, as far north as 64° and 65° north latitude, and from this extending to the shores of the Mediterranean. It is grown also in North Africa, the temperate parts of Asia, on the east side of North America, and in other districts, in more or less quantity. But the chief Flax-growing districts are the three following, viz.: —First, those portions of Russia and Prussia lying south-east of the Baltic, from which there is an exceedingly large exportation by Riga, Revel, Libau, Pernau, and St. Petersburgh, to a great portion of Northern Europe, as well as to England and this country, both as Flax and Flaxseed. The second district is that of Belgium, Holland, and part of France, from which, especially from Belgium, we get the finer kinds of Flax fibre,—the coarser being principally obtained from Russia. The third, is that of Egypt, which chiefly supplies the countries bordering on the Mediterranean.

The great capability of the Flax plant to grow in such very opposite climates as to temperature may be partly accounted for, when we

recollect that it is an annual of very rapid growth, which soon completes the period of its existence; so that it can be cultivated in the summer in the colder climates, and in the winter in the hotter: thus, for example, in Egypt it is sown in December or January in the fields just quitted by the Nile, and is harvested in April or May; whilst with us, and in colder climates, it is sown in April or May, and gathered in August or September; and by this arrangement the differences of temperature during the period of its growth are not so very great, comparatively speaking, between the northern parts of Europe where flax is grown and that of Egypt.

This power which the Flax plant possesses of adapting itself to a wide range of climate is of great importance, as it enables mankind to cultivate such a valuable plant in so many countries, and under such diverse circumstances, which, were it not for this adaptability of the Flax plant, would be impossible.

THE SOILS ADAPTED FOR THE GROWTH OF FLAX, AND THE CONDITIONS FOR ITS SUCCESSFUL CULTIVATION.

As in the case of climate, so in that of soil, we find that the Flax plant is capable of growing under very diverse conditions; for we find it cultivated in soils partaking more or less of the sandy, argillaceous, calcareous, or peaty character according as sand, clay, lime, or vegetable matter—the four great constituents of soils in general—preponderate. And it appears that the success of the Flax crop does not so much depend on the particular kind of soil in which it is grown, as on the condition to which that soil has been brought, and the skill and attention bestowed on the culture and management of the crop. However, as in the case of other plants, there are certain soils which appear to be more especially adapted for the growth of this plant; and it is a point of some practical importance to know the description of soil best adapted for the Flax crop, where the agriculturist may have different kinds of soil at his disposal for its culture.

General experience seems to show that Flax succeeds best on a deep loamy soil, or one in which there is an intimate admixture of those four soil constituents just mentioned, in such proportion as to partake to some extent of the properties of each. Further, it should at the same time be neither too wet nor too dry, and of such an open and friable character as will readily permit the delicate fibrous roots of the Flax plant, which frequently grow to a length of two or three feet, to extend themselves freely in a vertical and lateral direction in search of food. For this reason, strong stiff clays should be avoided, as they do not permit this ready extension of the roots. On the other hand, very dry gravelly soils are found to be unsuitable for the growth of this crop. However, as a general rule, Flax may be grown on any soil of even moderate fertility; but of course it will grow in the greatest luxuriance, and yield the largest produce, where the land is most fertile and of that open and friable character which seems to be best adapted to its nature.

The conditions for its successful cultivation, are—that the soil be deeply tilled, well cleaned and drained, and be at the same time in good heart and tilth. The importance of each of those conditions, as regards the growth of Flax, is easily understood: thus, depth of tillage, whether effected by the plough or spade in preparing the soil for Flax, as for other crops, has the effect of increasing the feeding ground, as it were, from which the plant receives its earthy food, and places at its disposal a larger amount of those mineral substances which are indispensable to the growth of this as of other crops; and thus materially aids and favours the growth and development of the plant.

As to cleaning and freeing the soil as much as possible from weeds in the cultivation of Flax, its importance is obvious to any one who reflects, that where the same soil is producing two crops—the one yielding the agriculturist either money or meat, and the other neither, whilst at the same time it is consuming rapidly the available mineral food for the remunerative crop, and thus impoverishing his land—the sooner and more completely such crops are got rid of, the better.

This is more particularly the case in the growth of Flax, which, being in its cultivated condition of a delicate and slender habit, is ill fitted "to rough it,"—as it has been happily expressed—with the stouter and stronger indigenous weeds.

As to draining, the many beneficial effects produced in the soil by that process, consequent on the removal of excessive moisture, and the admission of air, which are so well known and seen in the growth of our other crops, are especially required by Flax; and it is idle to expect that it will grow with profit where there is an over-abundance of moisture in the soil. Therefore, one of the most important points to be attended to in the growth of this plant is, that the ground be thoroughly drained.

The last two conditions referred to are—that the soil should be in good heart and tilth, or, in other words, that it should contain the necessary substances, and that its particles should be in a highly comminuted state. As to the first, its importance is obvious, for from no other source than the soil can this, like our other crops, derive those earthy constituents which are necessary for their growth and development. As to the second, that the ground should be in good tilth, this condition, which practice has long shown to be of great importance in the growth of all our crops—has only been recently fully appreciated by the vegetable physiologist and chemist; as it has been shown that the mineral food of plants cannot be conveyed to their roots from a distance by water percolating through the soil, because the latter, having a great attraction for those substances, readily removes them from water holding such bodies in solution, and retains them firmly locked up, as it were, in some physical state of combination, and consequently the rootlets must receive the principal supplies of their earthy constituents from those portions of the soil in immediate contact with them; and from such the substances required become gradually dissolved,

either by some solvent action of the roots, by the agency of carbonic acid, or by other circumstances not clearly made out, whereby the roots can gradually imbibe their mineral food, when and in such quantities as they require. Hence we see the necessity of having the soil in good tilth; for the finer the state of division to which we reduce its particles, the greater will be the surface of soil we enable the delicate rootlets of plants to come in contact with; and by thus increasing the surface of absorption, we enable them to acquire more readily, and in greater proportion, their necessary mineral constituents. This comminution of the particles of the soil is of especial importance in the cultivation of Flax, which, being a rapid growing plant (the whole period of its growth occupying only from about fourteen to sixteen weeks), and its rootlets being of a fine fibrous character, it requires to be rapidly supplied with nutriment, which condition will be fulfilled by having the soil where it is grown in good heart and tilth, and of a sufficiently open and friable condition to allow the rootlets freely to extend themselves in search of food.

THE ROTATION IN THE CASE OF FLAX, AND THE PREPARATION OF THE SOIL FOR THAT CROP.

As to the crop which Flax should follow or precede in rotation, the peculiar characters of this plant enable it to occupy almost any place in the rotation which the nature of the soil, the climate, the market, or the circumstances of the grower, may render most advantageous: thus, it may follow or precede a grain or a green crop, a forage plant or a following; such positions it is found occupying in different countries where it is extensively and successfully cultivated.*

As a general rule, however, the best rotation on soils of average quality is after wheat or other grain crops, for the following reasons—that, after the reaping of those crops, the autumn affords an opportunity for having the land thoroughly cleaned and deeply ploughed, and for leaving it in such a state exposed to the air during the winter, that its decomposing and disintegrating action may produce a fine tilth. The stubble, too, of those crops acts beneficially in keeping the land open, and thus facilitating the action of frosts and rains in this disintegrat-

---

* The North-East Agricultural Association of Ireland, in their directions for the proper management of the Flax crop, recommend the following rotations:—

RICH SOILS.	AVERAGE SOILS.	POOR SOILS.
1. Grass.	1. Grass.	1. Grass.
2. Oats.	2. Oats.	2. Oats.
3. Flax.	3. Potatoes or turnips.	3. Potatoes.
4. Potatoes or turnips	4. Wheat.	4. Flax (on half only).†
5. Wheat.	5. Flax (on half only).†	5. Hay.
6. Clover hay.	6. Clover hay.	
7. Pasture.		

† Omit Flax in next rotation on this half.

ing process, and thus materially aids in producing a fine condition of the surface soil, suitable to receive the seed in the following spring.

Mr. Wilson, in his valuable little work, "Our Farm Crops," observes, in speaking of the cultivation of Flax, "that if the land intended for that crop has been thoroughly tilled and cleaned in the autumn, and left with a good deep winter furrow, it will require but little preparation in the spring: at that period of the year," he says, "*it is always better to avoid using the plough, if possible,* because the finely weathered surface is by it turned in; and it is well nigh impossible by any mechanical treatment of the soil, to reduce a fresh furrow slice to the same tilth; while every time any implement or animal passes over the surface, it becomes compressed and consolidated, and in some soils and seasons materially injured."

Though what Mr. Wilson states as to the desirability of not using the plough in spring appears in theory to be correct, there is much diversity of opinion and practice on this point; for many recommend and adopt spring ploughing. If, however, it is thought desirable to plough in spring, it should not be deeper than about three or four inches, so as to preserve the winter surface for the growth of the plant, and it is always better that it should be performed some time before the sowing of the seed, which will allow the seeds of different weeds remaining in the ground to vegetate, and by so doing, many of them will be killed or removed in the subsequent harrowings of the soil to prepare it for receiving and covering in the seed, and thus avoid a good deal of trouble in the weeding of the crop afterwards.

As to the application of manure to the ground intended for Flax, its direct employment in this country is not generally practised, fearing lest the rankness of growth resulting from it would render the Flax more liable to lodgment, and consequent injury during summer rains; besides, it is thought that the ground is sufficiently enriched by the manure employed in the growing of the preceding crops. If, however, the land is considered too poor, it may receive a light application of any of our ordinary manures, or artificial Flax composts, which may be applied before the last harrowing of the ground to prepare it for the seed.

I shall defer all further details as to the preparation of the ground, the sowing of the seed, and the subsequent treatment of the crop, till the latter part of this paper, in which, under the Directions for the Proper Management of the Flax Crop, these and other practical matters connected with the culture of Flax, will be fully treated.

CHEMISTRY OF THE FLAX PLANT.

I shall now offer a few remarks on the chemistry of the Flax plant, which will enable us to judge whether one of the great arguments against the extension of the growth of Flax, viz., that it is a very exhausting crop, is a fair one. Flax, like other plants, consists of two parts, viz., the organic and inorganic—the combustible and incombustible, or mineral portion. The former, which constitutes the chief part of the plant, con-

sists, as is well known, of four simple bodies, viz., carbon, hydrogen, oxygen, and nitrogen, the first three or all of which, grouping themselves together in certain proportions, form the cellulose of which the fibre consists, the oil, and other organic substances produced during the growth of this plant. The latter,—the inorganic or mineral part, which constitutes the ash that is left when the plant is burnt,—consists of some nine or ten different substances, and amounts to from three to four and a half per cent. of the seed, and about five per cent. of the straw of the Flax plant; and though the quantities of each of those mineral matters are small when compared with the organic part, still they are all indispensably necessary to the growth of this, as of our other crops.

In the nutrition and growth of Flax, as of other plants, the organic elements—the carbon, hydrogen, oxygen, and nitrogen—are supplied directly or indirectly, under different compound forms, from the atmosphere, in unlimited quantities. The inorganic or mineral substances, however, not occurring in the air, can be only derived from the soil. Now, though all of those nine or ten mineral substances are equally important as regards the growing plant, they are not practically of equal value to the agriculturist, for this reason, that some of them occur in almost inexhaustible quantities in most soils, and therefore require little or no attention on his part, whereas others, occurring more sparingly in soils, may be either originally deficient, or by the continued growing of different crops which remove more or less of them be soon reduced to such a small proportion, that the soil cannot yield the necessary quantity, and consequently different crops (especially those that require a good supply of the deficient substances) cannot be grown, at least with any profit, on such impoverished or exhausted soils. Therefore, it is those sparingly distributed mineral matters that require the especial attention of the agriculturist. Now, general experience seems to show that the two most important of the mineral constituents of plants, as regards the agriculturist, are—*phosphoric acid and potash;* not only because they are generally sparingly distributed in the soil (at least, in an available condition), but likewise as being the most costly to purchase of the mineral constituents of our manures.

All our agricultural crops are more or less exhaustive; that is, they all remove from the soil those mineral substances required by plants. But some of them, requiring a larger amount of those sparingly diffused substances (particularly the two bodies just referred to), may, in one sense, be considered more exhaustive than others for the generality of soils.

We shall now consider what are the total quantities of mineral matter, of phosphoric acid, and of potash, which from the results of chemical analysis have been estimated to be removed from the soil by average crops of some of our most important plants, including Flax; those quantities are shown in the following Table:—

Total Quantities of Mineral Matter, of Phosphoric Acid, and of Potash, removed from a Statute Acre by an Average Crop of the following Plants:—

	Entire Mineral Matter.			Phosphoric Acid.			Potash.		
			Total Quantity.			Total Quantity.			Total Quantity.
Wheat,	in the Grain,	25 lbs.	178 lbs.	11·47 lbs.		19·65 lbs.	7·49 lbs.		25·70 lbs.
	,, Straw,	153 ,,		8·15 ,,			18·21 ,,		
Oats,	,, Grain,	58 ,,	228 ,,	10·55 ,,		14·90 ,,	9·72 ,,		42·26 ,,
	,, Straw,	170 ,,		4·35 ,,			32·54 ,,		
Barley,	,, Grain,	49 ,,	208 ,,	17·25 ,,		22·43 ,,	9·68 ,,		38·93 ,,
	,, Straw,	159 ,,		5·18 ,,			29·25 ,,		
Beans,	,, Grain,	63 ,,	231 ,,	23·67 ,,		35·83 ,,	22·63 ,,		111·80 ,,
	,, Straw,	168 ,,		12·16 ,,			89·17 ,,		
Peas,	,, Grain,	96 ,,	432 ,,	32·18 ,,		48·41 ,,	35·85 ,,		51·74 ,,
	,, Straw,	336 ,,		16·23 ,,			15·89 ,,		
Potatoes,	,, Tubers,	400 ,,	580 ,,	50·28 ,,		63·99 ,,	223·00 ,,		273·43 ,,
	,, Tops,	180 ,,		13·71 ,,			50·43 ,,		
Turnips,	,, Bulbs,	340 ,,	640 ,,	33·11 ,,		60·99 ,,	125·73 ,,		201·68 ,,
	,, Tops,	300 ,,		27·87 ,,			75·95 ,,		
Beet,	,, Bulbs,	483 ,,	1539 ,,	19·80 ,,		78·00 ,,	149·70 ,,		385·50 ,,
	,, Tops,	1056 ,,		58·20 ,,			235·80 ,,		
Flax,	,, Bolls,	48 ,,	272 ,,	18·00 ,,		33·50 ,,	11·00 ,,		25·00 ,,
	,, Straw,	224 ,,		15·50 ,,			14·00 ,,		

The above quantities in the case of all the crops, with the exception of Flax, are from the results of analyses by different chemists, given in Morton's "Cyclopedia of Agriculture," where the quantities taken as average crops are estimated at the following amounts:—

Wheat,	Grain,	25 Bushels, at 60 lbs. each.
	Straw,	at twice the weight of the Grain.
Oats,	Grain,	50 Bushels, at 40 lbs. each.
	Straw,	at two-thirds more than the Grain.
Barley,	Grain,	40 Bushels, at 52 lbs. each.
	Straw,	at one-fourth more than the Grain.
Beans,	Grain,	25 Bushels, at 63 lbs. each.
	Straw,	at 2800 lbs.
Peas,	Grain,	50 Bushels, at 64 lbs. each.
	Straw,	at 5600 lbs.
Potatoes,	Tubers,	at 8 Tons.
	Tops,	at 4½ ,,
Turnips,	Bulbs,	at 20 ,,
	Tops,	at 6 ,,
Beet,	Bulbs,	at 30 ,,
	Tops,	at 5 ,,

The quantities in the case of Flax are from the results of Dr. Hodges, who estimates two tons of straw, and sixty bushels of bolls, dried, and weighing 960 lbs., as an average crop of Flax.

From the above Table it would appear, taking one thing with another, that there is no great difference between the exhaustive power of Flax and our ordinary cereals—that in some respects it is less so than beans or peas; but that it is far less exhaustive than either potatoes, turnips, or beet, whether we consider the total quantity of mineral

matter, the phosphoric acid, or the potash removed from the soil; so that we cannot regard Flax as a particularly exhausting crop, as is generally done.

But here we view it under the most unfavourable aspect; for it rarely happens that the whole of the crop is sold off the farm, but the seeds, or a portion of them, are used for feeding purposes, and the straw is very commonly steeped there, and it is only the Flax fibre that is disposed of.

If, however, the water which is used in steeping the Flax was employed for irrigation, and the expressed seeds or linseed cake, for feeding the cattle on the farm, we would return to the soil almost all the mineral matters taken up by the plant; for the Flax fibre and oil—the two most important products of this plant—retain, after proper preparation, but a very small proportion of mineral matters—those of the straw remaining to a great extent in the water used for steeping, and those of the seed in the expressed cake.

These statements are borne out by the analyses of Sir Robert Kane, the late Professor Johnston, Messrs. Way and Ogston, Dr. Hodges, and other chemists, who have investigated this subject, and have all maintained the non-exhausting characters of Flax if properly cultivated.

From the elaborate and important investigations of Messrs. Way and Ogston on the mineral constituents of plants, these gentlemen have been led to conclude that an average crop of Flax contains a larger amount of mineral matter than an average crop of any of our cereals produced from the same extent of ground; but that only a small portion of that matter belongs to the fibre, the part of the plant which is permanently removed from the soil, and that this consists almost entirely of comparatively valueless substances. The really valuable soil constituents, they find, are contained chiefly in the leaves, which in a great part drop off on the field, in the seed and seed vessels (which should be returned to the soil in the form of manure); and, lastly, in the organs of the stalks, irrespective of the fibre. They have further ascertained, that about four-fifths of the soil constituents contained in the stalk, and those the most valuable (phosphoric acid, potash, &c.), are extracted by the water during the operation of steeping; and that nearly three-fourths of the remaining portion are again separated with the woody parts by the scutching, &c., leaving only a minute quantity (comparatively speaking) of mineral matter in the fibre.

Consequently, the results of those gentlemen confirm, in a most satisfactory manner, the statements of other chemists as to the Flax plant, the cultivation of which by no means produces a necessary exhaustion of the soil, which almost ceases when the refuse matters obtained in the separation of the fibre, especially the water used in steeping the Flax, are returned to the soil.

From Dr. Hodges' experiments, he calculates, that if the fibre were only sold off the farm, a crop of two tons of straw per acre would remove only about five pounds of mineral matter—a quantity too small to exercise any appreciable injurious effect on the fertility of the soil.

Flax, therefore, instead of being (as is very unjustly regarded) one of the most exhaustive crops, would, if so cultivated, be one of the least in this respect that we could possibly grow. Nay, more, it would certainly have the effect of increasing the fertility of the soil; because the tillage and the workings of the ground—which are so necessary for the successful cultivation of Flax—must tend greatly to improve the physical and chemical condition of the soil, rendering it far more suitable for the growth of other crops.

In proof of this, I may remark, that the Flemish agriculturists, who may be justly considered as the most successful Flax growers in Europe, and best agriculturists generally, regard Flax, not as a crop that exhausts, but as one that improves the condition and fertility of the soil.

But, supposing that no part of the plant is returned to the soil, all being sold off the farm, and even granting that this crop removes a larger amount of those sparingly-diffused mineral substances (which we have shown is not the case), still, the Flax plant being such a rapid grower, and consequently occupying the ground for so short a period, and yielding when properly cared a greater money return than any of our other crops, its cultivation would be highly profitable, and leave the grower after purchasing, if he could not produce, the manure necessary to maintain the fertility of his ground, a larger profit, generally speaking, than he could possibly obtain by the exclusive culture of the less remunerative cereal and green crops.

THE PRACTICABILITY AND ADVANTAGES OF EXTENDING THE GROWTH OF FLAX IN IRELAND.

So much has been said and written of late on the practicability and advantages of extending the cultivation of flax in this country, that it is scarcely necessary for me, in a Paper like this, to dwell on that part of the subject, or to urge the desirability of those who have influence and wish for their country's prosperity uniting their efforts in furtherance of this national object, which promises, if carried out properly, to improve the condition of all classes throughout Ireland, and will, it is hoped, by giving increased employment, stem to some extent the great current of emigration taking place from our shores.

I may, however, observe, that the practicability of growing Flax in other parts of Ireland besides the North may be inferred from what I have already stated, as to the great power the Flax plant possesses of adapting itself to such a wide range of soil and climate; furthermore, practical experience has shown that Flax may be successfully grown in almost every part of Ireland. And the desirableness of extending its cultivation may be inferred from seeing the very prosperous condition of those parts of this country where Flax is extensively grown, as in the province of Ulster; which, were it not for the cultivation of the Flax plant, and the manufacture of linen from its fibre, would now be some of the most impoverished and backward parts of this country. And so fully alive are the people of the North of Ireland to the growing importance

of this branch of agricultural and commercial industry, that they have greatly extended the cultivation of this plant; whilst in other districts of Ireland their example has been recently followed to some extent; so that there was a greater amount of Flax produced last year in Ireland than was ever previously grown in this country, and greatly in excess over the former year; thus, the number of English acres under Flax in 1862 was 150,070 acres; and in 1863, 214,099 acres—being an increase of 64,029 acres, or considerably more than one-third greater than in the preceding year; and the Flax crop on the whole appears to have been in every way most profitable; and in many instances large sums were realized by different individuals from the sale of their Flax crop; and though there was a much larger supply, the price of Flax still kept up, from the great demand for that substance.

In the present year, the amount of Flax sown throughout Ireland, as far as can be learned, greatly exceeded that sown last year;* and the prospects of the crop appear to be very good.

Again, there is no reason why other parts of Ireland should not as well as the North participate in the advantages derivable from the growth of Flax; for it is generally believed that the soil and climate of many other districts are far more favourable to the growth of this crop than the colder and more mountainous districts of the North; and there are many instances of Flax being grown in the South, and in other parts of this country, with the greatest success and profit to the grower.

ADVANTAGES OF THE FLAX CROP.

Amongst the advantages of the Flax crop may be mentioned the following:—

First,—It is not so liable to be injured by wet seasons as our cereals and other crops. This is shown by the experience of the last few years, which have, as is well known, been very injurious to our grain crops, but have not affected (at least to the same extent) that of Flax.

Second,—Its growth is very rapid, so that it occupies the ground a short time, comparatively speaking, and thus enables us to grow a greater number of crops on the same soil.

Third,—It is far more profitable, when properly attended to, than any of our other crops. It is difficult, however, to state what is the average yield and profit on an acre of Flax, as they vary so much according to a great variety of circumstances.

Fourth,—Its culture supplies not merely a source of agricultural, but of industrial employment; in this respect it is more beneficial than any of our grain or other crops occupying the same extent of ground, in addition to its being more valuable.

---

* From the recent returns of the Registrar-General for the present year, published September, 1864, we learn that the acreage amount of Flax sown this year exceeds that of last year by 87,761 acres.

Fifth,—It may at all times be included in the ordinary rotation of crops without fear of exhausting the soil, if we do not grow it too frequently on the same ground, or take care to return to the soil, either in the Flax water and linseed cake (the latter having served first as food for the cattle on the farm), or in some other manure, the mineral substances removed by the crop. If Flax be cultivated with these precautions, the fertility of the ground will remain unimpaired for any number of years.

That these and many other advantages derivable from the growth of Flax are now so generally admitted, and that its more extended cultivation in Ireland is considered both practical and tending to improve the condition of this country, is evidenced by the active measures which are now taking place throughout Ireland to carry out this important object. Thus, we hear of meetings being held of the different agricultural societies, and of the chief persons of various towns and districts, to encourage the extension of the growth of Flax in this country. Nay, more, companies have been formed in different places, and other active steps taken to give immediate effect to the advancement of this great national object,* which, if attained, there can be no doubt would materially improve the agricultural, social, and commercial condition of Ireland.

DIRECTIONS FOR THE PROPER MANAGEMENT OF THE FLAX CROP.†

THE SEED, AND THE SOWING OF IT.

It is a matter of much importance to the grower of Flax to select proper seed, as a good deal of the success or otherwise of the crop will depend on the kind which is sown. Foreign seed is universally preferred; and for the generality of soils that obtained from Russia, and known under the name of Riga seed, is the best, although Dutch seed in many districts has been used for a series of years with perfect success, especially in the case of heavy damp soils, and is said to yield a Flax of finer fibre, though not so large a crop as that grown from Riga seed. If neither can be procured, home-grown seed may be used, it being preferable to American, which from its producing plants having a tendency to branch, instead of growing with single erect stems, causes much of the fibre to be lost in the scutching. In purchasing seed, that

---

* In furtherance of that important object, since this Paper was read, the Government have granted a sum of £2000, which has been placed at the disposal of a joint committee of the Royal Dublin Society and of the Royal Agricultural Society, for the encouragement and promotion of Flax culture in this country.

† Though the Directions here given for the proper management of the Flax crop were not read before the meeting of the Royal Dublin Society, it was thought that this paper, when published, would be rendered much more practically useful by having them added to it.

which is shining, plump, heavy, and feels slippery to the hand, should be selected, as indicating that such seed is fresh, a circumstance of much importance, as seed beyond a year old should not be sown. In all cases, however, it will be safest to buy the seed from the most respectable establishments, even though by so doing the cost of the seed may be somewhat greater.

Before sowing, the seed should be sifted, to separate from it the seeds of all weeds it may contain, which will save a great deal of trouble in the weeding of the crop afterwards. This may be effected by using wire sieves having twelve bars to the inch, which, being constructed for this purpose, can easily be procured.

As to the proportion of seed that ought to be sown, it may be stated at from two to three bushels to the statute acre; the former quantity for poor, and the latter for rich soils; about $2\frac{1}{2}$ bushels, or 126 lbs. of clean seed being taken as a fair average quantity.

It should, however, be remembered that it is always better to sow rather too thick than too thin, when the principal object in growing Flax is the fibre; for, when thickly sown, the stems grow tall and straight, and but slightly branched at the top, producing a fibre far superior in length and fineness to that of Flax grown thin, which on the other hand is much branched, and produces a good deal of seed, but the fibre of which is coarse, and of very inferior quality.

The ground having been well pulverized and cleaned by previous ploughing and harrowing, a light roller should be passed over it, to give an even surface, and produce a certain amount of consolidation; after which a short toothed or seed harrow follows; and if the ground has not been laid down in ridges, it should be marked off in divisions of from eight to ten feet in width, for the better distribution of seed at the time of sowing On the ground so prepared, the seed is sown broad cast, by hand or machine, in the proportion stated; and after the sowing of the seed, which should be done by a very skilful person, it is covered by passing a seed harrow once up and down the divisions, and once across or anglewise, which has the effect of distributing the seed more evenly, and avoids the small drills made by the teeth of the harrow. This being done, a light roller should be passed over the ground, unless it is so wet as to adhere to it in clods, when of course that operation should be dispensed with, being then far more injurious than beneficial. In the sowing of Flax it ought also to be borne in mind that the seed should be covered only by about one inch of earth, which is the proper depth at which it ought to be placed in the ground.

As to the time of sowing, the end of March or the beginning of April is the period that is generally recommended, and it is of great importance that it should be done in dry weather. But the time of sowing will to some extent be influenced by the special object in view in the cultivation of Flax: thus, when it is grown for fibre alone, or for the fibre and seed together, it is better to sow somewhat earlier than when the production of seed is the principal object; for, when sown late, the crop grows so quickly during the early summer months, that

the vegetative processes are too rapid to give sufficient time for the consolidation of the tissues, which is necessary for the production of good fibre, and which the slower vegetation of the spring months generally secures where the sowing has been performed early; consequently, for fibre purposes, about the last week in March, if the season is mild and favourable, is the best time; when both fibre and seed are required, the sowing may be a week or two later; and when the production of seed is the principal object, it may be delayed till about the end of April.

THE WEEDING OF THE CROP.

If proper care has been bestowed on the cleaning of the seed and the ground, but few weeds will make their appearance; these, however, must be removed by careful hand-weeding. This is best effected when the Flax has attained a height of about three or four inches; but should be done before it exceeds six inches; for, if left longer, the Flax will be injured during the weeding. This process is generally performed by young persons, or females, who with coarse cloths round their knees, or having them well padded, weed in a kneeling posture, and creep along the ground on all fours. By this method the young Flax plants are less injured than by walking over the ground, especially if the weeders have shoes furnished with nails. For this operation a dry, windy day is most favourable; and the weeders should always work facing the wind, so that it may assist in raising the Flax plants which have been bent down in that direction during the weeding process. When the Flax, however, has been sown in ridges (as is sometimes done, especially where the ground is wet, or not properly drained), the weeders should work sideways from the pathways or furrows between the ridges, so as to injure the Flax as little as possible.

THE PROGRESS OF THE FLAX CROP, AND THE PROPER TIME FOR PULLING IT.

The plant having attained a height usually of about two feet (though sometimes growing much higher), flowers towards the latter end of June, or early in July, when its delicate blue blossoms present a very beautiful appearance. After the flowers fall off, the seed capsules or bolls begin to form, and acquire their full size about the middle or latter end of July. When fully formed, they are nearly globular, with the top surfaces slightly drawn up to a point; and on opening them are found to have usually ten cellular divisions, each containing a single seed, appearing at first as a colourless integument, enclosing a mucilaginous liquid, which soon assumes a more solid consistence, changing to a pale green, and afterwards, as the seed ripens, passing into a brown colour. As the plant becomes more matured, the stalks near the ground lose their green appearance, and assume a yellow tint, becoming at the same time considerably harder, from the contraction of the vessels through which the sap was conveyed; and this alteration will proceed gradually up the stem until it reaches the seed capsules, indicating the

passage of the sap into those organs for the maturing of the seed; and soon after this, the plant, having completed the term of its existence, sheds its seed, and dies.

As to the proper time for pulling the plant, this depends on the principal object we have in view in cultivating Flax. Thus, if it be for the purpose of producing seed for either sowing or for the production of oil, the plant must remain until its seeds are ripe, which will be denoted by the hardened condition of the seed capsules, and the brown appearance of the seed, together with the yellow colour of the stems, and the falling off of the leaves. But if (as is generally the case, at least in this country) the object is the fibre, we must not allow the plant to be fully matured; for, if so, the fibre will be coarse, and of inferior quality. If, on the other hand, we pull it too early, although the fibre is fine, the great waste which is produced in the scutching and hackling renders it unprofitable. It is, therefore, a point of much practical importance to know the proper time at which Flax should be pulled.

General experience has shown that where Flax of good quality, but not of extreme fineness, is required, the best time for pulling is when the seeds begin to change from a green to a pale brown colour, and when about two-thirds of the stalk from the ground have become yellow. When, however, Flax of the very finest fibre is required, as in the manufacture of certain cambrics and muslins, it should be pulled before this, and is sometimes removed from the ground so early as when the Flax begins to flower. But the former practice is generally far the most profitable; for the higher price brought by the finer Flax does not compensate for the greater yield of fibre in the more matured plant, and for the seed, which may be very profitably used for feeding purposes, for the extraction of its oil, or even occasionally for sowing.

The Flax, as is well known, is pulled by simply catching it in small handfuls below the seed vessels, and laying each handful on the ground one across the other diagonally, taking care that the root ends of each bundle should be even like a brush, which will increase the value of the Flax to the spinner, and consequently to the grower, who will be fully repaid by the higher price received for any additional care and trouble bestowed in making up and placing the handfuls properly. After the pulling of the Flax, much diversity of practice exists as to its subsequent treatment previous to the steeping process, which, without going into some minor points of difference, may be divisible into the three following courses—viz., 1st. The Flax may be immediately freed from its seed capsules or bolls by rippling, and then steeped at once; 2ndly. It may be made into stooks or bundles of a peculiar construction, in which state it is suffered to dry gradually, and when this has been effected, the seed is removed by beating or rippling it, and the straw is shortly afterwards steeped; or, 3rdly. It may be dried, as before, and being stacked or otherwise stored up (the seed having been removed previous to the storing or subsequently, when convenient), the Flax straw is steeped the following summer. The first course, however, being the one which is generally practised (at least in this country),

and is that which is most recommended to be adopted here, it will be well to describe it a little more in detail.

THE RIPPLING OF THE FLAX.

The Flax, having been pulled in the manner stated, is at once freed from its seed capsules; this, adopting the first course, is very easily effected by drawing it in small handfuls through a sort of comb termed a ripple, which is a simple instrument, consisting of a row of iron teeth* screwed into a block of wood. This, taken to the field where the Flax is being pulled, is fastened to the centre of a plank about nine feet long, supported on two stools. At the opposite ends of this the ripplers may either stand or sit astride, being at such a distance from the comb as to allow of their striking it properly and alternately.

The handfuls of Flax being placed diagonally across each other (as already stated, in the pulling), and bound up in bundles or sheaves, these are laid down at the right hand of the rippler, and untied, when he, taking up a handful and grasping it firmly with the one hand about six inches from the roots, and with the other having spread it out at the top so as to present a broad fan-like surface to the ripple, draws it quickly through the comb, and thus detaches the bolls. There is, however, some care and dexterity required in this process, so as not to injure the fibre, and the proper manner of performing it is best learned from those already acquainted with it. After the Flax is thus deprived of its bolls, the rippler lays it down on his left-hand side, placing one handful across the other, after which it is tied up into sheaves, and removed. The object of thus crossing the handfuls after rippling in tying up the sheaves is, that they may easily be separated from each other after the process of steeping, and spread out evenly in the subsequent grassing of the Flax. As to the bolls, they should be carefully collected by placing a winnowing sheet or cloth on the ground under the ripple to receive them as they fall off, the seed they contain being, as is well known, very valuable as a food for cattle, as well as for the manufacture of oil.

If the weather be dry, the bolls should be suffered to remain in the field, spread out on the winnowing cloths or other contrivance for drying, turning them from time to time to assist their drying; they may then be passed through a coarse riddle, and afterwards through fanners, to separate straws and leaves. If, on the other hand, the weather be moist, the bolls must be dried within doors, by being spread on the floor of a barn or loft where they can be exposed to a current of air, and turned twice a day.

---

* The teeth of the ripple should be made of rod iron, half inch square, placed in the block so as to be three-sixteenths of an inch apart at the bottom and half an inch at the top, the angles of the iron being turned so as to be opposite the ripplers. These teeth should begin to taper to a point three inches from the top, and be about eighteen inches in length, which will give sufficient spring, and save much breaking of the Flax during the rippling process. Such an instrument can be readily made by any handy blacksmith.

When they are nearly dry, they are removed to a corn kiln, where they are exposed to a temperature not exceeding a summer heat, being carefully turned as long as moisture remains. By this plan of slow drying, the seed absorbs all the juices which remain in the husk, and becomes quite ripe. If, on the other hand, it is at once taken from the field, and dried hurriedly on the kiln, the juices will be destroyed, and in the shrivelled and dried-up seed but little nutritious matter will remain.

The bolls being thus dried and cleaned, either within or without doors as the case may be, the seed may be threshed out, when the plumpest and heaviest portion should be reserved for crushing, or even sowing, and the lighter seed and chaff may be very profitably employed as a food for cattle.

Adopting this treatment of Flax, it ought not, if possible, to be allowed to remain on the field the second day, but should as soon as it is pulled be rippled, and then immediately put to steep, in order to prevent its hardening, which would retard the various fermentative changes which take place during the steeping of the Flax.

THE STRUCTURE OF THE STEM OF THE FLAX PLANT, AND DIFFERENT MODES OF TREATING THAT PORTION OF THE PLANT TO EFFECT THE SUBSEQUENT SEPARATION OF ITS FIBRE.

The ultimate object of the steeping, and of other processes to which the stem of the Flax plant is afterwards submitted, being, as is well known, the separation of the fibre, it will be well to consider its structure, in order to understand more clearly how the different processes adopted may aid more or less in effecting that object. If a portion of the stem of this plant be broken across, and then carefully examined, it will be found to consist chiefly of three distinct parts—viz., the centre hard cellular tissue, having all the appearance of wood, and usually called the shove, or boon ; a tubular sheath, placed around this, composed of bundles of long and tough fibres, cohering to each other firmly ; and exterior to this, a thin and delicate skin or bark,— the whole, but especially the fibres, being as it were cemented together by a nitrogenous compound. This substance it is necessary to separate, in order to detach the fibre, and obtain it in a state fit for manufacturing purposes ; but so intimate is the nature of its union with the fibre, that mechanical means alone are quite insufficient for its complete separation. Various methods have been proposed and adopted, which effect more or less completely the removal of this cementing substance ; these may be divided into two classes—viz., those which accomplish its removal by directly dissolving it, and those which produce the same effect by its gradual decomposition.

Amongst the first are the various alkaline and acid chemical solvents, as well as steam and water at a high temperature ; these, especially the latter, though they promised to be very advantageous, have not in practice realized the expectations entertained regarding them, and have consequently been almost entirely discarded. As to the second class, wherein

the cementing material is removed by effecting its gradual decomposition, this object is carried out differently in different countries;—thus in some parts of America it is effected by leaving the Flax spread out on the grass to the action of the atmosphere for several weeks, whereby the cementing substance is gradually decomposed, so that the fibre can then be separated by the different mechanical processes through which it afterwards passes. This, however, is a very tedious process, and one attended with many disadvantages. The same end is more quickly and much better attained by steeping the Flax in water, which is the process adopted in most countries. This is carried out by either placing the Flax in very slow running streams or rivers, as in Belgium and some other parts of the Continent, or by putting it in pools specially constructed for that purpose, as with us,* and also adopted in many other countries. We shall therefore confine our remarks on steeping to the latter method of conducting it.

THE STEEPING PROCESS.

This operation requires much care and attention, as the value of the fibre and the profit it yields depend more, perhaps, on the manner in which it is performed than on any other operation of the Flax grower; consequently, it will be well to consider it somewhat in detail.

First, then, as to the pond or pool in which the steeping is conducted.—This should be made, if possible, some time before it is required, and in choosing a site for its construction particular attention should be paid as to the supply of water suitable for the process. It is desirable also that the situation should be warm and well sheltered, though not too much shaded by trees or otherwise. If these two circumstances as to water and situation are favourable, others are comparatively of minor importance.

The kind of water which is best adapted for the steeping of Flax is river water, especially that which has flowed for some distance exposed to the action of the air, by which more or less of its earthy salts are separated, rendering it softer, and more suitable for this purpose. Water which has flowed over peat, or through peaty soils, is generally found to answer very well. But, on the other hand, waters which contain a large proportion of carbonate of lime, and other earthy salts (as is generally the case with spring waters), giving to them more or less of the well-known character of *hardness*, are unsuited for the steeping of Flax; and waters which have anything of a ferruginous character from the presence of salts of iron should be especially avoided, as they are quite unfit for that purpose. As to the pool itself, the best size to construct it is from twelve to eighteen feet broad, by from three and a half to four feet deep, the length being in proportion to the quantity of Flax to be steeped; but

* A clause in the Fishery Laws of this country prohibits the steeping of Flax in rivers or streams, on account of its rendering the water poisonous to fish, and great numbers having been before that prohibition destroyed during the steeping season.

with the breadth and depth given, a pool of about thirty feet in length ought to be sufficient to steep the Flax of one acre. The kind of soil which forms the bottom of the steep pool is thought to influence to some extent the colour of the fibre, a clay bottom being said to give a yellowish-white tinge, an alluvial soil, a bluish shade, whilst a peaty one produces frequently a very pure white. It is advisable that a small drain, six or eight inches deeper than the bottom of the pool, should be cut at a distance of a few feet from it on every side, for the purpose of either preventing any water passing from the surrounding soil into the pool which might injure the Flax; or, on the other hand, to prevent the water from the pool passing into the surrounding soil.

If the ground be of a very porous character, it may be necessary likewise, in making the steep pool, to guard more effectually against the escape of water from the pool itself; this will be best effected by cutting a deep and narrow trench parallel to the sides of the pool, at a distance of about three or four feet from its sides, and then filling it with clay, which should be rammed hard, so as to render it as impervious to water as possible.

If river water cannot be obtained or made available for the filling of the pool, and recourse is obliged to be had to spring water, it should be put in the pool some five or six weeks before the steeping of the Flax, in order that the exposure to the air, by the separation it effects of more or less of its calcareous salts, may render it as soft as possible.

It will be sufficient, however, in the case of river water, to place it in the pool a day or so previous to the steeping of the Flax.

The water being in a fit state, the Flax is put into the pool in regular rows, the sheaves or bundles resting on their butt ends, and standing nearly upright, so that when the pool is filled it presents the appearance of a dense crop, with the summit of the stems just appearing at the surface of the water; or, as is frequently adopted, the bundles are laid on the flat in regular rows, the ties of each succeeding row resting on the roots of that immediately below it.

The Flax is then covered with either sods of grass, the green side resting on the Flax, with wheaten straw kept down with stones, or with logs of wood; the object being to keep the Flax completely under water, yet at the same time not resting on the bottom of the pool.

Where the water is at once suitable for steeping, as where there is a reservoir or pond at command, many adopt the practice of packing the Flax in the pool and covering it over in the way described first, and then letting in the water, which has this advantage, that the Flax can be better and more evenly packed than where the pool is full of water at the time of putting in the Flax.

After the Flax has been in the water a few days it swells, and becomes lighter, by the gases evolved during its fermentation, and additional weight must be placed over it to keep it under the water, which should be afterwards removed as the fermentation lessens and the Flax again becomes denser. Sometimes, too, it may be advisable to let in or

draw off some of the water, to keep the Flax always, during its steeping, about two inches below the surface of the water, and not let it either be exposed to the air or be sunk too deep in the pool or resting on its bottom.

As to the time required to steep the Flax properly, this will depend on the temperature and state of the weather, the kind of water, the description of Flax, and many other circumstances; but as a general rule it will be sufficiently steeped after from eight to fourteen days, the process being more quickly effected in warm than in cold weather.

It is, however, of great importance that every Flax grower should know when the Flax has been sufficiently steeped, as its quality is much deteriorated by being left either too short or too long a time in steeping; and when it has arrived at a certain stage of the process, a few hours more or less materially affect the quality of the fibre, and consequently the profits of the Flax grower.

About the seventh day the Flax should be examined, the usual test being to take a few stalks of average thickness, and, breaking their shove or woody centre in two places, about six or eight inches apart, in the middle of the stalk, catch the broken shove with the fingers, and see if it can be easily pulled out (drawing it downwards) without breaking or tearing the fibre, and without any of it adhering to the shove. If this is found to be the case, the Flax has been sufficiently steeped, and should be removed from the pool without further loss of time; but if not so, of course the steeping must be continued. After the fermentation has subsided, this trial should be made about every six hours, as the changes which take place then are sometimes very rapid; and if the Flax be allowed to remain longer in steeping than is necessary, the fibre becomes weak and cottony; if, on the other hand, it is removed too soon, or before the test just mentioned indicates that it is advisable to do so, much of the fibre is broken off during the scutching, and its quality in general is coarse and dry.

When the test shows that it has been steeped enough, it should be very carefully removed from the pool; for in no state does the flax suffer greater injury from careless handling than immediately after steeping: consequently it should never be roughly lifted out of the pool with forks or grapes, but should be handed out carefully by men standing in the pool to others on the banks, the business of the latter being to place the bundles on their root ends close together, or on their sides, on a slope, where they are left to drain for from twelve to twenty-four hours before spreading; but the heaps should not be too large, lest the Flax might be injured by heating in that very damp condition.

As to the water itself which has been employed in the steeping, it should (where it is possible) be used for manurial purposes, as it contains a considerable amount of the most valuable mineral constituents of plants, and is found to constitute an excellent liquid application, especially for meadows.

THE SPREADING OF THE FLAX AFTER STEEPING.

The Flax, having been sufficiently drained, is removed to where it can be spread out, exposed to the air and light, the object being to cleanse and improve the colour of the Flax, as well as to dry it. For this purpose a clean, short, and thick piece of pasture ground should be selected; and, having mowed down or removed any weeds that may rise above the surface of the sward, lay the Flax evenly on the grass, spreading it out thin and very equally, which will be easily effected if the directions given under the head of rippling have been attended to; for the handfuls will then readily come asunder without being entangled. While on the grass, some recommend that it should be turned two or three times (which is done with a long wooden pole), with a view to prevent more completely its being of different shades of colour, from unequal exposure to the light and air, which is frequently the case from inattention to this circumstance. If it is to be turned, and should there be a prospect of rain, that ought to be done before it comes on, that the Flax may by the rain be beaten down, and made to lie close upon the grass, thus preventing its being blown about and disordered.

THE LIFTING AND DRYING OF THE FLAX BEFORE STACKING.

When the Flax has lain on the grass about six or eight days, if the weather be showery, or ten or twelve if it be dry, it ought to be ready in lifting. A good test of its being sufficiently thus exposed, or as it is termed "grassed," is to rub a few of the stalks from top to bottom, and if the wood or shove breaks easily and separates from the fibre, leaving it sound, the Flax has lain long enough on the grass; this is also indicated when a large proportion of the stalks or stems are observed to form a sort of bow and string, caused by the fibre contracting and separating from the central woody portion. But the most certain and most satisfactory test is to try how a small portion of the Flax behaves when submitted to the hand break or to the Flax mill.

In lifting the Flax, care should be taken to keep the lengths straight and the ends even, as otherwise much loss will occur in the subsequent breaking and scutching. Let it then be set up to dry for a few hours, and afterwards be neatly tied up in small sheaves or bundles; and if it is not to be soon scutched, it should be stacked, or packed under cover; but in either case it ought to be put up loosely, that the air may get through it, and that there should be no danger of its heating. If it is stacked out of doors, the stacks should be built on stones, brambles, or, better still, on pillars, in order to keep them dry at the bottom, and allow a free circulation of air about them; and, finally, they should be very carefully thatched, to prevent the Flax being injured by wet. In this way the Flax will not only keep for years, but it is thought that the quality of the fibre is improved by keeping at least up to the third or fourth year after steeping. Flax, however, is sometimes dried by artificial heat, which is effected by placing it on kilns; this practice is very generally and properly condemned, as being highly pernicious to the fibre, im-

pairing its quality, and consequently reducing its money value; and if the Flax has been properly steeped and *grassed*, no such drying is at all necessary, but to make it ready for breaking and scutching, simple exposure to the sun is all that is necessary.

BREAKING AND SCUTCHING.

The Flax is now ready to undergo the final operations of *breaking* and *scutching*, which have for their object the separation of the woody portion or shove from the fibre, so as to render it fit for the market. These may be done by the use of different very simple implements or contrivances worked by the hand, which are too well known to need description, or by machinery; and the preference given to the use of one or other depends on the circumstances of the Flax grower. It is by manual labour that the greater part of the Flax grown in Russia, Holland, and Belgium is dressed; and even in this country a good deal of Flax is so prepared for the market, though by far the greater portion is dressed by machinery; and it is generally admitted that less injury is done to the fibre by hand breaking and scutching than where mills worked by steam, water, or horse power are employed for those purposes. Manual labour, however, has this great drawback, that it occupies much more time than machinery, and consequently the latter is becoming more and more generally employed; and improved and powerful breaking and scutching mills have been recently erected in various parts of the country, which, though still susceptible of further improvement, effect a great saving of time and labour in preparing the Flax for the market. But the circumstances of the Flax grower will influence him as to whether he should handscutch his Flax, or send it to where it can be scutched by machinery. Hitherto it has been generally considered that it is more advantageous for the small farmer and cottier to handscutch his Flax, and for the larger farmer to employ machinery, manual labour being too tedious and expensive where much Flax has to be scutched; but the increased facilities which are now being introduced into this country for having Flax scutched, owing to the construction of improved and portable scutching mills, as well as of those which have been recently erected in different parts of the country, will, there can be little doubt, make the practice of scutching by machinery that universally adopted in Ireland, whereby so great a saving will be effected in the time and labour consumed in this process where manual labour is alone employed.

THE COURTRAI SYSTEM OF MANAGING THE FLAX CROP.

In addition to the foregoing directions as to the management of the Flax crop, it may be well to notice here the practice which is followed with great success in some parts of the Continent, especially in that district of Belgium which is in the neighbourhood of Courtrai, and consequently that mode of treating Flax is usually designated as the Courtrai system. This consists in carefully drying the Flax in the field after it is pulled; and when this has been sufficiently accomplished, it is

ricked or stored up till the following spring, when it is considered fit for steeping. The chief peculiarity of this system consists in the mode in which the Flax is dried and ricked, which are accomplished in the following manner :—The handfuls of Flax as soon as they are pulled are set up in long narrow stooks, which are made by resting the tops against each other, the root or butt ends being placed on the ground spreading outwards like the sides of the letter A. These stooks are made from eight to ten feet in length, and a strap keeps the ends firm together. Being thus exposed to the action of the air and sun for six or eight days, according to the state of the weather, the Flax will be sufficiently dry to be tied up in bundles of the size of small corn sheaves; these are then made into a rick, which is usually constructed in the following manner: two poles are laid along the ground, parallel to each other, at a distance of about a foot apart, and in a direction north and south, so that the sun during the day may get on both sides of the rick; at the ends of each of these poles a strong upright one is placed.

The sheaves of Flax are then laid at right angles across the parallel poles, placing the tops and roots of each bundle alternately, and making the breadth of the rick the length of the sheaves; in this way it is built up to the height of about seven or eight feet, when it is finished by placing a single row of sheaves on the top lengthwise, or across the others, and then putting another row as before, the tops of all being placed the same way; by this means the necessary inclination or slope is given to throw off the rain; and being thus constructed, the rick is finally covered or thatched with a little straw, which is secured by a rope or otherwise. In this way the Flax may be safely kept for months, till it can be stacked or put in the barn; but in either case it is usual to remove the seed in the winter previous to the steeping of the Flax, in the spring, or early part of summer. Whatever advantages this system may possess, it certainly has this drawback, that a much longer time is required before the Flax is finished and ready for the market than where the system usually adopted in this country is followed, viz. of steeping the Flax immediately after being pulled. It is, however, a question whether the very superior quality of the Flax which comes from those parts of Belgium where this system is adopted may not in some degree be more or less connected with the practice of drying the Flax previous to its steeping, whereby certain changes are produced in the Flax, which render the fermentative action more slow and controllable during the subsequent process of steeping, and effect other alterations, whereby a fibre of better quality is obtained, which more than compensates for the longer time occupied in the process; at all events, the experience of the Flax growers of those districts where this system is followed, has no doubt shown them that, circumstanced as they are with regard to soil, markets of consumption, &c., this method of treating Flax is the most advantageous for them to pursue.

THE END.