CHEMICO-AGRICULTURAL SOCIETY OF ULSTER.

THE

RAW MATERIAL

OF

THE LINEN TRADE:

FLAX.

BY

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THE RAW MATERIAL OF THE LINEN TRADE.

In the month of June the fields of Ulster are covered with the blue flowers of a tall and graceful plant, which attract the attention of every stranger. Towards the end of July, the blue flowers fade away and are replaced by green balls, which gradually assume a golden colour, and glisten in the sun. The commencement of this change in the colour of the capsules of the plant is eagerly watched by the Northern farmer, who knows that the time is close at hand for pulling the crop, and submitting it to the various processes which give so much occupation to the people in this part of Ireland. This valued plant of the Ulster farmers, is a member of the family termed by botanists *Linacæ* (the flaxworts); it is the *Linum usitatissimum* of Linnæus, and from the earliest ages of the world has afforded a most important textile material. It would be easy to multiply references to the important place occupied by the flax plant in the earliest civilisation, both in the ancient seats of industrial knowledge in the East, and among the primeval races of Europe. The use of its fibres for the manufacture of linen appears to have prevailed in Egypt from the most ancient times, and the interesting discovery by M. Heer, of Zurich, of the carbonised fruit of the *Linum usitatissimum* in the lacustrine establishments of the age of stone, both at Waugen, and at Roben-hausen, in Switzerland, affords us evidence of its early employment in Europe. At Waugen, pieces of cord and shreds of tissues of a material resembling flax were discovered in the ancient lake dwellings. It is, however, from Egypt that the most striking

proofs, not only of the great antiquity of the culture of the plant, but of the skill which had been acquired in its manufacture, have come down to us. It is not merely that the ancient flax-growers of that country have left, in those remarkable pictorial representations which they placed on the walls of their temples and cemeteries, illustrations of every department of flax management, from the sowing of the seed to the weaving of the fibre, but in the wrappings of their dead they have preserved for our inspection specimens of that "fine linen" to which we have so many allusions in the sacred Scriptures, and which, all over the East, had spread the reputation of the looms of ancient Egypt. Some years ago the body of a mummy, which had been presented by Sir James Emerson Tennent to the Museum of the Natural History Society of Belfast, was unrolled, and determined, by the examination of Dr. Hincks, well known as one of the most distinguished Egyptologists of the present day, to be that of the daughter of a courtier or personal friend of Amenemhe IV., the last sovereign but one of the twelfth dynasty, who lived about 3,400 years ago. The bandages removed were found of every description of quality, from the "fine linen," resembling our finest lawn, to a coarse fabric like sacking; and, as several of the pieces were darned, it was conjectured that all the old linen of the house had been employed in the work. The Egyptian flax of the present day would be unfit to produce the finer qualities; its growth is too rapid under the burning sun. With us coarser fabrics are made of short, broken flax or tow, but the Egyptian fabrics show no trace of tow yarn. The quality and fineness of the cloth, which was submitted to examination by Mr. John Mulholland, varied from six hundred to twenty-four hundred. In all the pieces, it was remarked that the weft was much finer than the warp, the warp being deficient in quantity to the extent of from a third to a half; and as usual at the present day, thick threads were inserted at the end of each web to prevent their unravelling. The finer fabrics had a twilled appearance, owing to the weft rising on the surface, from the looms employed not being capable of light weaving.

Thus, on the body of a lady who died five hundred years before the birth of Homer, who lived, as Sir Emerson Tennent remarked on the occasion of unrolling her remains, when Cecrops founded Athens, and before the fall of Nineveh, and who may have stood in the presence of the great Hebrew lawgiver, were found, in every variety of texture, fabrics resembling those in the production of which the spinners of Belfast now occupy the place of the ancient inhabitants of the valley of the Nile. The splendid linen trophy which the merchants of Ulster raised in the hall of the late London Exhibition proved that in this western land a people unknown to the nation over which Amenemhe IV. ruled, have succeeded in giving to the produce of the flax a perfection which it probably had never attained in the early home of its manufacture.

The remarkable development of the linen trade of the North of Ireland within the last half-dozen years, has, probably, at the present, more than any previous time, directed attention in all parts of the United Kingdom to the subject of flax cultivation. The value of the flax crop to the Irish farmer, and the influence which the extension of the linen manufacture has exerted on the prosperity of Ulster, are strongly illustrated in the history of the once insignificant town of Belfast, which has become the linen metropolis of Ireland, with a busy population of 140,000 inhabitants. Forty years ago, this town did not possess a single spinning mill. Of the 700,000 spindles now at work in Ireland, more than three-fourths belong to Belfast and its immediate neighbourhood, and of the 35,000 persons employed, a like proportion is located in Belfast. In almost every street of the town, palace-like warehouses are springing up in the place of the old dingy offices; and, though in the month of July, 1863, the assistance of 8,500 power-looms had been added to the productive powers of the factories, yet so great was the increased demand, caused by the dearth of raw cotton, that our spinners were unable to meet the requirements of their customers. Though there was last year an enormous increase in the home supply of flax, yet the iron

fingers of our mills consume far more than the fields of the United Kingdom have yet produced. The area devoted to the cultivation of the plant in 1864 amounted to 301,942 acres; while in 1809 only 35,056 acres were produced in Ireland. Last year, from the want of adequate preparation and unskilful management, many farmers were disappointed in their expected profits; and in the present year, in some remote districts where there are no scutching-mills, and the people do not possess that knowledge of the crop which exists in Ulster, it is probable that a smaller amount of the crop will be grown. It is to be regretted that there should be any decrease in the home supply, for it is not merely in Ireland that the demand for raw material is likely to increase. The instructive reports of Mr. Alexander Redgrave and Mr. Robert Baker, Inspectors of Factories, for the half year ending 31st October, 1864, which have just been published, show us that the following Continental countries have added largely to their spinning power.

List of spinning mills, with an approximation of the number of spindles in the following countries :—

Country.	Number of mills	Spindles at work.	Spindles ordered.	Spindles projected.	Number of Spindles ten years ago.
Bohemia	34	137900	72700	4000	33000
Moravia	21	47300	58416	3800	20000
Prussia	22	133800	38200	8300	47000
Saxony	5	15000	9200	6000	4000
Austria	1	7000	3000	..	..
Hanover	3	8000	..	..	..
Bavaria	4	10200	..	..	2000
Poland	1	4000	..	6000	..
Switzerland	3	5000	..	..	3500
Total	94	368200	181516	28100	109500

Thus when the spindles ordered, and those projected to be added, are at work, flax-spinning in the above countries will have increased in ten years 426 per cent. In France, Belgium, and Russia also, a rapid increase in the number of spindles has taken place. In 1864 France had 563,000 spindles, and by the end of 1865 it is expected that this number will be increased to 680,000. Even with the enormous increase in the production of flax in Ireland last year,

the produce of 301,942 acres, estimated at 75,486 tons, is far below the amount required by our spinners of the United Kingdom, who were obliged to import 91,406 tons from foreign countries, and are thus forced to depend for the raw material upon countries which are likely, in the course of a few years, to dispute with us for the position which we at present enjoy as the chief linen manufacturers in the world. We are of opinion that Ireland possesses, in her soil and climate, advantages for the production of flax which, if her fields were judiciously cultivated, would enable her to produce more fibre than would be required to meet the wants of Europe. The mild moist climate of the island is most favourable for that slow and regular growth of the plant which is essential to produce soft, yet strong, pliable, and easily divisible filaments; and its soils are in general readily reduced to that fine state of division which is necessary to enable the plant readily to obtain the materials required for its perfect development. It has at all times been necessary for our spinners to send to Belgium and France for the delicate fibres required to spin certain numbers. Hitherto, even in Ulster, our farmers have not given that attention to the management of the crop in all its stages which has long been devoted to it in some continental countries; yet we believe, judging from the samples of Irish fabric occasionally produced, that our farmers, by judicious management, might produce finer qualities of fibre, and thus secure more remunerative prices. It is an old saying, that "flax is either the best or the worst crop that a farmer could grow." The want of success, we consider, depends more frequently on the ignorance or carelessness of the cultivator than on the soil. We have seen attempts to grow flax upon fields which were rendered incapable of yielding profitable returns of any kind of crop. Still, as in the days of the poet Tusser, it may be complained that—

> "Crop upon crop many farmers do take,
> And reap little profit, for greediness sake."

The treatment of the soil in many parts of Ireland excites the astonishment of those familiar with the efforts made, in

districts where agriculture is more advanced, to maintain its fertilizing qualities. "Were," says the author of a sensible little work on flax, "human ingenuity employed upon framing a scheme which should have the power of converting the best land into the worst condition, at the shortest possible notice, we can readily conceive that it must have a strong family likeness to the plan generally adopted in Ireland."

In both England and Scotland the cultivation of flax as a fibre crop has not at any time extended beyond a limited area. The idea that it exerted some peculiarly "scourging effects upon the soil," has at all times rendered farmers indisposed to introduce it among their regular crops. With respect to the exhausting effects of the culture of flax, chemistry teaches us that, like every crop grown by the farmer, flax takes from the soil certain constituents upon the presence of which its fertility depends. But it also teaches us that the amount of those materials which are necessarily removed from the farm is very small, indeed much less than is removed by most of the crops grown on our farms; and that, provided we save the highly nutritious seed-capsules and consume them in feeding our cattle, and utilize the woody matters of the stem removed in scutching as fuel, and restore the ashes to the soil, the quantity of inorganic matter carried off the farm in the fibre sold to the spinners is but trifling, and may be replaced in artificial manure at the cost of two or three shillings per acre. Properly managed, we believe that flax may be made one of the least exhausting of all crops grown by our farmers. The ignorance respecting the value of the fibre of the flax-plant which even at the present day prevails in some parts of England is most remarkable, and was amusingly illustrated some years ago by the remark of an English farmer, who every year cultivated the plant solely for the sake of the valuable feeding which its seed afforded, that "he was puzzled what to do with the straw, as it was most troublesome—it would not even rot properly in the manure heap." In some parts of England the only use made of the straw is to employ it for thatch!

The Irish farmer destroys the nutritious seeds in the steep-hole, as he seldom removes them before steeping, but prizes the straw; while the English flax-grower, in many districts, sows the crop solely for its seed, and despises the still more valuable fibre.

The sowing of the flax seed should, if the weather permit, be completed before the beginning of May, though in some districts it is delayed beyond that period. In Ulster it is considered advisable to sow not later than the 15th of April; the usual allowance of seed being at the rate of $2\frac{1}{2}$ to 3 bushels to the statute acre. The seed selected by our farmers is either the produce of Livonia or Esthonia brought from Riga, or Dutch seed, which is preferred to Russian when the soil is strong and heavy. Great care should be taken in the selection of sound seed. Black seed, or that which has been kiln-dried, should be rejected. Sound seeds have a brilliant golden or clear brown colour. The vegetative power of the seed is frequently tested on the continent by sowing a certain number of the seeds in the month of February, when there is but little activity of vegetation, and the seed is considered a fair sample if one-half of the number sown produces plants, In the commercial cities of the Baltic the method adopted to ascertain the quality of the seed, is to place over the fire a metal plate until it is almost red-hot, and then to allow the seeds to fall one by one upon it. The sound seeds spring away with a report, while those in which the oily parts have dried up, and which have become incapable of vegetation, remain on the plate and are burned. The sowing is invariably performed by the hand, broad-cast. The seed should be covered with only a light coat of earth, and a light seed harrow, followed by rolling, will complete the work.

The flax plant is found, as might be expected from the history of its extensive cultivation both in eastern and northern countries, to thrive upon soils of very diverse qualities, and in regions varying very much in temperature. Yet it is only in situations in which the proper climatic conditions exist, and on soils of special qualities, that its textile fibres develop themselves in perfection, or exhibit that combination

of softness, strength, and fineness which renders the flax of certain countries so much esteemed. In European countries littoral regions constitute the favourite localities for its cultivation, and the plains of Belgium and Holland, the Baltic provinces of Russia, the coast of the Mediterranean, and the maritime provinces of France are the districts from which our chief supplies of fibre are derived.

A friable loamy soil resting on a well-drained clay bottom, free from stagnant water, should, if possible, be selected for the cultivation of the plant. On lands reclaimed from rivers it may also be grown with advantage. Thus on the slob reclaimed from the river Foyle, in the county of Londonderry, which gave a soil that we found to possess the following composition, superior crops have been raised:—

COMPOSITION OF SLOB LAND FROM LOUGH FOYLE.

I.—BY WASHING.

Clay and Organic Matters, ...	10.97	Denomination.
Sand, ...	89·03	Sandy Garden Loam.
	100.00	

II.—BY ANALYSIS.

Potash, ...	0·11	0·94 soluble in Water.
Soda, ...	0·03	
Lime, ...	0·09	
Chlorine, ...	0·17	
Sulphuric Acid, ...	0 06	
Organic Matter, ...	0·48	
Oxide of Iron, ...	7·49	12·45 soluble in Acid.
Alumina, ...	3·31	
Lime, ...	1·12	
Magnesia, ...	0·09	
Carbonic Acid, ...	0·65	
Phosphoric Acid, ...	0·02	
Silica, ...	0·28	
Organic Matter, ...	7·14	
Insoluble Silicious Matter, ...	79·01	
	100·105	

Nitrogen per cent. 0·19, equal to 0·23 Ammonia. Water in the Sample, 11·38 per cent.

If the bed for the seeds has been rendered fine and level, and they have been deposited at a uniform depth, the plants may be expected to appear above ground in ten or twelve

days. Under the influence of the showers of April they will rapidly put forth their leaves. When they have attained the height of three or four inches the farmer should carefully remove every weed that springs up to rob the plants of their fair proportion of the elements of the soil. A breezy day should be selected for weeding. In Belgium bands of women with bare feet, or list slippers, advance over the fields on all fours, placing a cloth under their knees, and proceeding in a direction opposite to the wind, so that the soft and tiny plants pressed down in their course are elevated by the current of air, and enabled to attain an upright position. The loosened soil brings fresh supplies of food into contact with the absorbing rootlets, and the work of development goes regularly on. At this early stage of growth the plants are not easily injured. We have made some analyses which show that each plant at this stage consists of:—

Water, ...	87·63
Organic Matter, ...	10·64
Mineral Matters, ...	1·73
	100·00

If the weeding be delayed until the stems become more rigid, from the increased amount of solid matter formed, much injury will be done to the regular growth of the fibre. Usually when the seed has been sown in April, the crop will be ready for removal from the field about the end of July. The Belgian farmers, to obtain the fibre of superior fineness, recommend that the removal should commence "between the falling of the flower and the formation of the seed, so that unless it is wished to sacrifice the quality of the flax to obtain seed, the former must not wait the full maturity of the latter." In this country, however, it is considered that it is more profitable, and more likely to insure a strong and fine fibre, to allow the plants to remain until the leaves have fallen from the lower part of the stem, and its colour, for two-thirds of its length, has acquired a yellow tinge. The flax is removed by pulling up the stems, which is always done by hand, the work in Ulster being chiefly performed by women. We think that some more expeditious method will yet be applied.

We have heard that some years ago our inventive friends, the Americans, had hit upon and patented the plan of a pulling machine, which with one horse could pull and spread six acres in a day.

When there is a second growth of short stems it is usual for the pullers to take hold of the long stems, just below the seed-vessels, so as to leave the short stems for a second operation. The handfuls of pulled straw, as they are removed from the soil, are laid diagonally across each other, to be ready for the removal of the bolls or "rippling," which should be performed in the field at the same time as the pulling is going forward.

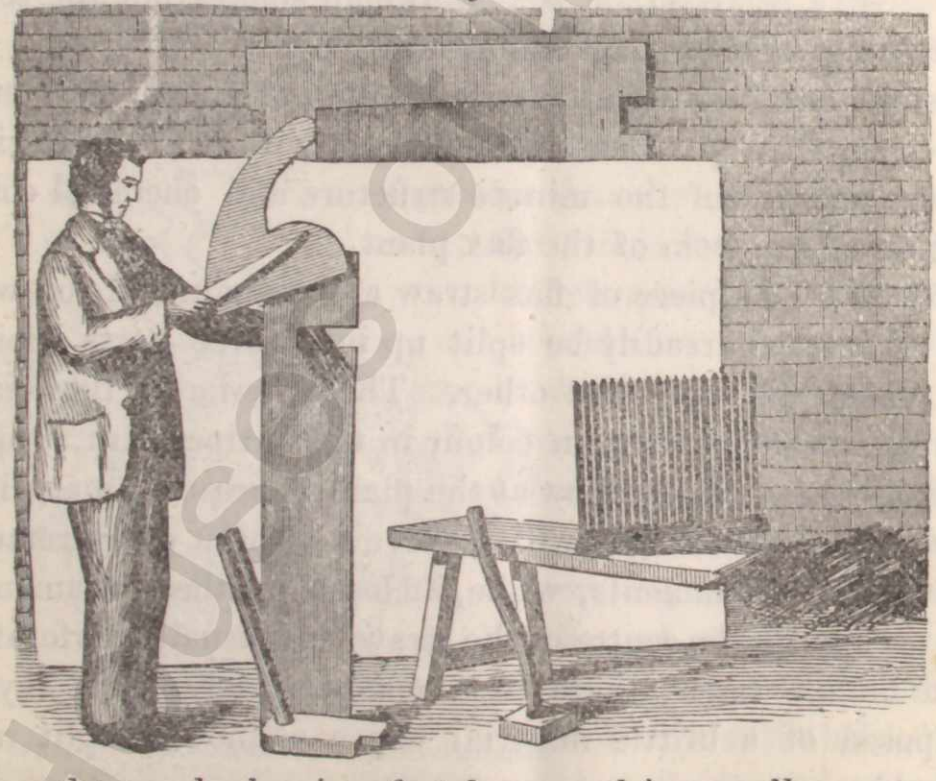
The farmers of England and Scotland, who have learned to appreciate the highly nutritive qualities of flax seed, will be surprised to find some of the growers of the crop in Ireland, even at the present day, contending that if the seed-vessels be removed the flax will not "water" properly, or give fibre of a good quality; and in many of the best flax districts this notion every year leads to the destruction in the steep-holes of valuable food, which, if preserved for feeding cattle, would add enormously to the profit of the farmer, and at the the same time preserve the fertility of the soil. We have, in autumn, seen mounds of the valuable bolls decaying on the coasts of Down and Antrim, to which they have been carried by the streams from the flax pools.

About the end of July, or early in August, when the seed has been sown about the middle of April, the flax plant may be expected to have attained that degree of maturity which is regarded as affording the fibre in the most suitable condition for textile purposes. In Belgium, as we have stated, the flax is generally pulled in a greener state than in this country, as the object is to obtain the most delicate qualities of fibre; but the Irish growers find that the amount of loss in managing the soft and tender straw renders it more profitable to allow the plants to become more mature before attempting their removal. We have already described the simple operations adopted in removing the crop. It might be expected that at this stage the business of the farmer pro-

perly terminated. Such is the case in many continental countries. In Belgium the crop is purchased by factors, who relieve the grower from all the trouble of further management, and undertake the various operations required to prepare the fibre for the spinner. If this system could be adopted in this country, it would tend in no small degree to facilitate the extended cultivation of the crop, especially in those new districts in the South and West of Ireland in which efforts have lately been made to encourage the farmers to introduce it.

In Ireland, however, at the present time, the flax-grower also prepares the fibre for the market. When the crop has been pulled, the usual method adopted, where the farmer has learned to value the seed, is to proceed at once to remove the seed capsules or *bolls*. This is effected by drawing the straw through an implement called "a ripple," which consists of a number of tapering angular bars of iron, each 18 inches long, fixed to a block of wood. These bars are placed three-sixteenths of an inch apart at the bottom, and at the top are about half an inch asunder. This row of iron teeth is

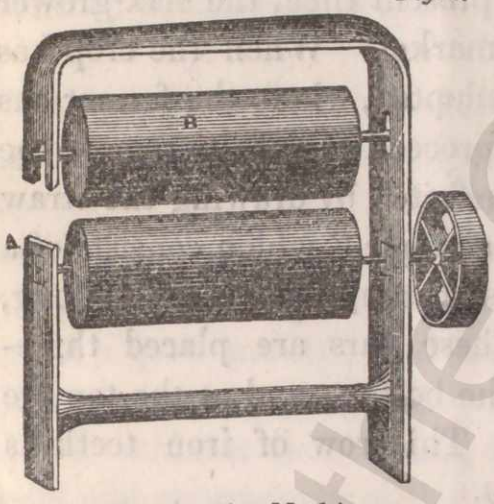
Fig. 1.



screwed to a plank nine feet long, and is usually supported on two stools. The bolls are received upon a winnowing

cloth placed under, and afterwards dried first by exposure to the sun, and finally to the heat of a kiln at a temperature not exceeding 70°. As the rippling proceeds, the straw deprived of the bolls is made up into small bundles, and secured by ties formed of rushes, which have previously been prepared for the purpose, by being dried and rendered pliant by beating; and thus arranged, it is carried from the field to be submitted to what may be regarded as the commencement of the special operations for the separation of the textile fibre.

Fig. 2.



Flax Seeding Machine.

Though the simple ripple described is that generally employed by the farmer, in establishments in which large quantities of straw are collected the bolls are more expeditiously and completely removed by passing the flax between a pair of iron rollers (*fig.* 2), after which, the workman shakes out the seed by striking the straw against an upright post.

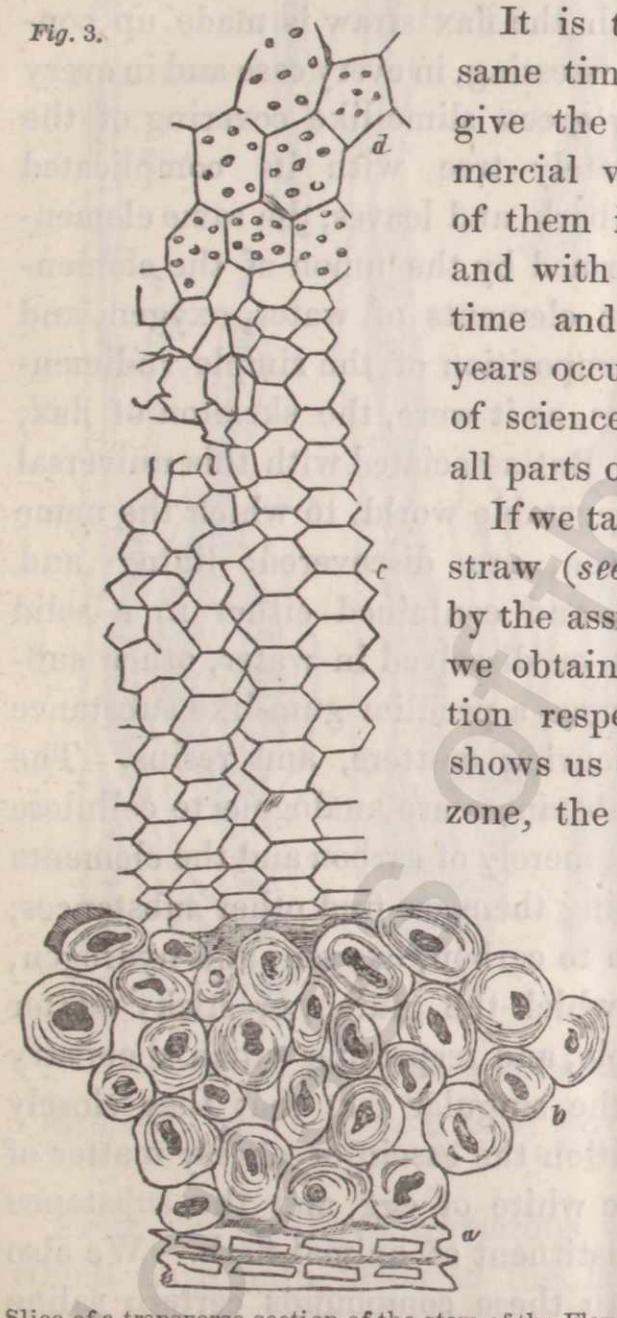
Before entering upon the description of the process employed for the separation of the fibre, it will be useful to give a short account of the minute structure and chemical composition of the stem of the flax plant.

If you take a piece of flax straw and examine it, you will find that it can readily be split up into three parts, which are placed one round the other. The exterior of these is a thin membrane of a green colour in the unripe plant, which is replaced by a fine yellow as the plant approaches maturity. The second portion you will observe to consist of extremely fine hair-like filaments, while, inclosed by these filaments, and occupying the centre of the straw, and usually perforated by a hollow canal, there is a comparatively thick layer, composed of a brittle material which cannot be split into threads.

A transverse section of the straw with a penknife will

show these three portions presenting the appearance of rings or circles of different diameters placed one within the other. So far it is possible by the naked eye, and especially when the stem has been softened by maceration in water, to recognize its division into three portions; and the flax grower is well aware that the thin investing skin and central brittle woody matter are of no value to him, but must be broken up and removed, to enable him to obtain the fine filaments which are inclosed between them.

Fig. 3.



Slice of a transverse section of the stem of the Flax Plant, magnified 400 times its natural size.

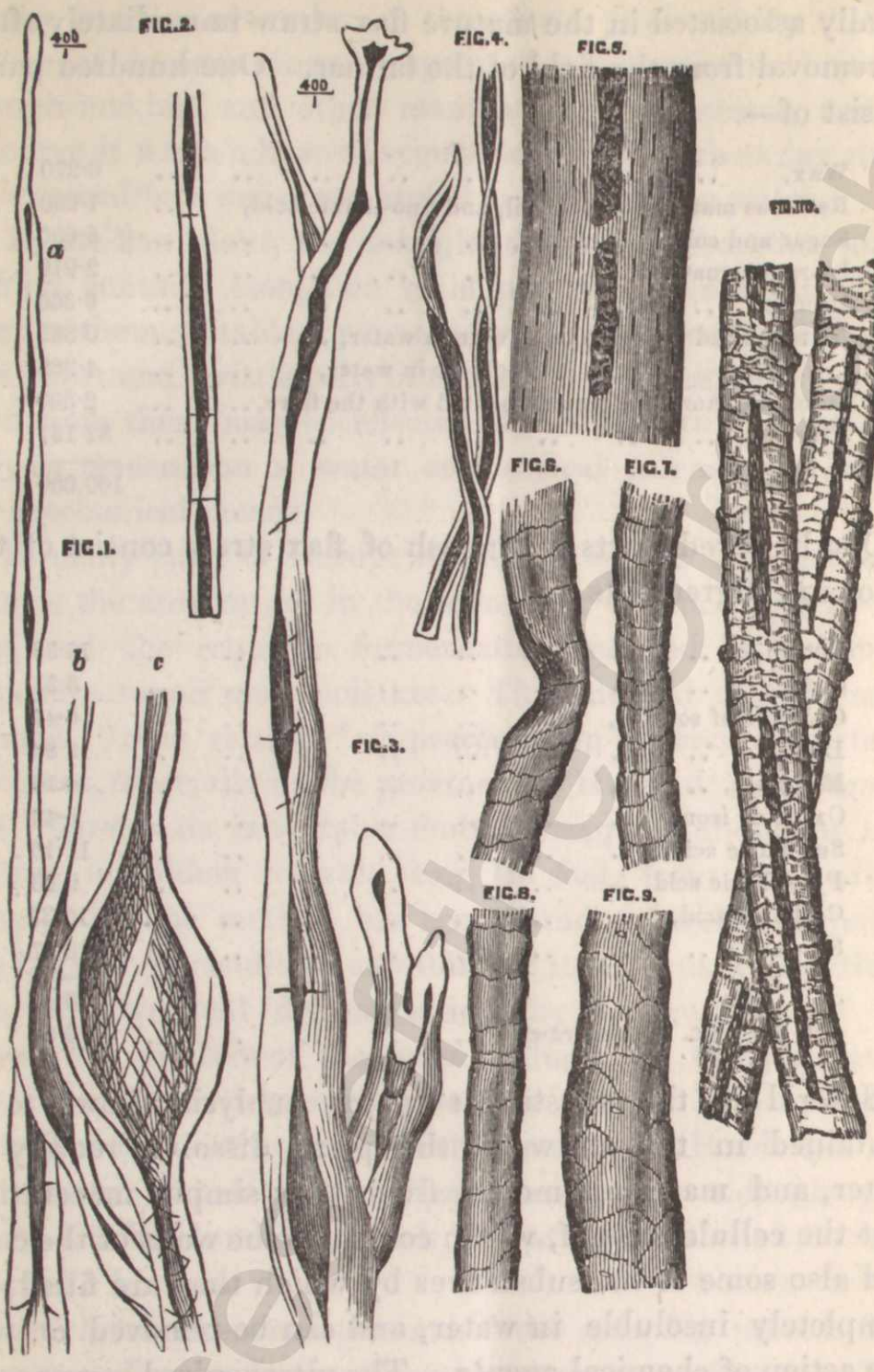
a Epidermis. *b* Liber fibres. *c* Woody tissue. *d* Pith cells.

It is these delicate, but at the same time tenacious fibres, which give the flax plant its chief commercial value; and the separation of them in the most perfect form, and with the least expenditure of time and labour, has for several years occupied the attention of men of science and of manufactures in all parts of Europe.

If we take a horizontal slice of flax straw (*see fig.* 3), and examine it by the assistance of the microscope, we obtain some additional information respecting its structure. It shows us that the external layer or zone, the "skin" of the plant, is composed of an extremely delicate membrane, formed by the union of minute cells or vesicles closely pressed together, while the middle layer or ring consists of a number of tubes with very minute cavities, their walls or sides being apparently formed of numerous layers of lining

material, by which the cavity has been almost obliterated. These tubes or elongated cells have been termed *bast cells*, and constitute in flax, hemp, and other plants, the material employed for textile purposes. Proceeding inwards from the circle of bast cells, we find the third layer composed of short cells, hardened by deposits which render them brittle and inelastic.

The chemist, whose science enables him to resolve the various structures of plants into their elements, discovers that all the parts of which the flax straw is made up consist chiefly of a substance possessing, in every case and in every plant, from the apparently green slime-like covering of the stagnant pool to the stately tree with its complicated arrangement of wood, and bark, and leaves, the same elementary composition, being formed by the union of the elementary body, carbon, and the elements of water, oxygen, and hydrogen. Such is the composition of the simple rudimentary substance which forms, as it were, the skeleton of flax, and of every other plant. But associated with this universal building material of the vegetable world, to which the name of *cellulose* has been given, are discovered, lining and strengthening these cells, and contained either in a solid form within their cavities or dissolved in water, other substances, as starch, gum, sugar, a peculiar gum-like substance named dextrine, oils, colouring matters, and resins. The greater number of these substances are analogous to cellulose in composition, and consist merely of carbon and the elements of water; but accompanying them we find other substances, which contain, in addition to carbon, oxygen, and hydrogen, the element nitrogen, of which the gluten, or sticky matter of wheat affords an example, and respecting which chemistry has made known to us the singular fact that they closely resemble in their composition the casein or cheesy matter of milk, the albumen of the white of egg, and the substance which forms the chief constituent of animal flesh. We also find invariably united with these compounds certain saline and earthy matters, derived from the soil, and indispensable to vegetable development.



Fibres of Flax, Hemp, Jute, Cotton, and Wool magnified.

Fig. 1, Flax; Fig. 2, Jute; Fig. 3, Hemp; Fig. 4, Cotton; Fig. 5, Coarse long Wool; Figs. 6, 7, Fine Saxony Wool; Figs. 8, 9, Fine English Wool.

From the results of numerous examinations of flax straw which have been made in the laboratory of the Chemico-Agricultural Society, both of Irish and foreign flax, the following statement may be regarded as correctly representing the proportion in which these constituents of plants are

usually associated in the mature flax straw immediately after its removal from the field of the farmer. One hundred parts consist of—

Wax, ...	0·270
Resinous matters, volatile oil, and lino-tannic acid, ..	1·090
Sugar and colouring matter, ...	5·630
Inorganic matters, ...	2·910
Pectine, ...	0·360
Nitrogenized compounds, soluble in water, ...	0·835
,, ,, insoluble in water, ...	4·268
Insoluble inorganic matters united with the fibre, ...	2·500
Fibre, ...	82·137
	100.000

One hundred parts of the ash of flax straw consist of the following ingredients:—

Potash, ...	13·88
Soda, ...	5·33
Chloride of sodium, ...	6·47
Lime, ...	18·86
Magnesia, ...	4·10
Oxide of iron, ...	5·40
Sulphuric acid, ...	11·16
Phosphoric acid, ...	9·63
Carbonic acid, ...	10·37
Silica, ...	10·37
	100·43
Ash per cent. in the straw, ...	3·89

Several of the substances which analysis shows to be contained in the straw of the plant dissolve readily in water, and may be removed from it by simple maceration. But the cellulose itself, which composes the walls of the cells, and also some of the substances by which they are filled, are completely insoluble in water, and can be removed only by the action of chemical agents. The nitrogenized compounds, however, both in plants and animals, are remarkable for the facility with which they undergo transformations when the conservative influence of life is removed, and also by communicating to substances which contain no nitrogen, as sugar and starch, the tendency to undergo decomposition, or, in other words, to dispose the elements of which these substances consist, to arrange themselves in new forms. We have

many familiar examples of the effects produced by the presence of decomposing nitrogenized substances in brewing, starch-making, and other manufacturing processes, and we observe it when a heap of vegetable matter, such as flax straw, is exposed to a moist atmosphere, or steeped in water.

In the flax plant, the hemp, and other herbaceous plants which contain elongated cells possessing qualities which render them suitable for textile purposes, intermingled with the short and brittle cells of the cellular tissue, their separation from them may be effected by fermentation in the open air, by maceration of water or chemical solvents, or simply by mechanical means.

In many parts of Europe the flax is spread over the fields late in the autumn, or in the months of January and February, and the requisite fermentation induced by prolonged exposure to air and moisture. This method of treatment, termed "dew retting," is practiced in several districts in Belgium, especially in the provinces of Hainault and Namur; but where water is suitable for steeping, and abundant, dew retting is seldom resorted to. In fact, from the earliest times, only one method has been found properly to separate the fibre in a condition suitable for its various applications, viz., the gradual decomposition by fermentation of the cementing matters of the straw, induced by the maceration of the flax either in stagnant pools or rivers. It is a remarkable circumstance to find both the natives of Hindostan and the ancient inhabitants of Egypt, employing methods precisely similar to those which are at present used in this country.

In Belgium the management of the steeping process may be regarded as having attained the greatest perfection. The system which is pursued in that country is that which we would gladly find introduced into Ireland. Here the grower of the flax also steeps it, and submits it to the treatment required to prepare it for the spinner. In Belgium the work of the farmer is usually completed when he has brought the plant to maturity, and its technical preparation is taken up by factors, who devote themselves to the separation and pre-

paration of the fibre. The beneficial result of this division of labour is exhibited in the high value of the Courtrai flax, which occasionally sells at £250 per ton ; while in Ireland the average value of flax last year was only 6s. 6d. per stone. The Courtrai flax-factors usually convey the straw to the river Lys, the waters of which have acquired so high a reputation for steeping, that last year flax was sent to it from many parts of France to be steeped. We have analyzed the water of this river, and find that it is in no respect superior to that of many Irish streams, but it is deep and its current is gentle, and its flax-steepers have an amount of skilled knowledge which gives them great advantages. Though we have not yet been able in Ireland to grow any flax equal in value to that of Courtrai, our experience has convinced us that, if properly managed, there are very few districts in which our farmers may not succeed in producing that medium quality of fibre which is most in demand.

In Ireland the flax, on its removal from the field, is placed in a shallow pond excavated in the neighbourhood of a stream, from which it can be filled with water. A careful farmer, long before the season for pulling the crop, makes preparation for the steeping. Some make ready the ponds during the preceding winter. Good water, with full exposure of the pond to the warming influence of the sun, and free from the shadows of trees, are regarded as essential requisites. What is termed by the flax-steeper "good water," is pure, soft water, free from mineral impurities. The presence of iron, from its forming coloured compounds with the peculiar tannic acid of the straw, is decidedly injurious ; and calcareous waters act slowly and imperfectly on the constituents of the straw, and also form compounds which resist the solvent action of fermentation. The size of the pool is regulated by the quantity of flax to be steeped, and some of our most experienced farmers advise that no pool should be larger than can be filled with flax in one day. From eight to ten feet wide, and four deep, is a frequent size of the ponds in some districts. The flax is deposited in the ponds in layers so arranged that the tie by which each bundle is secured rests upon the root

ends of the preceding bundle, and a covering of straw or sods, with some stones placed on the top of the flax to prevent its rising out of the water. In a day or two, according to the temperature of the season, fermentation commences, and is accompanied with a brisk disengagement of bubbles of gas. The water acquires the colour of ale, and a scum collects on its surface, to remove which it is considered advisable to allow a gentle current of water to flow over the surface of the pond from the supplying stream.

In the steeping season the districts surrounding some of our small country villages are exceedingly disagreeable to strangers, who find the atmosphere in all directions impregnated with the odours from the numerous steeping pools. The particular odour of the flax pool we have found to depend upon the evolution of compounds of butyric acid and valerianic acid, produced by the decomposition of the constituents of the flax plant, during which also carbonic acid and other gases are given off in large quantities. In Belgium the vitiation of the atmosphere by the steeping of flax along the river Lys is regarded by many persons as productive of fever and other diseases, and petitions have been presented to the Chamber of Representatives to obtain an abolition of the practice. We have made numerous inquiries in this country, both from farmers and medical practitioners in the chief seats of the flax industry, and cannot discover that fever or other diseases can be traced to the effluvia from the steeping holes in Ulster.

The method by which the Irish farmer ascertains that the fermentation has sufficiently advanced to allow the flax to be removed from the water, is to draw a few stalks from one of the bundles. These he breaks across in two places, about two inches apart. If he can readily pull away the central woody portion without tearing the filament of the layer which surrounds it, he considers that the flax has been sufficiently "watered."

The next stage in the management of the flax is the "grassing" of the steeped straw, by which the separation of the loosened fibres is greatly facilitated. For this purpose a

newly mown meadow or a short pasture ground is selected, and the straw is spread thinly over it, and allowed to remain exposed to the air. In showery weather six days will usually be sufficient exposure; and if at the end of that time the stalks are perceived to present the appearance of a bow and string, produced by the fibre contracting and separating from the inelastic woody portion, the flax may be "lifted" and put up in small stacks, so built as to allow the air freely to circulate through them. Thus steeped and grassed, the straw is ready for the application of the mechanical operations by which the worthless, brittle, woody matters may be removed, and its textile filaments dressed and rendered suitable for their important uses.

The ordinary method of steeping in ponds or rivers, though apparently simple, requires very careful attention, and is attended with great risk. Like the fermentation of the brewer, the peculiar series of decompositions which facilitate the breaking up of the various organic structures which compose the stem of the flax plant, are liable to be affected by changes of temperature and other disturbing causes; it is not, therefore, surprising that in the open air, in a variable climate, it should progress irregularly, and that, notwithstanding the anxious attention of the farmer, one part of the straw should be oversteeped, while another part has not experienced the alterations required to facilitate the perfect separation of the fibre. Even in districts where the management is conducted by trained workmen the imperfections and uncertainty of the old system are found so much to interfere with the profits of the flax-grower, that numerous attempts have been made on the continent and in Ireland to substitute for it a less hazardous method. In some places "dry scutching," that is, the separation of the fibre from the unsteeped straw by mechanical means, has been attempted, but has failed to produce fibre of good quality or requisite firmness. In France, chemical solvents, dilute acids, alkalies, and solutions of soap, have also been tried; but though it is possible by the action of these solvents to break up the structures of the plant and to obtain fibre apparently of good quality, yet experience proved that it

was inferior in tenacity and other essential properties to that procured by the ordinary methods.

The first attempt in advance of the traditional methods which offered any prospect of a more favourable result, was made by an American named Schenck, who, in 1847, arrived in Belfast with specimens of fibre prepared by exposing the straw to the action of water heated by steam, and maintained at the temperature of 90 degrees for sixty hours. The introduction of Mr. Schenck's method seemed likely to produce a complete revolution in the system of flax management, and it was expected that the preparation of fibre for the spinner would be made entirely a factory operation, and thus be rendered independent of the ignorance and unskilfulness of the farmers in those districts which it was most desirable that the cultivation of the plant should be extended, but in which the want of skilled labour opposed very great obstacles to its introduction. In Ireland, however, the establishments erected under Mr. Schenck's patent did not give satisfaction; spinners complained that the fibre was injured, and the expense of conducting them was so great, that it was found necessary to return to the old method of steeping. There is at present only one factory in Ireland in which the hot water system is followed; but in England and in Belgium, where it is known as the "rouissage manufactureur," it has given greater satisfaction. At Calne, in Wiltshire, certain modifications of the original method are employed, and from the reports of our spinners, we find that the fibre obtained there is regarded as of excellent quality.

We have had many opportunities of observing the application of Schenck's process, both under the direction of Mr. Schenck and his intelligent successor, Mr. Bernard, and we have always regarded it as calculated, if judiciously applied, to prove of great value in the production of flax fibre. It is, in fact, merely the ordinary method of fermentation *accelerated and placed under control*, and, if managed by persons acquainted with the business, capable of preparing flax in the most satisfactory manner. In many of the works conducted on Schenck's method, the temperature of the water was raised

too high, and the soluble constituents of the plant hardened and made obstinately to adhere to the fibre. Uniform temperature, not exceeding 70 degrees, which can be obtained at but trifling expense, and the application to the steeped straw of the pressure of a pair of smooth cylinders of cast iron, while at the same time a stream of water is made to flow upon the rollers as proposed, first, be believe, by Mr. Pownall of London, so as to wash away the softened organic impurities, will enable the steeper to accelerate the process of steeping, and yield the fibre in the best condition.

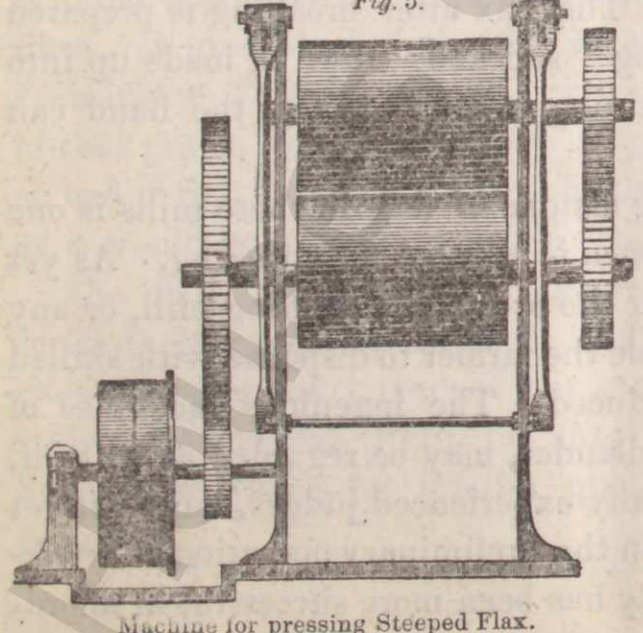
In Belgium much interest has lately been excited by the application of a new process proposed by M. Julien Léfébure, who obtained a gold medal at the London Exhibition of 1862, for flax and hemp prepared by his system. Through the kindness of His Excellency Lord Wodehouse, Lord Lieutenant of Ireland, who has procured a report from Belgium for the Chemico-Agricultural Society of Ulster on this method, we are enabled to give some account of its chief features.

Léfébure's method is described as being based "upon a combination of chemical and mechanical elements." An alkaline solution is used as the solvent, and three successive operations are required. In an establishment in which 1000 kilogrammes of undressed flax are daily treated, producing 175 kilogrammes of prepared flax ready for spinning, the first operation is *crushing* the flax (*broyer*) so as to remove the woody matters: 1000 kilogrammes of green flax when crushed give 320 kilogrammes of filaments. The second operation is *washing* in water and alkali; the expense of the quantity of water required for the above quantity of flax is 16 francs. The third operation is *drying*. A "séchoir" machine for drying 320 kilogrammes of crushed and washed flax should measure 20 metres cube, and the flax is hung upon sticks placed one above the other at the distance of 45 centimetres. The dried flax gives a return of 175 kilogrammes. The cost of preparation is stated to be from 26 to 27 centimes per kilogramme. The report unfortunately does not give us any description of M. Léfébure's machine for removing the woody matters, and though M. Rey, a leading Belgium "filateur,"

and the great linen manufacturer, M. Taek of Courtrai, report favourably of the merits of the system, yet we require more information to lead us to place much confidence in any method which attempts to separate the fibre from the straw previous to its being submitted to some process of softening.

The next operation which the steeped and dried flax undergoes, when treated either by the ordinary method or by the hot water process, is "breaking" or rolling. This is performed either by machinery or manual labour. In Belgium a simple mallet-shaped implement is much used for this purpose; but in this country a machine called a *break* is preferred; this consists of two heavy pieces of wood, each of which is furnished on one side with a number of parallel angular bars, so arranged that when the pieces of wood, which are connected by a hinge, are brought together, the angular surface of the bars on one piece are screwed into the hollows formed by the bars on the other. One of the pieces are permanently fixed on a stand, while motion is communicated to the other by means of either an iron spring or an elastic pole of wood attached to it, and connected with a treddle on which the workman presses with his foot. By placing a handful of the dried straw between the angular bars, and causing the movable piece to descend, it presses the straw between the bars, and breaks the inelastic structures of the central part, while the guiding fibre remains uninjured.

Fig. 5.



Machine for pressing Steeped Flax.

In large establishments, however, the flax is rolled by being submitted to the action of a series of fluted rollers of metal.

The woody matters having been broken by the break, it is necessary that the fibre should be deprived of its worthless appendages. This is effected

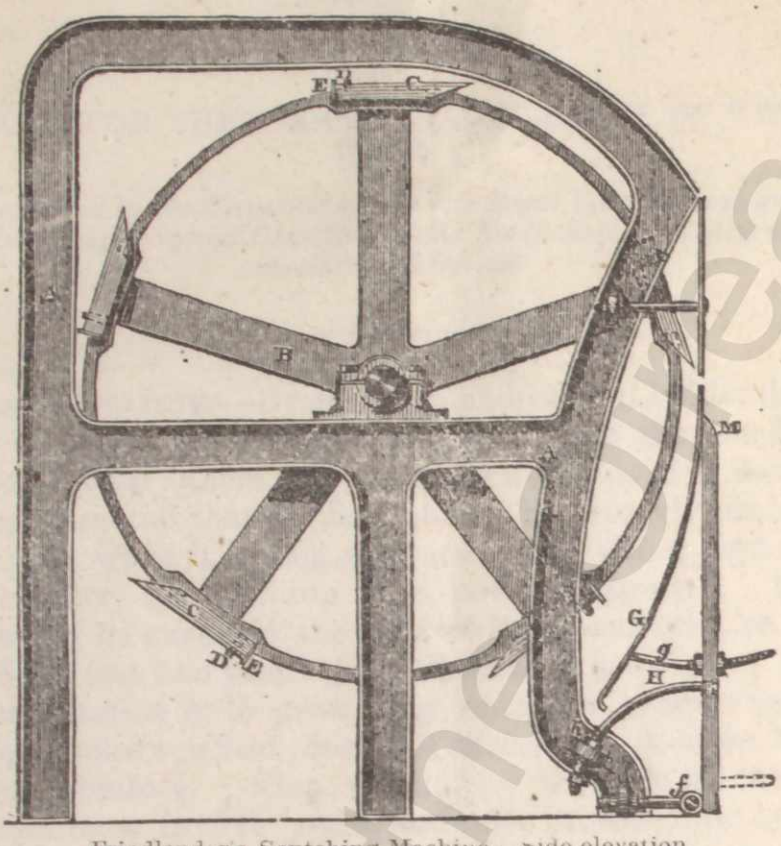
in some districts by a simple manual implement, which is merely a thin blade of wood attached to a handle. The workman by whom the "scutching," as this operation is termed, is performed, takes in his left hand a handful of the straw and passes a portion of it through a slit in the side of an upright stand of wood called "a stock," and submits it to repeated blows, and presents every part of it to the blade, so that all the woody matters are beaten out and the flax rendered *clean*. The woody matters constitute what is known as "*shove*," while any short or injured fibres which are removed in the operation are sold as "scutching tow."—(*See Fig.* 1.)

Numerous mechanical inventions for facilitating the labour of removing the woody matters from the textile fibre have been introduced by our engineers; but as yet only one form of scutching machinery has succeeded in acquiring the confidence of both farmers and spinners, viz., the scutching mill which is at present found in every flax-growing district in Ulster. The scutching arrangements in these mills consist of a number of wooden beaters screwed to wheels which, at distances of about three feet, are fixed on a horizontal iron shaft, usually driven by water power. Each set of blades is inclosed in front by partitions of wood, and is made in descending to revolve near an opening on one side of the partition, through which the workman can insert the flax without risk of being injured. The flax after breaking is prepared for the scutcher by being "stricked," that is, made up into even parcels, each containing as much flax as the hand can grasp.

The cost of scutching a stone of flax in these mills is one shilling, of which twopence is charged for stricking. As yet no efficient substitute for the ordinary scutching mill, or any machine which can enable the farmer to dispense with skilled labour, has been introduced. The ingenious machines of Rowan, Potts, and Friedlander, may be regarded as on trial, and in the opinion of many experienced judges, have not yet satisfied expectation. In the preliminary operation of breaking, mechanical ingenuity has been more successful in afford-

ing the farmer reliable assistance; and the breaking machines of M'Adam, of Messrs. Sanford & Mallory, and of Friedlander, have given satisfactory results both in this

Fig. 6.



Friedlander's Scutching Machine—side elevation.

country and on the continent, and are at present extensively employed. No matter, however, what machinery is used if the crop has not been properly cultivated and carefully watered (steeped), it will be impossible to make it yield good fibre. A great deal of the flax brought to market last year, even in the North of Ireland, was almost worthless. Some of that grown in the south, Mr. Maguire, M.P., tells us, was so bad "that it would be as difficult to make fibre out of it as it would be to make it out of copper wire."

The flax straw—rippled, steeped, and scutched as described—is ready for market; and the textile fibre is purchased by the flax buyers of our northern spinners at prices which, in 1864-65, were, for superior qualities, from 8s. to 8s. 6d. per stone; for inferior qualities, from 6s. to 6s. 6d. per stone.

APPENDIX.

DIRECTIONS FOR THE PROPER MANAGEMENT OF THE FLAX CROP,

Originally compiled by the Committee of the late Royal Flax Improvement Society, Revised by a Special Committee of the North-East Agricultural Association of Ireland.

Soil and Rotation.—By attention and careful cultivation, good flax may be grown on various soils; but some are much better adapted for it than others. The best is a sound, dry, deep loam. It is almost essential that the land should be properly drained and subsoiled; as, when it is long saturated with either underground or surface water, a good crop need not be expected. The subsoiling should be executed the year of the green crop, so as to be completed at least two years before the flax is grown.

The best rotation is to grow after wheat, on average soils; but in poor soils, where wheat does not succeed, it is often better to grow after potatoes. Flax should on no account be grown oftener than once in five years, and once in seven, or even ten, is considered safer.

Any departure from this system of rotation is likely to cause loss and disappointment.

Preparation of the Soil.—One of the points of the greatest importance in the culture of flax is by thorough-draining, and by careful and repeated cleansing of the land from weeds, to place it in the finest, deepest, and cleanest state. This will make room for the roots to penetrate, which they will often do to a depth equal to one-half the length of the stem above ground.

After wheat, one ploughing may be sufficient on light, friable loam, but two ploughings are better; and on stiff soil three are advisable—one immediately after harvest, across the ridges, and two in spring, so as to be ready for sowing in the first or second week of April. Much will, of course, depend upon the nature of the soil, and the knowledge and experience of the farmer. The land should be so well drained and subsoiled that it can be sown in flats, which will give more even and much better crops. But, until the system of thorough-draining be general, it will be advisable to plough early in autumn to the depth of six or eight inches; throw the land into ridges, that it may receive the frost and air; and make surface drains to carry off the rains of winter. Plough again in spring, three or four inches deep, so as to preserve the

winter surface for the roots of the flax. The spring ploughing should be given some time before sowing, to allow any seeds of the weeds in the land to vegetate, and the harrowing in of the flaxseed will likely kill them, and save a great deal of after weeding. Following the last harrowing, it is necessary to roll, to give an even surface and consolidate the land, breaking up this again with a short-toothed or seed-harrow before sowing, which should be up and down, not across the ridges, or anglewise. These operations can be varied by any skilful farmer, to suit peculiar soils or extraordinary seasons. The object is to have clean, fine soil, as like as possible to what a garden soil should be.

The rotation we recommend is :—

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.*

SOWING.—The seed best adapted for the generality of soils is Riga, although Dutch has been used in many districts of country for a series of years with perfect success, and generally produces a finer fibre, but not so heavy a crop as Riga. In buying seed, select it plump, shining, and heavy, and of the best brands, from a respectable merchant. Sift it clear of all the seeds of weeds, which will save a great deal of after trouble, when the crop is growing. This may be done by farmers, and through a wire sieve, twelve bars to the inch. These sieves can be had in Belfast. Home-saved seed has produced excellent crops, yet it will be best, in most cases, to use the seed which is saved at home for feeding, or to sell it for the oil mills. The proportion of seed may be stated at one Riga barrel, or three and-a-half imperial bushels to the Irish or plantation acre; and so on in proportion to the Scotch or Cunningham, and the English or Statute acre, viz., about 2½ bushels for the Scotch acre, and about 2 for the Statute acre. It is better to sow rather too thick than too thin; as with thick sowing the stem grows tall and straight, with only one or two seed capsules at the top; and the fibre is found greatly superior, in firmness and length, to that produced from thin-sown flax, which grows coarse and branches out, producing much seed, but a very inferior quality of fibre. The ground being pulverised and well cleaned, roll, harrow, and sow. If it has been laid off without ridges, it should be marked off in divisions, eight or ten feet broad, in order to give an equal supply of seed. After sowing, which should be done by a very skilful person, as the seed is exceedingly slippery, and apt to glide unevenly from the hand, cover with a seed harrow, going twice over it—once up and down, and once across or anglewise, as

this makes it more equally spread, and avoids the small trills made by the teeth of the harrow. Finish with the roller, which will leave the seed covered about an inch—the proper depth. The ridges should be very little raised in the centre, when the ground is ready for the seed, otherwise the crop will not ripen evenly; and when the land is properly drained there should be no ridges. Rolling the ground after sowing is very advisable, care being taken not to roll when the ground is so wet that the earth adheres to the roller.

Weeding.—If care has been paid to cleaning the seed and the soil, few weeds will appear; but if there be any, they must be carefully pulled, or cut with a knife when the weeds happen to be large, or when potato stalks appear. It is done in Belgium by women and children, who, with coarse cloths round their knees, creep along on all fours. This injures the young plant less than walking over it (which, if done, should be by persons whose shoes are not filled with nails). They should work, also, facing the wind, so that the plants laid flat by the pressure may be blown up again, or thus be assisted to regain their upright position. The tender plant, pressed one way, soon recovers; but, if twisted or flattened by careless weeders, it seldom rises again. The weeding should be done before the flax exceeds six inches in height.

Pulling.—The time when flax should be pulled is a point of much nicety to determine. The fibre is in the best state before the seed is quite ripe. If pulled too soon, although the fibre is fine, the great waste in scutching and hackling renders it unprofitable; and if pulled too late, the additional weight does not compensate for the coarseness of the fibre. It may be stated, that the best time for pulling is when the seeds are beginning to change from a green to a pale brown colour, and the stalk to become yellow for two-thirds of its heighth from the ground. When any of the crop is lying and suffering from wet, it should be pulled as soon as possible and kept by itself. So long as the ground is undrained, and perfectly levelled before sowing, the flax will be found of different lengths. In such cases, pull each length separately, and, if possible, keep it separate in the pool. Where there is much second growth, the flax should be caught by the puller just underneath the bolls, which will leave the short stalk behind. If the latter be few, it is best to pull them all, as the loss from mixture and discolouration by weeds would counterbalance the profit. If the ground has been thorough-drained, and laid out evenly, the flax will likely be all of the same length. It is most essential to take time and care to keep the flax even, like a brush, at the root ends. This increases the value to the spinner, and, of course, to the grower, who will be amply paid by an additional price for his extra trouble. Let the handfulls of pulled flax be laid across each other diagonally, to be ready for the

Rippling, which should be carried on at the same time, and in the same field with the pulling. If the only advantage to be derived

from rippling was the comparative ease with which rippled flax is handled, the practice ought to be adopted; but, besides this, the seed is a very valuable part of the crop, either for the oil mill or feeding purposes at home. The apparatus is very simple. The ripple consists of a row of iron teeth screwed into a block of wood. This can be procured in Belfast, or may be made by any handy blacksmith.* It is to be taken to the field, where the flax is being pulled, and screwed down to the centre of a nine-feet plank, resting on two stools. The ripplers may either stand or sit astride at opposite ends. They should be at such a distance from the comb as to permit of their striking it properly and alternately. A winnowing sheet must be placed under them, to receive the bolls as they are rippled off; and then the ripplers are ready to receive the flax just pulled, the handfuls being placed diagonally, and bound up in a sheaf. The sheaf is laid down at the right hand of the rippler and untied. He takes a handful with one hand, about six inches from the root, and a little nearer the top with the other. He spreads the top of the handful like a fan, draws the one half of it through the comb, and the other half past the side; and, by a half-turn of the wrist, the same operation is repeated with the rest of the bunch. Some, however, prefer rippling without turning the hand, giving the flax one or two pulls through, according to the quantity of bolls. The flax can often be rippled without being passed more than once through the comb. He then lays the handfuls down at his left side, *each handful* crossing the other, when the sheaf should be carefully tied up and removed. The object of crossing the handfuls so carefully, after rippling, when tying up the beets for the steep, is that they will part freely from each other when they are taken to spread out on the grass, and not interlock and be put out of their even order, as would otherwise be the case. If the weather be fine, the bolls should be kept in the field, spread on winnow-cloths, or other contrivance for drying; and if turned from time to time, they will soon dry. Passing the bolls first through a coarse riddle, and afterwards through fanners, to remove straws and leaves, will facilitate the drying. If the weather be moist, they should be taken in-doors, and spread out thinly and evenly on a barn floor, or on a loft, leaving windows and doors open to allow a thorough current of air, and turned twice a-day. When nearly dry, they may be taken to a corn kiln (taking care not to raise it above summer heat), and carefully turned until no moisture remains. By the above plan of *slow* drying, the seed has time to imbibe all the juices that remain in the husk, and to become perfectly ripe. If it be taken at once from the field, and dried *hurriedly* on the kiln, these juices will be burned up, and the seed will become shrivelled and parched, little nutritious matter remain-

* The best ripples are made of half-inch square rods of iron, placed with the angles of iron next the ripplers, 3-16th of an inch asunder at the bottom, half an inch at the top, and 18 inches long, to allow a sufficient spring, and save much breaking of flax. The points should begin to taper 3 inches from the top.

ing. In fine seasons, the bolls should always be dried in the open air, the seed threshed out, and the heaviest and plumpest used for sowing or crushing. The light seed and chaff form most wholesome and nutritious feeding for cattle. Flax ought not to be allowed to stand in the field, if possible, even the second day; it should be rippled as soon as pulled, and carried to the water as soon as possible, that it may not harden.

WATERING.—This process requires the greatest care and attention. River water is the best. If the spring water must be used, let the pond be filled some weeks before the flax is put in, that the sun and air may soften the water. That containing iron or other mineral substances should never be used. If the river can be had, it need not be let into the pond sooner than the day before the flax is to be steeped. The best size of a steep pool is 12 to 18 feet broad, and $3\frac{1}{4}$ to 4 feet deep. Place the flax loosely in the pool, in one layer, somewhat sloped, and in regular rows, with the root end underneath; the tie of each row of sheaves to reach the root of the previous one; cover with moss sods, or tough old lea sods, cut thin, laid perfectly close, the sheer of each fitted to the other. Before putting on the sods, a layer of rushes or ragweeds is recommended to be placed on the flax, especially in new ponds. As sods are not always at hand, a light covering of straw may do, with stones laid on it, so as to keep the flax just under the water; and as the fermentation proceeds, additional weight should be laid on—to be removed as soon as the fermentation ceases, so as not to sink the flax too much in the pool. Thus covered, it never sinks to the bottom, nor is affected by air or light. A small stream of water allowed to run through a pool has been found to improve its colour. It will be sufficiently steeped, in an average time, from eight to fourteen days, according to the heat of the weather and the nature of the water. Every grower should learn to know when the flax has had enough of the water, as a few hours too much may injure it. It is, however, much more frequently *under*-watered than *over*-watered. The best test is the following:—Try some stalks, of average *thickness*, by breaking the *shove*, or wood part, in two places, about six or eight inches apart, at the middle of the stalk; catch the broken bit of wood, and if it *will pull freely out, downwards, for that length, without breaking or tearing the fibre, and with none of the fibre adhering to it*, it is ready to take out. Make this trial every six hours after fermentation subsides, for sometimes the change is rapid. Never lift the flax roughly from the pool, with forks or grapes, but have it carefully handed out of the flax drain by men standing in the water. It is advantageous to let the flax drain twelve or twenty-four hours after being taken from the pool, by placing the bundles on their root ends, close together, or on the flat, with the slope; but the heaps should not be too large, otherwise the flax will be injured by heating.

The water can be either used as liquid manure for meadows, or kept in the pool till the first flood—it should not be run off into

the river when the water is very low, as the odour is very unpleasant, and the water thus impregnated is poisonous to fish, and contrary to law—see Fisheries Act, 5 and 6 Vict., c. 106.

Spreading.—Select, when possible, clean, short, thick pasture ground for this operation; and mow down and remove any weeds that rise above the surface of the sward. Lay the flax evenly on the grass, and spread thin and very equally. If the directions under the head of rippling have been attended to, the handfuls will come readily asunder without entangling. Some people recommend turning it on the grass with a long rod, which is not, however, generally done in Ireland.

Lifting.—Six or eight days, if the weather be showery, or ten or twelve if it be dry, should be sufficient on the grass. Ten days may be taken as a fair average in ordinary weather. A good test of its being ready to lift is to rub a few stalks from the top to the bottom; and when the wood breaks easily, and separates from the fibre, leaving it sound, it has enough of the grass. Also when a large portion of the stalks are perceived to form a *bow and string*, from the fibre contracting and separating from the wood stalk. But the most certain way is to prove a small quantity with a hand-break, or in a flax mill. In lifting, keep the lengths straight and the ends even, otherwise great loss will occur in the rolling and scutching. If heavy dews or damp weather prevail, don't lift after 3 o'clock, p.m. Let it be set up to dry for a few hours, and afterwards tie it up in small bundles; and if not taken soon to be scutched, it will be much improved by being put up in small stacks, loosely built, with stones or brambles in the bottom to keep it dry, and allow a free circulation of air. Stacks built on pillars would be the best.

Drying by fire *is always most prenicious.* If properly steeped and grassed no such drying is necessary; but to make it ready for breaking and scutching, exposure to the sun is sufficient. In some districts it is put to dry *on kilns* in a damp state, and it is absolutely burned before it is dry, and the rich oily appearance of the flax is always greatly impaired.

Breaking and Scutching.—If done by hand, try the Belgian system, which is considered superior to that practised in Ireland. If by milling, the farmer will do well to select those mills in which good machinery has been introduced; and it is to be hoped that, ere long, by further improvements, increased economy in these establishments will be attained.

The Courtrai System.—This mode of preparation requires to be very carefully executed, as inattention will reduce the value of the straw and yield inferior fibre. When made up for drying in large sheaves, the straw is much injured, the outside stalks being much discoloured by the heat of the sun before the inside of the sheaf is dry. The flax stems should be put together in bunches, about one-half larger than a man can grasp in one hand, spread a little, and laid on the ground

in rows after each puller; the bunches laid with tops and roots alternately, which prevents the seed-bolls from sticking to each other in lifting. It should be stooked as soon after pulling as possible, and never allowed to remain overnight unstooked, except in settled weather. The stooking should go on at the same time as the pulling, as, if flax is allowed to get rain while on the ground, its colour is injured. A well-trained stooker will put up the produce of a statue acre or more in good order in a day, with two boys or girls to hand him the bunches. The flax should be handed with the tops to the stooker. The handfuls, as pulled, are set up, resting against each other—the root ends spread well out, and the tops joining like the letter A. The stooks are made eight or ten feet long, and a short strap keeps the ends firm. The stooks should be very narrow on the top, and thinly put up, so that they may get the full benefit of the weather. In six or eight days at most, after being pulled, the flax should be ready for tying up in sheaves of the size of corn sheaves. It is then ricked and allowed to stand in the field until the seed is dry enough for stacking. To build the rick, lay two poles parallel on the ground, about a foot asunder, with a strong upright pole at each end. The flax is then built the length of a sheaf in thickness or breadth. The bottom poles should be laid north and south, so that the sun shall get at both sides of the rick during the day. In building, the sheaves should be laid tops and roots alternately, built seven to eight feet high, and on the top a single row of sheaves lengthwise, or across the others, and then another row as before, but with the tops all the same way, which gives a slope to throw off rain; finish by putting on the top a little straw tied with a rope. In this way, if properly built, it will stand secure for months, or it can be put in a barn, if preferred; in either case, the seed is to be taken off during the winter, and the flax steeped in the following May.