LETTER

OF

THE COMMISSIONER OF AGRICULTURE,

TRANSMITTING

The report of the commission appointed under an act of Congress approved February 25, 1863, "for investigations to test the practicability of cultivating and preparing flax or hemp as a substitute for cotton."

DEPARTMENT OF AGRICULTURE,
Washington, D. C., February 28, 1865.

DEAR SIR: I beg through you to present to the Senate the report of the commission appointed by me under an act of Congress approved February 25, 1863, for "investigations to test the practicability of cultivating and preparing flax or hemp as a substitute for cotton, twenty thousand dollars."

I regard the report as one of great interest, and suggest to you that twenty thousand copies be ordered to be printed for this department.

Very respectfully,

ISAAC NEWTON, *Commissioner.*

Hon. H. B. ANTHONY.

9-1/69

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REPORT OF THE FLAX AND HEMP COMMISSION.

INTRODUCTION.

To the Commissioner of Agriculture:

We, the undersigned, who were appointed to act as commissioners to investigate and report upon the subject of textile products, as provided under the act of Congress making an appropriation for this purpose, beg leave to tender our report, after having made earnest and extensive investigations into the subject. In so doing we have to regret that, at the present stage of our examination of the subjects committed to our charge, we cannot render so full and complete a report as would be desirable, and that we must leave unsettled some very important questions which recent inventions and discoveries have developed in relation to the adaptation of the fibres of flax and hemp for spinning on cotton machinery.

When we entered upon the labors of our commission we found that the provisions of the law were not very explicit as to the mode of conducting our investigations, and we were left free to put our own construction upon the intent of Congress. This induced us to take the most comprehensive view of the subject, and we have endeavored to embrace in our report the results of our investigations into the whole subject of textile plants, so far as they have come under our observation, and presented claims of utility. We have called for contributions to the *Department of Agriculture of specimens of fibres and of the products prepared from them by the several parties who were engaged in the preparation of these materials. These have been critically examined, and when the results were promising, we have further investigated the processes and apparatus; and, finally, we have experimented upon such materials as appeared to be in the most advanced stage of development, and have tested their adaptation to the machinery of the country. In this way we have endeavored to avail ourselves of the knowledge of those who have devoted years to the investigation, and we have avoided the risk of incurring very heavy expense in repeating the experiments which have already been tried by others, and which have in many cases proved abortive, or at least fruitless of valuable results. We have also availed ourselves of the services of one of the best microscopists of the country, who from years of practice has become an expert in the investigation of fibrous materials, and whose rich and extensive cabinet of these substances has been opened for our examination. To Dr. George C. Shaffer we are indebted for the very interesting exhibition of the cellular constitution of many of the products that have been presented before us. Such a course has been pursued by the commission in the full belief that in this way only they could render to the country the best and most useful account of their stewardship, and furnish a mass of information that would be valuable to the people.

We suppose that in the brief language of the act, "*flax and hemp*" were used as representative terms, these plants being universally known and widely cultivated in our latitudes. But there are many plants, several of them natives of our own country, others that have been successfully introduced, and others that may be introduced with advantage, which present fibres of the greatest value, and which, therefore, should claim the attention of this commission.

A notion appears to have prevailed somewhat extensively that the appropriation of Congress was intended expressly and solely for the encouragement of the preparation of what is familiarly called *flax-cotton*, which necessitates such

* These specimens are preserved in the Agricultural Museum.

a shortening of the beautiful long filaments of the flax-plant as should adapt them for spinning upon the machinery which a century of improvements has so admirably fitted to the handling of the short staple of cotton. This interpretation appears to gain some encouragement from the words of the act "as a substitute for cotton," and also from the fact that many of the extensive manufactories of our country were standing idle, in consequence of the scarcity of the product of the cotton fields, caused by the desolation of the rebellion in the southern States. The radical differences that exist in these substances, as displayed by the microscope, make it appear almost impossible to substitute one for the other without also introducing some modifications of the machinery to be employed.

The commission has found it difficult to ascertain the value and amount of fibrous products that have been produced in the United States. The cotton crop has long been one of so much importance to the commerce of the world that its values have been regularly reported, and this has been set forth by the Superintendent of the Census Bureau as having been the subject of a wonderful increase in the last decade, amounting, indeed, to 110 per cent. The annual exportation at the beginning of this century was less than 5,000 bales. In 1849 the quantity grown had reached 2,445,703 bales of ginned cotton, of 400 pounds each. In 1859 it had further increased to 5,196,944 bales.

From the same source* it appears that the product of hemp fibre for 1850 was 3,943 tons, and that of the dressed fibre of flax was 3,783,079 pounds, equal to 1,891½ tons, making a total of these two products of 5,834½ tons, against about 489,120 tons of cotton fibre reported as the product of the same year, so that the relative amounts of these two classes of fibres are widely different. It is true that many reasons exist to explain the comparatively small amount of flax and hemp fibres that have been produced, some of which will presently be considered; nor is it easy to compute the extended ability of our country to furnish these products, which we firmly believe may be grown in various parts of the United States to any desired extent; and we find that the stimulus of advanced prices, and still more, the improvements in various agricultural machines, but especially in apparatus adapted to the preparation of the fibres of these plants for market, will have the desired effect, and that they have already had the effect of increasing the area of land devoted to flax and hemp. Hitherto the leading difficulties have arisen from the supposed necessity of employing hand labor in almost every stage of their production, from the sowing of the seed to the baling of the finished product when ready for the market. These obstacles have in a great measure been overcome by modern ingenuity, and we find that the seed may be sown with a drill machine, and more evenly distributed than when cast upon the soil by the most practiced hand, and in this condition the young crop can be hoed by horse-power with suitable cultivators, instead of the tiresome and expensive hand-weeding universally practiced in Europe, but which could never be accomplished by the farmers of our country. When we come to the harvesting of the flax, instead of the weary, tedious, and expensive labor of pulling the stalks from the soil, as formerly practiced, we have harvesting machines that cut the crop rapidly and as closely as may be desired, though not retaining the straw in as perfectly straight a condition, it is true, as the regular streiks or handfuls of the European flax gatherer, and yet sufficiently well to answer the ends of the manufacturer, who can afford to lose a percentage in the increase of tow or codilla, caused by the tangled condition of the straw. When dry, the flaxseed may be removed by a very simple apparatus of rollers that separate it without disturbing the straw, or by a slight modification of the common threshing machine, and the bundles are kept straight. When the tangling of the stalks is not objected to, as is the case with the tow machines next to be noticed, the threshing machine

*Preliminary Report of the Eighth Census, p. 84.

or tramping by horses may be resorted to. These tow machines are recommended as among the most important appliances in this branch of agricultural improvement. Tangled flax and hemp fibres have been found available in a great many kinds of manufacture where formerly the straight or long line, as it is technically called, was used. With the various improvements in modern machinery an unlimited amount of flax straw may be cheaply adapted to the use of the manufacturers of coarse linens, and may also be prepared for combination with wool in a large class of fabrics into the preparation of which it had already been introduced, in some cases mingling the fibres upon the cards preparatory to spinning, and in others, as the linseys and carpets, combining the threads of wool with those of flax when they are woven in the loom.

These flax machines, as they are called, are found in various parts of the country wherever the raw material is produced in abundance, and they have resulted in rendering valuable and useful an immense amount of fibre that was before wasted, and thus they have stimulated the growth of a crop formerly sown only for the seed.

In pursuing our investigations, and in making up this report, we have thought that a subdivision of the subject would be advisable, and, therefore, have considered the several topics in the following order:

1. The agricultural aspect, including the production of the crops, and the most appropriate treatment of the soil and of the plants to be produced.

2. The mechanical treatment of the product, which is to include the first processes of the preparation of the raw material, and which has been performed by the farmer, but which we think could more appropriately be assigned to such operators as will come near to the seat of production, with machinery adapted to the purpose of separating the fibres of these plants from the accompanying matters with which they are naturally combined.

3. The chemical processes which are needed, in many cases, to perfect the preparation of the fibres. Some of these processes, such as those of bleaching, are often deferred until after the manufacture of the tissues.

4. The manufacturing stage, which is the most important part of the investigation, since here the thorough utilization of the products is perfected, and because this will be the only safe test of the value of some of the substances brought before us.

5. Peculiarities of fibres, and their classification, in which their adaptability to certain distinct purposes in the arts will be made apparent, and their unfitness for other purposes will be shown, with illustrations of the cells of which these fibrous substances are composed.

6. Next will follow the consideration of several other textile plants, and the native modes of their preparation in separating the fibres.

7. Lastly will follow a list of the exhibitors and of the various articles they have presented for the examination of the commission.

In conclusion, we respectfully submit this report upon these interesting investigations. We have continued the research to a point where the most flattering results appear ready to open, and regret that the limit set upon the commission renders it necessary that the pursuit should be relinquished when the desired end is almost in view.

J. K. MOORHEAD.
JNO. A. WARDER.
CHAS. JACKSON.

WASHINGTON, *February* 27, 1865.

Having examined and approved the above report, I respectfully submit the same to Congress.

ISAAC NEWTON,
Commissioner of Agriculture.

WASHINGTON, D. C., *February* 27, 1865.

AGRICULTURAL.

In taking up the consideration of this portion of our subject, it is proposed to treat of the culture and production of flax and hemp as farm products, with the necessary details of the preparation of the soil, culture, and management of the crops, as well as of harvesting and disposing of them, until turned over to the manufacturer. We conceive it to be very important, in this as in many other branches of agronomic production, that there should be a well-defined limit between what are properly the duties of the farmer and those more appropriate to the manufacturer or the manipulator of his crops; this will establish a subdivision of labor that cannot fail to exert a happy influence upon the productions of agriculture, instead of hampering it by increasing its labors, which are already, in many instances, too onerous. In the case under consideration, it would, we think, be best for the farmer's labors to terminate after the harvesting of the crop, with the separation of the seed and the delivery of the crude straw to the manufacturer.

In some instances, where the producer occupies an isolated position, it may be found best to use a simple farm-brake so as to enable him to compress his produce into a smaller compass, and thus reduce the expense of transportation; by this course, too, he would be able to retain a large portion of the waste products at home upon his farm to be returned to the soil; but even then we should recommend a division of labor, and think the brakes had better belong to practiced workmen, who should attend to this branch of business in the preparation of the fibre for a neighborhood, going from farm to farm, as is often done for the grain crops by the owners of the modern threshing machines.

We shall offer some general considerations upon the subject of the culture of this class of crops which will be of interest, and, we hope, of value to the agriculturist. These will involve the question as to the exhausting properties of these fibre plants, their analysis, and the analysis of the soils best adapted to their production. We shall also examine the facts with regard to the place these crops should occupy in a judicious rotation.

In regard to the derivation of the word which is in common use to express the products of flax, it is somewhat singular that *linen* should appear to have a doubtful origin. We generally and most naturally attribute it to the root of the Latin word *linum*, meaning flax, and this is derived from the Greek *linon*, having the same meaning, as appears from its use by Homer in his Odyssey, referring to linen cloth made from flaxen fibres. But, in the ancient Greek language we also find that the word *xylinos* means, made of cotton; this word, however, had another signification—made of wood, which was its more natural meaning, seeing that its root-word *xylon* was their word for wood. May not this show that those who invented or used this original term realized a similarity in these fibres, such as we now perceive? But the great naturalist, Pliny, uses the word *xylinum*, in his extensive work on natural history, to *express* cotton, and this is the more remarkable when we consider that the old Irish word for flax and flaxen is so nearly the same, with only the introduction of the peculiar aspirate of that language, and that their word for flax was *lhin*.

HISTORY OF FLAX.

The flax plant, called by the botanists *Linum usitatissimum*, or the most useful, has been in cultivation since the earliest historic period, and, therefore, it becomes difficult to decide upon its first origin in a state of nature, but it is generally claimed as European. Be this as it may, the Egyptians are known to have cultivated this plant, to have manufactured it, and to have used it to envelop their mummies, and this is demonstrated to us in modern times, after the lapse of centuries, both by their hieroglyphics and by the revelations of the microscope. Upon the pyramids are delineated processes representing the agriculturist preparing the crop, and with the aid of the microscope we discover the very nature of the substance of the tissues used in embalming their dead. We learn from Scripture, also, that flax was an important crop in Egypt, and that the Almighty sent a plague of hail by which the "flax and the barley was smitten; for the barley was in the ear, and the flax was bolled." Isaiah speaks of those "that work in fine flax, and they that weave net-works," in Tyre and Sidon, when referring to the destruction of those ancient cities in the Levant.

Having thus referred to its antiquity, which has concealed its origin in a state of nature, we may allude to the fact that botanists describe many other species of flax in different parts of the world. The native country of the flax of cultivation appears to be an unsettled question among botanists, and this plant is found growing wild in most countries where the physical conditions are suited to its cultivation. The general opinion, however, ascribes it to the East. Be that as it may, the disposition which it possesses of suiting itself to a vast range of soils and climates is of infinite importance to man, as it enables him to avail himself of the advantages resulting from its cultivation to a far greater extent than he otherwise would be able to do.

The numbers of the natural family of plants to which our subject belongs are generally remarkable for the tenacity of their fibres, the elegance of their forms, the beauty of their flowers, which are tinted blue, red, or white, and for the emollient and demulcent properties of their oleaginous seeds. All of this family are harmless plants.

Although the culture of flax has long been quite extensively practiced in many parts of our western and northwestern States, the seed has heretofore been the only marketable product, while the straw has been almost wholly neglected and destroyed. Many thousands of acres are annually devoted to flax culture, producing from eight to ten bushels of seed per acre, and which should have furnished also about one ton of straw to the same surface. The extensive area devoted to this crop, and the large amount of seed produced, is not a tythe of the productive ability or capacity of our fertile country; but the same obstacles appear to limit us here, as have so prejudicially retarded the extension of flax cultivation in Great Britain. There is, besides the difficulty of obtaining hand labor and the high price of wages in this country, "the general opinion that flax is an exhausting crop." This question will be separately discussed upon another page.

The old methods of reducing the harsh stalks into the shining flax, which were slow, expensive, and laborious, after having been practiced from the remotest antiquity, have at length been supplanted by others which are rapid, simple, elegant, economical, and cheap, so that, by the exercise of a small portion of that enterprise which characterizes our countrymen in an eminent degree, every region in which the cultivation of the large staple *flaxseed* exists may be also the recipient of bounties flowing from the sale of a *staple* of still greater importance, the flax lint, a product which has been an incumbrance to the farmers of our day.

In former times flax was grown for the sake of its fibre chiefly. Every homestead had its little field of flax, often a mere patch, which was pulled by hand, and by the same hands rotted, dried, broken, heckled, and scutched. Other hands in the same household next took it to the spinning-wheel and to the loom, with which the shining fibres were deftly transformed into the woof and web which constituted their domestic treasures, and which enabled the industrious and frugal spinster to bring a valuable contribution to the establishment of a new household.

Why should not our American people grow flax and manufacture linen enough to supply themselves, and give steady and remunerative employment to thousands, and in this way keep at home many millions of dollars which annually go from the United States to Great Britain to pay for the products of this plant which is so well adapted to our own country? The entire history of the flax products of the past few years most convincingly shows that prosperity has been a constant attendant upon this crop. And we, in this country, need not go back to the barbarous and uncultivated condition that was so long suffered by Europeans—we can begin with the benefits of their improvements and our own. We know that in Belgium, the German states, Great Britain, and France, they struggled through centuries of bad management of the flax crop, but Americans have the advantage of all their experience to commence with, and those of us who would now enter upon this new field of enterprise may have a bright future promising success.

PROFITS.

The following cases are cited to show what may be done with this crop. It is reported in the American Agriculturist for February, 1864, that Aaron Kimball, near Worcester, Massachusetts, planted one hundred and thirty-six square rods, rather more than four-fifths of an acre, which yielded him for the 401

pounds of flax	$106 26
130 pounds tow	5 20
8 bushels seed	36 80
Total product	148 26
Deduct expenses	54 58
There is left clear profit	93 68
Or to an acre about	110 00

Mr. M. B. Brown, of Alleghany county, Pennsylvania, communicates the following results of a flax crop:

He ploughed four acres of creek bottom, a very rich black loam. He made the soil as fine as a garden, by using the roller and harrow. On the 18th of April he sowed broadcast at the rate of one bushel of seed per acre, and covered with a light harrow and followed with the roller. In four days the seed came up very evenly. Owing to a long-continued drought the straw was short—say about two feet high. On July 14 it was cut with the scythe, and cured like hay, in the swath. He carted it to the barn and threshed it August 1st to 10th, using a horse-power threshing machine and separator, receiving fifty bushels of seed, which sold for $2 25, or $112 50. The straw was spread on a meadow, and occasionally turned, for two months, when it was taken to Pittsburg and sold for $25 per ton, two tons making $50. Thus the crop from four acres yielded $162 50, or $40 62 per acre.

He considers it a pleasant crop to handle, giving about as much trouble as wheat. In a wet season he thinks it would produce much more flax, and that the quantity sown is about right for a crop of both seed and lint.

IS FLAX AN EXHAUSTIVE CROP?

It is often asserted the flax is an exhaustive crop. Let us look into this question and sound it by the light of scientific experiment and inquiry. Some investigations were made by Dr. Hodges for the purpose of ascertaining the relative proportions of the produce of flax, and of the distribution of inorganic matters in them. The flax had been steeped, and contained .173 of ashes. Of the dried straw 4,000 pounds were taken, which produced—

Of dressed fibre	500 lbs.
Of fine tow	132 lbs.
Of coarse tow	192 lbs.
Total of fibre	842 lbs.

These products contained—

In the dressed flax	4.48 lbs. of ashes.
In the fine tow	2.08 lbs. of ashes.
In the coarse tow	2.56 lbs. of ashes.

Making a total of.................................. 9.12 lbs. of inorganic matter; so that 59.08 pounds which the crop had withdrawn from the soil remained in the useless portions, while only 9.12 pounds were carried off in the dressed fibre. Comparing these results with those obtained from an analysis of an acre of wheat, we shall see that that crop, in grain and straw, abstracts about 365 pounds of inorganic matter from the soil.

Flax has been cultivated in Ireland from a very early period, and its introduction into that island has been attributed to the Phœnicians. Irish writers claim that their ancestors cultivated and manufactured this staple before the English became an agricultural people. That they very early were possessed of a knowledge of its treatment is evident, and it has ever since been so important a crop with them that Irish linen is proverbial. In their language, the name for thread is *lhin*, which was also applied to flax. The early Brehan laws required that the farmers should be acquainted with the mode of working flax.

It appears, however, that it was not until the Huguenots settled in Ireland that the manufacture of linens became well established. Among them was Lewis Crommelin, who settled near Lisburn, to whom Ireland is indebted for the permanent establishment of the linen manufacture. He had looms, implements and spinning-wheels imported from Holland, by means of which an improved style of goods was produced. Government aids were bestowed upon the manufacture, so that it was well fostered. The Royal Dublin Society, as early as 1739, exerted itself to supply the cultivators with practical instruction, by means of agents who had been trained under the skilful flax-growers of Belgium. The great impetus, however, was given by the establishment of manufactories to spin the thread by machinery; and at the same time there was an irregularity in the supply of raw material from the continent, which induced the manufacturers of Ulster, in 1811, to organize the society "for the improvement of the growth of flax." This society was fostered by government, and extended its operations over the island, and now has its headquarters at Belfast, and actively diffuses information among the farmers, and offered liberal premiums for improvements in machinery.

The committee of this society congratulate the members in the following terms in the report of 1850:

"The society has now been nearly nine years engaged in its arduous labors to accomplish the great national object for which it was formed. Although it has had many difficulties to surmount, and many prejudices to contend with, and although the complete attainment of its aim is apparently yet distant, a dispassionate review of what it has already accomplished must show that it has been productive of much good, and that its further progress will be more rapid than the past. During the period that has elapsed since its foundation in 1841 it has succeeded, notwithstanding the opposition that prejudice and long-rooted habits have presented, in generally improving the growth and preservation of the flax-plant in all the districts of Ulster to which its operations have been extended. It has introduced scutching machinery of a very superior description to that formerly in use, and has thus accomplished a great economy in labor and material. It has induced the saving of a large portion of seed, formerly lost in the steep pools, thereby enabling the grower to increase the profits of his crop by the sale of the seed, or its use in feeding his cattle. It has protected the farmer from the frauds under which he frequently suffered in the purchase of seed for sowing, and has succeeded in establishing his legal claims for redress, in cases where there has been a deception on the part of the seller.

"Since its attention has been directed to the districts of the other provinces, it has done much towards the great extension of flax cultivation at which it has aimed. Outside of the twenty-three counties of the provinces of Leinster, Munster, and Connaught, its operations have been extended to twenty-one. In some of these—Cork, Mayo, Limerick, Tipperary, Queen's, Wexford, and Lowth—it may now be said to have firmly taken root; and in the rest, it is in a greater or less state of progress, according to the circumstances of the districts or the period at which the society took them in charge. Where the flax has been extensively grown during the late years of distress, it has been of the utmost service to the poorer class of farmers by enabling them to reserve for the support of their families and live stock the food crops that would have otherwise gone to pay rent and taxes, but whose place for this purpose flax has supplied. The amount of employment thus given has been very great, more especially to the weaker classes of the population. And it has paved the way to an improved system of husbandry by the attention which it exacts in the preparation of the soil.

"When the society was instituted, flax was the only crop in which the Irish farmer had to maintain an open competition with the foreigner. While all kinds of grain, produce, and cattle were subject to high duties on importation, the duty on foreign flax had been reduced to a mere nominal amount. This premium upon other crops resulted in the neglect of flax, notwithstanding the peculiar suitability of our soil and climate for its growth. A change, however, has now occurred in this respect." * * * * *

England has become famous for her threads, and at the present time there are upwards of eighty spinning-mills in Ireland, in which fully half a million of spindles are daily employed, and the manufacture is now ahead of the agricultural production.

RUSSIA.

Mr. Ward tells us in his pamphlet that, of the 150,000 tons of flax annually consumed in the United Kingdom, 70,000 tons only are of home growth, while 80,000 tons are imported. Of this, Russia supplies 60,000 tons, which was formerly rendered at from $120 to $144 per ton.

The extensive cultivation of flax in that country is mainly owing to the alluvial soil upon which it is grown, and the low price of labor among the serfs. The vast plains of the interior are traversed by large rivers which annually overflow and leave a rich deposit upon the soil, which encourages the growth of the crops. The soil is well adapted to the flax culture, but a want of care accounts for the low grade of Russian flax. The quality of the fibre varies, however, and is partly distinguished by its color. The silver-colored is the best, and that from Wasnikow and Carelia is remarkable for a shining whiteness. It is mostly brought from beyond Moscow by water, in large, flat-bottomed boats or barges. Several thousand of these reach the lake Ladoga in the spring and summer. Greater care is taken in sorting the flax at Riga than at St. Petersburgh, hence the superiority and greater trade at this point.

The following table will show the sources from which the British demand is in a great measure supplied, giving Russia credit for a still larger share of the supply:

From Dickson's work it appears that the Belfast flax spinners report, that in 1832 the yarns exported from Ireland were valued at $25,000; but that—so great had been the increase of the production during the next twelve years—in 1843 the export amounted to $6,000,000.

The linen manufactures of Great Britain are estimated by the same author at more than twenty millions of dollars.

The average annual production of fibre, in the chief countries where flax is grown, is given by Dr. Ure as follows:

Russia	130,000 tons.
France	48,000 "
Belgium	18,000 "
Holland	9,000 "
Austria	60,000 "
Prussia	32,000 "
Ireland	35,000 "
Egypt	10,000 "
Total	342,000 "

Adding all other countries, the amount may be estimated at 400,000 tons. The value of this fibre may be $100,000,000, and of the seed produced, $25,000,000, making a total value of the raw material of flax amounting to one hundred and twenty-five millions, which has its value very much enhanced by the processes of manufacture into woven fabrics or into oil.

From Morton's Cyclopædia of Agriculture we learn that in six years the total importation of flax was:

In 1840	62,662 tons.
1841	67,368 "
1842	55,113 "
1843	71,857 "
1844	79,174 "
1845	70,921 "
Total	407,095 "

Thus the flax imports during those six years give an annual average of 67,849 tons, which, at a fair valuation, or £67 ($335) per ton, is equal to	$22, 729, 415
Add annual imports of flax-seeds for sowing and feeding, 616,000 quarters, (English,) valued at £4 per quarter, being twenty shillings per quarter below the price for many years in Ireland	12, 320, 000
Add annual imports of oil-cake, 86,000 tons, valued at £9 per ton	3, 870, 000
Total	38, 919, 415

The same authority informs us in respect to the individual and personal advantages which flax culture will confer on the farmer. The following instances are actual facts bearing on this subject. Flax has been grown to leave a profit of $100 per Irish acre, (eight of which are nearly thirteen imperial acres,) after paying expenses, which is verified by the following statement:

	Dr. Flax.
Rent of one acre of land	£1 6*s*. 9*d*.
2½ bushels seed	1 10 3
Ploughing and sowing	0 15 0
12 hands, weeding	0 12 0
12 hands, pulling	0 18 0
6 hands, watering and grassing	0 10 0
Lifting and carting home	0 8 0
Scutching 60 stone	3 0 0
Taxes and rates	1 0 0
Total	10 0 0

	Contra Cr.
By produce of one acre of second quality of flax, 60 stone, at 10 shillings	£30 0*s*. 0*d*.
Deduct rent and expenses	10 0 0
Net profit	20 0 0
Or	$100 00

Again: Mr. Warnes, of Trimmingham, of Norfolk, in one of his published letters on this subject, says: "A great proportion of my flax is produced at the rate of one ton from three acres of land, or at £85 per ton, at the rate of £28 per acre; or at £53 per ton, at £17 10*s*. per acre, exclusive of seed, which, in some instances, amounted to twenty-six and twenty-eight bushels per acre; but taking twenty as the average, at the present prices of English linseed, £7 per acre may be added to the above sum."

By this statement Mr. Warnes, it appears, can, by growing the coarse quality of flax at £53 per ton, have for the produce of one acre: Flax, £17; seed, £7; gross produce, £24.

And I may add a few certificates in further proof of my assertions as to the profits made by flax culture when a proper system has been followed:

MODEL FARM, *Caledon*, *November* 29, 1845.

SIR: In answer to yours of the 24th, I have much pleasure in favoring you with an account of the flax crop, and expenses thereon, grown on the Earl of Caledon's model farm in 1845:

CROP.

Produce of 1 acre, 1 rood, 39 perches, sold at 11*s*. 3*d*. per stone	£55 16*s*. 7*d*.
Tow, (or shorts of the flax)	0 8 8
130 bushels of bolls, which I consider worth 8*s*. per bushel	4 6 8
	60 14 3

EXPENSES OF CROP.

5 bushels of seed, at 15*s*. 3½*d*. per bushel	£3 16*s*. 6*d*.
Weeding	0 10 0
Pulling, rippling, and steeping	4 3 8
Taking out of steep and spreading	2 1 4
Lifting and tying	1 2 8
Scutching	4 9 4
	16 3 6

Leaving a balance of £44 10*s*. 9*d*, or, at the rate of £29 13*s*. 10*d*. per acre after deducting all expenses.

It is but fair to add that we had to carry the flax to and from the steep on barrows for eight perches, as the steep was in a bog.

JOHN BARR, *Manager*.

J. W. ADAMS, Esq.

ANALYSIS OF THE CROPS.

Professor Kane read a paper before the Irish Academy, in which he pointed out that many of our most valuable vegetable productions were composed chiefly of simple compounds of a few elements combined with very small portions of the mineral elements of the soil; among these are sugar, gum, starch, and ligneous fibre.

Though the valuable product be thus constituted, it is observed that the plants which are most productive of these substances must be in a vigorous, healthy state of growth, and that, in their development, various mineral elements of the soil must be consumed by them; therefore they are exhaustive crops. But as the valued product does not contain them, the waste portions may be returned to the soil to keep up its fertility.

Prof. Kane presented a series of analyses, which he had made to determine their constituents.

The stem of hemp, dried at 212° Fahrenheit, he found to contain—

Carbon	39.94
Hydrogen	6.06
Oxygen	48.72
Nitrogen	1.74
Ashes	4.54
	100.00

The leaves of hemp contained—

Carbon	40.50
Hydrogen	5.98
Nitrogen	1.82
Oxygen	29.70
Ashes	22.00
	100.00

The ashes of the hemp-plant consisted of—

Potash	7.48
Soda	.72
Lime	42.05
Magnesia	4.88
Alumina	.37
Silica	6.75
Phosphoric acid	3.22
Sulphuric acid	1.10
Chlorine	1.53
Carbonic acid	31.90
	100.00

Dressed hemp fibre gave but 1.4 per cent. of ashes, after having been dried at 212° Fahrenheit. Its organic composition is similar to that of woody fibre, and devoid of nitrogen. The characteristic constituents are lime and nitrogen. The substances dissolved by water in steeping hemp contain a narcotic principle used in medicine. Sir Robert Kane evaporated some of this liquor to dryness and analyzed the product, with the following results :

Hemp extract.

Carbon	28.28
Hydrogen	4.16
Nitrogen	3.28
Oxygen	15.08
Ashes	49.20
	100.00

Exclusive of the ashes, in the same proportion, we have—

Carbon	55.66
Hydrogen	8.21
Nitrogen	6.45
Oxygen	29.68
	100.00

Approaching azotized animal substances in its composition, and forming a very rich manurial application. The ashes of the hemp-leaves contain only 8.05 per cent. of soluble matter, while those from the hemp extract had 60.4 per cent. of soluble matter.

He next examined the stem after it had been steeped and peeled. After drying at the usual temperature, he found that this matter consisted of—

Carbon	56.80
Hydrogen	6.48
Nitrogen	.43
Oxygen	34.52
Ashes	1.77
	100.00

The ashes contain but a trace of alkali, and the nitrogen is in very small quantity. Hence it appears that, though hemp be an exhausting crop, the valuable fibre takes up but a small portion of the wealth of the soil, and that the valuable elements are left upon the farm.

Mr. Kane's examinations as to the composition of flax led to similar conclusions, as will appear from the following analysis :

The stems of flax dried, with some leaves, yielded—

Carbon	38.72
Hydrogen	7.33
Nitrogen	.56
Oxygen	48.39
Ashes	5.00
	100.00

The flax contains very little nitrogen. In hemp there is more oxygen than necessary to form water with the hydrogen; but in flax there is an excess of hydrogen. The composition of the ashes is also different, as will be seen by the table :

Potash	9.78
Soda	9.82
Lime	12.33
Magnesia	7.79
Alumina	6.08
Silica	21.35
Phosphoric acid	10.84
Sulphuric acid	2.65
Chlorine	2.41
Carbonic acid	16.95
	100.00

Lime is in smaller proportions; soda, potash, magnesia, and phosphoric acid are in larger proportion; hence the exhausting properties of the crop are explained.

The extract from the steep water, properly dried, yielded—

Carbon	30.60
Hydrogen	4.24
Nitrogen	2.24
Oxygen	20.80
Ashes	42.01
	100.00

The ashes of the plant yielded 33.90 per cent. of soluble matters; that from the extract gave sixty per cent. of soluble matter; hence the value as a manure of the steep water. The composition of the waste, or stem, from which the fibre had been removed, was very similar to the corresponding portion of the hemp.

We should also investigate the constitution of what are considered the waste products of the flax crop, and in so doing we are delighted to find that, according to the analysis of Mr. Way, the shives contain, of oil and fatty matters, 7.02 per cent.; of albuminous matter, 9.93 per cent.; of starch, gum, sugar, &c., 26.29 per cent.; so that this dry woody substance, as it appears when cursorily examined, is really a valuable substance for stock-feeding. How much more so when separated from the unrotted straw may be readily imagined.

Professor Hodges gives a somewhat different result as derived from his investigations, with other specimens. He found of nitrogenous matters 3.23 per cent.; of oil and fatty matters, 2.91 per cent.; of gum and soluble matters, 14.66 per cent.

An analysis of the residual oil-cake by the same authority gives, as the average of seven examinations—

Nitrogenous matters	28.47	per cent.
Fatty matters	12.90	"
Gum and soluble matters	39.01	"
	80.38	"

Showing the great value of this material for stock-feeding.

It must be remembered that the seed crop is brought to the market for two distinct purposes—for sowing as seed, and for the production of oil and the resulting oil-cake. Different regions of the globe are called upon to furnish supplies for these several objects. That which is sold for sowing is all produced in the northern countries, while that which is purchased exclusively for the manufacture of oil is brought from Russia, Hindostan, and the southern portions of Europe. In a large portion of the United States also this crop is grown almost exclusively for the production of oil.

Professor Hodges, of the Society of Belfast, gives the following comparative analysis of the New Zealand flax, *Phormium tenax*, and of common flax, grown in Ireland:

The ashes, respectively, contained—

	New Zealand.	Ireland.
Potash	14.93	20.32
Soda	5.38	2.07
Chloride of sodium	8.75	9.27
Lime	28.52	19.58
Magnesia	1.41	4.05
Oxide of iron	1.21	2.83
Sulphuric acid	4.64	7.13
Phosphoric acid	18.96	10.24
Carbonic acid	13.12	10.72
Silica	3.86	12.80
	100.78	99.01

[*From Morton's Cyclopædia.*]

ANALYSIS OF SOILS.

"The composition of the soil on which the cultivation of flax may best be carried on, being a problem of the highest practical interest to this country, the Flax Improvement Society of Ireland commissioned their agent to make analysis of some soils which had produced remarkably good flax. The soils were light clay loams, and afforded the following results, which are extracted from the report of the society:

	No. 1.	No. 2.	No. 3.
Silica and silicious sand	73.72	69.41	64.93
Oxide of iron	5.51	5.29	5.64
Alumina	6.65	5.70	8.97
Phosphate of iron	.06	.25	.31
Carbonate of lime	1.09	53	1.67
Magnesia and alkalies, with traces of sulphuric and muriatic acids	.32	.25	.45
Organic matters	4.86	6.67	9.41
Water	7.57	11.48	8.73
	99.78	99.58	100.11

The organic matter in these soils was rich in nitrogen; their fertility is, therefore, from the analysis, easily understood.

At a meeting of the society Sir Robert Kane said:

"Every farmer present is aware that crops exhaust the soil; that the plants take out of the ground a number of materials, and that it is necessary to restore similar materials to the soil in order to keep up its fertility; therefore, the manure which the farmer puts in with or before his seed is, in a degree, the raw material of which the grown crop is made. It is just as much a part of the plant as the seed itself. Then the farmer sells and sends away his grown crop to be used for food, as in the case of wheat, oats, and potatoes—he thereby sends away and sells the essence of the manure which he had put into the ground; and as he thus gets paid for the manure which he has exhausted, he must put in as much more for the next crop, which is to be dealt with in the same way. Now, in the case of flax, there is the important peculiarity that *it is not eaten*, and hence does not return to the land any manure in the ordinary way, whilst it takes out of the soil just the same materials as oats or potatoes, so that it is really a very exhausting crop, if we look only to the growing of it. But the flax crop differs from other crops in this, that the value of oats or potatoes, and all food crops, depends on what they take out of the ground, whilst the valuable part of the flax is the fine fibre, or thread, which has taken nothing out of the ground. If you burn a bundle of flax stalks it will leave behind a large quantity of white ashes, which consists of the different substances which the plant took out of the ground; but if you burn a bundle of well-dressed flax it will leave *no ashes.* They have evidently been carried off with the waste parts of the plant in the steeping and scutching. They are thrown away, and yet they are materials of which the plant had robbed the soil, and which should be given back to the land in order to keep up its fertility. To the practical farmer it is, therefore, of the greatest importance to recollect this principle, that the fibre, or valuable part of the flax, is not formed by the exhaustion of the soil, but the materials which the plant takes out of the land are all found in the steep-water and the chaff; and that if these be returned to the earth they will restore its fertility, and that thus the flax crop may be rendered one of the least injurious to the ground and most remunerative to the farmer."

The true analyses of the fibre, as given above, show that it does yield ashes, and that this does contain inorganic or mineral matter, though in very small amount, as will be shown. We must now present some testimony of an opposite character and equally imposing:

Professor Hodges states that the "result of an analysis of the fibre of the flax plant proves that that part of the plant is not destitute of matters derived from the soil," and that the scutching tow contained a still larger proportion of such elements. The professor admits that "flax is an exhausting crop; that is, like every other plant that is cultivated for food or clothing, or that springs up along the highway, it takes certain matters from the soil. When only a part of the plant, like wheat, is sent to market only a part of the matters of the soil is lost to the farm, and its exhaustion is delayed." But he claims that flax is not so exhaustive as some other crops, and gives the following table showing the amount of phosphoric acid and alkalies contained in a hundred parts of the ash of several plants:

	Phosphoric acid.	Potash & soda.
Flax	7	12
Wheat straw	3	13
Oat straw	3	29
Bean straw	7	55
Red clover	8	36
Cabbage	12	32
Potato stalks	7	44
Turnip tops	9	34

Mr. Ward says that flax cannot be an impoverishing crop to the farmer, as the seed and chaff make better manures, when the cattle are fed with it, than any other fodder. Liebig states that the seed and refuse of the plant are rich in phosphates.

It has been ascertained in Scotland and in England that the finest crops of wheat may be grown immediately after flax in a rotation, and this is confirmed by the statements of some of the most intelligent farmers of Ohio, many of whom speak very highly of the flax crop to take the place of a naked summer fallow as a preparation for wheat, and some very fine crops of wheat have been harvested after flax.

Hence it may safely be concluded that flax is not a remarkably exhausting crop, although it belongs to that class called man-crops, in England called white-crops, which do not usually make any important return to the land, and which may therefore, to the extent of the valuable elements they withdraw from the soil, be fairly considered exhausting. And yet flax is to be continued in a suitable rotation to take its place with other profitable crops.

It is fortunate for us that flax has a very wide range of soils in which it may be cultivated: Sands, loams, light and heavy clays, gravels, chalk, marls, alluvials, peat, and reclaimed marsh lands, are all seen, under ordinary circumstances, to produce a crop of this fibre. Sandy loams and alluvials appear, however, to be best adapted to its cultivation. In Ireland large crops are obtained on peat bogs, with a clay substratum. This plant needs an open soil through which the water may percolate freely, as its roots are of a fibrous nature and extend both laterally and vertically to a considerable distance. The conditions required for its successful cultivation are that the soil be deep, in good heart and in good tilth, well drained, and free from weeds; if these exist, we may, under ordinary circumstances, expect a good crop. Owing to the rapid growth of the plant, and the consequent shortness of time it occupies the land, it offers many opportunities to the grower, and admits of more changes in the rotation than most other farm crops.

In some of the best Belgian flax districts the soil is a sandy loam, containing as much as ninety per cent. of silicious matter, and depends for its superior excellence entirely upon the persevering industry of its skilful cultivators. A moderately tenacious subsoil, neither so loose as to allow the water to run away too rapidly, nor so compact as to cause it to stagnate about the roots of the plants, is considered by the continental farmers as the most desirable. The soil must be deep, and the Belgians have a popular saying that the flax has roots which go as deep into the soil as the stem grows above the ground.

In our own country we find a great variety of soils that appear well adapted to the production of this crop. River alluvials, level uplands, mucky flats, and the deep, black prairies of the west, particularly those that rest upon a strong clay subsoil, sufficiently deep below the surface, are all of them well adapted to the growth of flax.

Mr. Denman, a Belgian gentleman who was employed by the Royal Flax Society of Ireland as a teacher of the proper methods of managing the crop, recommends as of the greatest importance in the culture of flax that the land be well drained and repeatedly and carefully cleansed from weeds, and thus reduced to the finest, deepest, and cleanest tilth, in order to facilitate the penetration of the roots, which often go to a depth equal to the height of the plant above ground.

"A light ploughing immediately after harvest is required for all soils; but if they be heavy and stiff, they should be laid in ridges before winter, and thus to remain until a fortnight before sowing, when they should be deeply ploughed. Light soils may have their last ploughing before the setting in of winter. If the land be not sufficiently rich, liquid manure or rape-cake powder should be applied before sowing the seed, after which it should be harrowed and rolled, and should look like a garden."

As the expense of preparing grass land directly for flax may be too great, he advises that some other crop should intervene, of such plants as do not occupy the land long, and which require the frequent stirring of the earth, such as beans, peas, turnips, &c; we should say Indian corn. This cultivation will have the effect of rendering the sod sufficiently fine and loose, and will help to kill the weeds which would otherwise be a serious injury to the flax crop. It is asserted that the Livonians, when clearing a forest, burn the wood upon the surface as a preparation for flax, and that they prefer soil thus prepared to all others. Stiff soils should be exposed to the action of winter frosts, to loosen their textures, and when not too wet in February, some rotten manure may be ploughed in.

Denman recommends from two to two and a half bushels of seed to the acre, when sowed broadcast; but if the land is rich and the season favorable, there may be danger of sowing too much seed, as the flax will lodge, and the fibre will be materially damaged. When drilled, a smaller quantity will be sufficient; and if the intervals be wide, half the quantity will suffice. He recommends from the middle of March to the middle or end of April as the best time for sowing in that country. In the south of Europe it is sown in September and October, but these autumnal-sown crops are not so productive in fibre as the spring-sown fields, though their product of seed is better. It is laid down as a general rule that land intended for flax should be brought to an exceedingly fine tilth before the seed is put in, and that it should be enriched by suitable manure.

The roots of flax penetrate deeply; therefore the soils best adapted to the crop are such as consist of a deep loam, which is not liable to be surcharged with moisture on the one hand, nor to become too dry on the other, and which is susceptible of receiving a very fine tilth; river bottoms are generally of this character. If water exist permanently a short distance below the surface, it is by some considered an advantage to the crop, as is the case in Zealand, which country is remarkable for the fineness of its flax, and where the soil is deep and rather stiff, with water almost everywhere at one and one and a half or two feet below the surface. If well manured and well tilled, and if the seasons be not too dry, fine flax can also be produced on elevated lands. The soil should neither be too rich, so as to make the flax coarse from its luxuriance, nor too much exhausted, so that the yield would be small. Neither light sandy soils nor hungry gravels are recommended for this crop.

A great deal of our prairie lands in the western States contains a soil which is admirably adapted to the production of flax, and the experiments which have been stimulated within a few years by the high price of seed, and by the introduction of machinery for the preparation of the product, have most abundantly demonstrated the admirable character and adaptability to this object of immense tracts of land in the prairie States which now are lying in a state of nature, or merely used for grazing.

Flax culture requires very careful preparation of the land; deep tillage, and thorough pulverization of the earth is very essential to success. By these means flax may be grown to advantage on almost any soils, though some are much better adapted to it than others. The best is considered to be a sound clay loam, or a dry loam with a clay subsoil; but this must not be too compact, and is always better for being loosened, and by all means well drained, for if saturated with water above or below, it will injure the flax. Nor is it considered in Flanders good policy to grow successive crops of this plant; once in ten years is sufficient. In this country farmers pay little attention to the subject of rotation of crops, which is found to be a matter of great importance in the improved agriculture of Europe.

A favorite rotation in Flanders is: 1st, potatoes; 2d, barley, seeded with grasses; 3d, meadow, cut for soiling stock; 4th, pasture; 5th, flax, or one half in oats, so that on the return of the rotation the part that was in oats may be put into flax.

After wheat one ploughing is deemed sufficient in Ireland on light soils; but two are still better, and three are better still. In this country a fall ploughing is very desirable, and this should be stirred as early as practicable in the spring; the harrow should follow, reducing the soil to a very fine tilth; if the ground be very loose on one hand, or at all cloddy on the other, it will be well to roll before sowing. After applying the seed as evenly as possible, a brush harrow, or light harrow with short teeth, should be drawn across the surface, and in some cases the roller should be applied to render the field as smooth as possible and to compress the earth about the seed, so as to insure its early vegetation and to have it come up as evenly as possible.

The quantity of seed sown per acre is a question upon which there is great diversity of opinion among farmers as well as among writers upon this subject, the amounts varying from half a bushel to three bushels and a half. The smallest quantity is that commonly applied in this country, where the farmer grows this crop exclusively for the seed and takes no care for the fibre. The plants not being crowded, branch freely and produce a greater amount of flowers and seed to each individual than where crowded. This error, which is very injurious to the character of the fibre, should be combated by all who desire to see the highest results from the encouragement of this important crop in our country.

Mr. Todd, author of the prize essay offered by the American Agriculturist, insists upon a thorough preparation of the soil; but, having sown the seed, he will not allow a hoof to trespass upon the mellow earth, preferring to use a light brush harrow drawn by hand, which, he says, can be done almost as fast as the seed is sowed. His objection to the introduction of the team with either brush, harrow or roller upon the soft, mellow earth, is that the heavy tramping of the animals cannot fail to make depressions that would bury portions of the seed too deeply and cause it to vegetate unevenly. He thinks a light brush, which merely hides the seed, covers it sufficiently. The brush harrow is made by boring holes in a piece of scantling, into which bushy twigs two feet long are fastened. If more brush is needed, additional pieces are nailed on to the scantling; a light pair of shafts are secured to the brush-head, by which the machine may be dragged steadily by a man or boy.

Our western farmers, especially, who grow the crop almost exclusively for the seed alone, sow but half a bushel, or at most three pecks; but in the eastern States, on poorer soil, the farmers desiring to secure crops both of seed and of fibre, sow five pecks, and it is found that they obtain a larger amount of seed per acre than the average in the west. In Europe two bushels, and even more, is a very common allowance for seeding an acre, where it is desirable to produce a fine lint, and they also often harvest twenty bushels of seed. Some experiments in heavy seeding in the United States have not proved entirely satisfactory, for though the stalks were very fine and slender, and the lint produced was very fine, the straw was too short; this may have arisen from the poverty of the soil where the thick seeding was tried. In the thoroughly farmed and highly manured fields of the flax region of Belgium, we find the largest amounts of seed are sown with the best results; on such lands, deeply cultivated and highly enriched with liquid manures, three bushels of seed to the acre has yielded crops of flax that gave very fine lint, the straw being three feet high, and valued at one hundred dollars per acre in the field; for, in Belgium the farmer sells his crop to the manufacturer, and is relieved from further care after it is ready to harvest.

There are immense tracts of excellent flax lands in our country, and there is no doubt that, with proper care and sufficient seed, our rich alluvions will produce a superior quality of lint whenever the enterprise of the manufacturers shall elaborate and produce proper machinery for the preparation of the crop; a desideratum which this commission is happy to announce has already come near to its accomplishment, as will be shown under the head of machinery in the mechanical section of the report.

But to return to the seeding: we consider it very important that a sufficient amount of seed be applied to the soil; whatever that amount shall be, must be settled by the experience of the farmer in each section of the country. In sowing the flax it will be of the greatest importance to the crop to have it evenly spread upon the surface, and this, while a matter of great moment, is not easy to accomplish. The seed is very smooth and slippery, and great skill, derived from long practice, is necessary to distribute it evenly. It has been suggested that this work may be best done by the use of some of our broadcast sowing machines properly adapted to this seed. The drill machines may be used if properly adjusted for this crop, but the rows must be made very close to prevent the straw from branching. In broadcast sowing the plants should stand at about one inch apart over the field. Great care should be taken to have the seed perfectly clean, and the soil selected for flax should not be foul with seeds of weeds, which are very injurious to the flax crop; nor can we ever expect to hand-weed our fields in this country, as is constantly done in the flax culture in Europe.

In the flax regions of the Old World there is a great prejudice against using home-grown seed, and we have found in this country also an impression in favor of importing seed, under the idea that the plant has got used to yielding lint there, and has become habituated to yielding seed only in this country. This is a mere theory without any foundation whatever; and, on the contrary, the American and Riga seed are preferred in Europe for the opposite reason, as it is argued that, where the crop has been grown for the seed alone, these will have been better ripened and more robust than when the crop has been crowded and prematurely harvested for the sake of the fibre. Some very carefully-conducted experiments to ascertain the value of different kinds of seed are reported in the proceedings of the Flax Society of Ireland, from which it appears that the home-grown Irish seed yielded the best results, as will be seen from the tables given. The season having been very unfavorable, the amounts are not large, but answer for a comparison:

Kind of seed.	Clean flax.	Seed.	Flax per acre.	Seed per acre.
	Pounds.	*Quarts.*	*Pounds.*	*Bushels.*
American	42	46	336	11½
New Riga	54	40	432	10
Dutch	49	44	391	11
Irish	70	42	540	10½
Old Riga	45	40	360	10

In Europe, after the ground has been pulverized and well cleaned, it is rolled and sown; and if the land has not been ploughed in ridges, the surface is marked off in divisions eight or ten feet wide. After sowing, the seed-harrow is passed over the ground three times, forward, back, and across, or anglewise, so that the seed shall be equally spread, and the land furrows be filled up. The work is finished by the roller, which compresses the soil about the seeds, that are buried about an inch deep. It is desirable to have them vegetate as evenly as possible. Grass seeds are sometimes sown with the flax, but if they grow well it must be at the expense of the crop.

The writer of the prize essay, above alluded to, makes an admirable suggestion with regard to sowing flaxseed, which is a process that is universally represented as a very nice matter, to be well executed, on account of the smooth and slippery character of the seed. He advises and reports as his practice the partial soaking of the seed, and then rolling it, or rather mixing it, while wet, with ground plaster, that enables him to handle it readily, and to distribute it evenly upon the ground, where its early vegetation is accelerated by the addition of this material.

From the latest accounts of the statistics of Ohio, it is manifest that the flax crop has been much increased in area. Mr. Mansfield, the statistical reporter of that State, reports that the breadth of flax in 1862 was 52,546 acres, but in 1863 it had extended to 95,170 acres.

The following very practical remarks were communicated to the commission by W. S. Lowrey, of Saratoga Springs, New York, and are introduced on account of their worth and brevity:

In this section the past year flax produced but one half the crop of ordinary seasons of both seed and fibre.

Soil.—Heavy clay loam stands first best as regards both fibre and seed. Gravelly loam second best, or produced but half a crop. Light sandy loam and coarse gravel third best, or from one-fourth to one-sixteenth of a crop the past season.

Preparation of soil.—We plough well. Harrow three or four times previous to sowing, to form a good seed bed. Time of sowing from the 15th of May to 30th. Flax, to coat well, must grow in cool weather. Quantity of seed I sowed, one and a quarter bushel per acre; one and a half would have been better.

Time to pull.—This should be done when one-half to two-thirds of the bolls are brown Allow me to remark that work on the flax crop has just commenced at this period of its growth, and that if the flax is uneven, poorly coated, and in the wet spots badly lodged, it will be impossible by any method to produce good fibre. On the other hand, if the flax is in quality and yield of fibre prime at this stage, and care be not exercised in handling and rotting, the result will be the same. Many of the best crops in the country were spoiled the past season by carelessness in handling and overrotting. Acres were badly damaged, and hundreds of dollars lost by making too large bundles to cure well at the time of pulling. They should be just large enough to reach around with both hands, fingers and thumbs touching.

Method of pulling.—Clasp several straws in the right hand, pass them to the left, and pull with both hands. Repeat this until the hand is full, lay this down, repeat again, and then tie both handfuls in one bundle. At night we set up all that is pulled during the day in loose stooks. This method preserves uniformity in curing, and part of the flax is not sun-burned while the other is green and unfit for sheltering. As soon as it is dry draw it into the barn to whip.

Whipping.—Place a flat stone on the barn floor, with one edge inclined to an angle of forty-five degrees, set another under it to block it up, clasp the bundle with both hands near the roots, raise it, and, with a smart stroke bring it down across the stone. Repeat it several times, until the seeds are mostly broken from the straw. Clean the seed with a fanning mill.

Rotting.—The common method is to spread the flax in thin swaths on close fed meadows, exposed to the dew, until the shive parts readily from the fibre. It is then turned bottom side upwards by running a pole under the straw; after three or four days longer it is raked and bound to convey to the barn. A better method is to place the straw in large beds on the surface of a shallow pond of soft water, roots uppermost and tops down, place some slabs or boards on the roots loaded with stones to sink it, and in from twenty-four to forty-eight hours, and from that to two weeks, according to the temperature, it will become soft, and the shive will part readily from the fibre. We then take it out and dry it on the grass by spreading it in thin swaths, and when dry rake, bind, and set it in stooks to air. When it is well aired it is not splintery like the dew-rot, but wiry and tough like a withe. The best way to rot flax we think we have discovered. This method is the perfection of simplicity, enabling any man who has an unfailing supply of soft water, with less than five hundred dollars capital, to rot flax for five dollars per ton, in from twenty-four to forty-eight hours, and in less time with larger capital and conveniences; the fibre every way being equal to water-rotted flax by the common method.

Why water-rot is better than dew-rot. 1st. It saves from fifty to one hundred pounds dressed flax to the ton, of the same quality. 2d. It finds a ready sale at the highest market price, and buyers assure us that in large lots it will command a premium over the dew-rotted. 3d. It is more durable. For proof, lay flax rotted by the two methods side and side, exposed to the action of the weather. 4th. The first method rots; the second cures.

Why we rot flax. 1st. There is a market for rotted flax at fair prices. 2d. We have at present no better method of preparing flax fibre. 3d. We rot because manufacturers leave for the farmer to do what should be done at the mill—a serious difficulty in the way of its extensive cultivation, which we believe can be obviated by adopting our method.

Severe sickness in the family prevents my writing but a few facts. Those few, however can be proved.

Yours, for the success of flax culture,

WM. S. LOWREY.

Herman von Bielke, of Bon, Schleswig, who is said to be a practical flax-grower, makes the following statement:

"Although in general the saving of seed is rather injurious to the flax, yet it is very desirable, for many reasons, that every flax-grower should yearly appropriate a small part of his flax ground, and especially that where it grows the thinnest, for the saving of seed. In the first place, because the Russian seed does not generally produce such fine flax as that which has been saved on the spot; secondly, because the grower is certain that, by proper and careful treatment of the saved seed, he will have what he can depend upon. This is not always the case with Russian seed, which is frequently either too old or too much dried by storing, from which it always suffers, or it is mixed by the dealers with other seed. Thirdly, because the Russian seed is often at so high a price in the spring. The seed should be allowed to ripen well before harvesting, and may be treated according to the Courtrai method; that is, dried in bundles in the field and not rippled till the winter or spring following. The capsules should not be threshed clean at first, to separate only the best seed. Seed of two or three years old is better for producing fine lint. If new seed be sown, it should first be thinly spread upon an airy floor, and frequently turned. It is not necessary to renew the seed from abroad if proper care be taken to select it. A small part of the crop may be allowed to stand till fully ripe."

Some of our best agriculturists have arrived at similar conclusions with regard to the choice of seed, and consider it always safest to select a portion of their own crop from which to save their seed. This is allowed to ripen fully, and, when dry, it is subjected to just so much action in threshing as shall separate only the ripest and heaviest seed, which is kept by itself, after being thoroughly cleaned from admixture of the seeds of weeds and imperfectly developed grains. This seed should be very carefully preserved, so that it shall neither contract moisture, nor be subject to heating in bulk. It should be moved occasionally from one cask to another to prevent the latter result.

In purchasing seed, the heaviest, brightest, and plumpest should always be selected, and that which has not been mixed from different crops should be preferred.

Mr. Ward tells us that the successful cultivation of this crop does not so much depend upon the quality of the soil, the nature of the climate, or the amount of capital and labor applied to it, as upon the favorable influence which the first two may exercise when combined with the judicious application of the others. When all these elements of production are in harmonious co-operation the result may be easily predicted; but when one or other of them is deficient, or partially defective, it becomes no easy task to assign to each its power or agency. This complication of production is widely extended in Belgium, and largely predominates in the flax districts; for the general condition of the soil is by no means so favorable for agricultural processes as that of Ireland, nor is the climate comparable to that of the latter as regards the flax plant; but the amount of labor which the Belgians so energetically and so judiciously apply to their soil more than compensates for any elementary deficiency that may exist. The old maxim that success crowns labor, therefore, deservedly characterizes agricultural pursuits in Belgium, and its application is never more justly felt than when it gives point to a material fact such as the flax cultivation of that industrious country presents.

A great portion of the soil of Belgium is alluvial, partly formed by the recession of the sea, and partly by the elevation of the land, the country being chiefly made up of the deltas of the great rivers of Europe—the Rhine, the Scheldt, and the Meuse. The agriculture of Holland and Belgium is therefore arable; artificial means are requisite to bring the soil under cultivation. The soils are generally inferior, but this is overcome by the labor of the people, who often commence with an almost hopeless sand whose loose and undulating surface seems to defy all vegetation. The first crops are generally oats, rye, or broom; the former are used for forage, and the tops of the broom are similarly applied, though the plants remain for three years, when they are ploughed in to enrich the soil. When the farmer is able to keep a cow, by growing turnips or clover, the manure of every kind is saved with care, and the conversion of the arid sand into productive soil is quickly effected.

The great feature of Flemish husbandry is deep cultivation. This is performed either by the spade or plough, and often by both conjointly. The land is gradually trenched to the depth of twenty inches or more. It is laid out in stitches about six feet wide, with the plough; between these a ditch is dug with the spade, about a foot wide, and the soil thrown upon the stitch. The next year a foot in width is taken from one of the stitches and thrown into the adjoining trench, so that in the course of six seasons the whole soil will have been trenched over.

All plants do not equally require a depth of soil, but many that appear superficial in their wants will frequently extend their roots much further than is generally supposed. The root of the flax plant, for instance, is known, under favorable circumstances, to go as deep below the surface of the soil as the top ascends above it. The object of the Belgian farmer is to obtain a deep and friable soil, equally enriched throughout, which is only accomplished with great care and attention. The land has the appearance of the most perfect garden cultivation.

The mode of subsoiling in Belgium is worthy of notice. After the plough, laborers follow with the spade, dig out the bottom of the furrow, throwing the soil upon the ploughed land to expose it to the action of the atmosphere; the next furrow being thrown into this opening, the soil is inverted completely, and this is trenching rather than subsoiling, and is not applicable where the subsoil is so tenacious as to retain water. Great attention is also paid to drainage.

In the Courtrai, Plock, and Tournoi districts, where the best flax is grown, the land is prepared with the utmost care, and the health of the plants is secured by the most unremitting attention. In these districts flax is rarely sown upon the same land oftener than every eighth year, and it generally follows wheat or oats. The portion of land set off for flax the ensuing season is covered with farm-yard manure immediately after harvest. Twenty-five or thirty cart-loads per acre are frequently applied. This is spread and ploughed in four or five inches deep, and remains for three or four months, when it is harrowed and ploughed in again a little deeper; and it is also trenched with spades at the same time. In this state it remains during the winter, and in the spring it is harrowed, and the roots are removed. Liquid manure is then applied to the extent of 2,500 gallons per acre.

It is then harrowed, picked, and rolled, and afterwards harrowed with a light, wooden harrow to loosen the surface, when the seed is sown at once. The average quantity is 166 pounds to the acre, the harrow follows, and, after picking and rolling, the work is done.

In Courtrai the flax is dried in the field, and then stacked without rippling, and left for steeping until next spring. To insure the preservation of the seed, the straw is put into stooks without tying it into sheaves. These are placed on cradles to preserve them from the damp. The seed ends are put in alternate layers, and the stooks are from four to six sheaves in height, and from three to four wide, and the whole thatched with straw. When perfectly dry, these are brought together and put into stacks like ordinary grain, and is considered to be improved by three years' keeping, as it will then scutch more easily and profitably.

Belgian flax, treated upon this method, commands almost fabulous prices, amounting very commonly to a yield of from £40 to £60 per acre; and for the finest quality from £80 to £100 has been obtained. The export of this fibre to France and England is one of the chief sources of profit to Belgium, and this has amounted to nearly one million of pounds sterling per annum. In Leeds and Belfast the finest numbers of yarn, those of 160 leas, or 15 hanks to the pound, are almost exclusively spun from the Belgian flax. This is confirmed by the reports of juries at the international exhibitions, which will be presented upon another page.

Some of these fine qualities are worth £70 per ton, some as high as £150 per ton, and the finest £200 per ton. But these prices are excelled by the fibre from which the Brussels and Mechlin lace is made, which has been known to sell at £4 per pound weight, nearly £9,000 per ton. Yet even this is small compared to the value of the manufactured article, since a lace handkerchief, weighing about two ounces, has been known to sell for £100.

The climate of Belgium, we are told by Bravoine, is not altogether favorable to the growth of flax, because about the first of April they often have a drought, and if the land is at all cloddy the vegetation of the seed is irregular, and that which springs is exposed to the ravages of insects.

Weeding is considered an essential part of the treatment, and is done by hand, when the flax plants are about two inches high. In Belgium the weeding is done by women and children, who creep about over the field upon their hands and knees, and always work towards the wind, so that the young flax plants may be raised again by the current of air coming in an opposite direction to that in which they have been pressed down.

In this country we shall not soon resort to hand-weeding, on account of the expense involved, but we must be careful to avoid as much as possible the necessity by selecting clean ground, and, with our perfected machinery, we are already able to avoid sowing the seeds of many weeds that are frequently mingled with foreign flax, because we can separate them with our superior winnowing apparatus. When, however, weeds make their appearance, they are either neglected, or, in some cases, they may be cut off with the scythe just above the heads of the flax-plants, or, better still, the coarser weeds may be cut at the ground with a sharp knife and carried out of the field.

The following directions are taken from Morton's Encyclopædia:

"In order intelligibly to detail the right method of flax culture, I shall suppose myself about to cultivate a farm of one hundred acres of such soil as I have named—hardly suited to wheat culture. Then, as draining is indispensable for flax culture, I should drain the land and commence my rotation thus, giving flax the lead: 1851, flax; 1852, clover; 1853, grass; 1854, oats; 1855, turnips; 1856, barley; 1857, clover; 1858, grass; 1859, oats; 1860, turnips. Then supposing the field to have been in barley in 1850, it should have been ploughed in October of that year as deeply as possible in ridges about six feet broad. After being ploughed the furrows should be deepened with the spade twenty inches deep and eighteen inches wide, and all the stuff thrown upon these ridges to remain until spring under the frost and snow of winter. About the end of March I plough the field again deep and level; then harrow it, and mark it lightly in ridges, so as to direct me in top-dressing it with the liquid manure; and in a day or two after I apply the manure, I sow broadcast about two and three-fourths bushels of good new seed per acre, taking care not to have mixed seed, (the seed of 1849 and 1850,) for the reason that they do not vegetate together. The seed being sown, I then apply a light short-tooth harrow to cover it, and on giving it a finishing stroke I sow the clover and grass seed; and after one stroke of the harrow I use the roller in order to close the ground. Frequently clover and grass seeds are left until the first weeding of the flax is about to be performed; and being sown, the treading of the persons weeding, and the pulling up of the weeds, affords sufficient covering for the seed. The flax being a short time on the land, being pulled sometimes in July and at others early in August, when vegetation is still active, the pulling up of the flax stalks moulds the young plants of clover and grass, and they generally make rapid progress afterwards. I seldom, if ever, knew failures of clover to occur when sown with flax.

"It is most important that a sufficient quantity of seed be sown, as the fibre must be regarded the chief consideration, and its quality is essentially improved by thick sowing. This arises from the closeness of the plants forcing themselves upwards with a single stem to gain access to the air, and thus prevent their branching, which shortens and renders the fibre irregular. I could not have the quantity of seed by sowing two and three-fourths or three bushels to the acre that I should have if I only sowed two bushels; but, in the cultivation of this plant I would make everything subservient to the formation of a long and delicate fibre, as to it alone I must look for remuneration.

"The flax crop in Ireland is in general sown much too thin, and this is the chief cause of the inferiority of the produce. This appears strange and unaccountable when we consider that the seed is seldom saved. If flax be sowed thin, say two bushels or two and one-fourth to the acre, you are certain to see it branch off when about one foot or so high, and thus produce a great quantity of seed; but when we understand that this object is effected at the expense of the fibre, which is not only rendered coarse but very deficient in quantity, we should guard against such losing practices. The cause of deficiency in quantity must be attributed to not only a lesser number of stalks per acre, but it will be found also to arise from the *shortness* of the fibre, as there never will be flax produced on the branches, and as a consequence we can only have fibre from the branched or forked part to the root end; therefore the production of seed in quantity is incompatible with the large returns from the fibre; and as it will be the wish of every well-doing farmer to practice the culture of that which will be most remunerative, the fine, long, and delicate fibre of the flax plant being the most valuable, he should regard the production of the seed as a secondary consideration. I have often observed in a field where the crop had been thick and abundant that the plants had rarely more than two or three seed bolls on a short forked top: the stalks, like trees planted closely in a young forest, spring up quickly without branches, whilst those scattered thinly are covered with branches. The weeding I should direct being done as the Flemish farmers do; no better mode can be taken."—(See Flanders, Agriculture of.)—*Morton's Cyclopedia.*

HARVESTING.

This is recommended by all European writers to be done by pulling—a slow, tedious, and expensive process which will never be performed by our farmers in the large way, and we know of many operators who are sowing some hundreds of acres apiece who could not possibly procure the labor necessary to pull their flax. Machinery again comes to our aid, and with proper care in the laying down of the land our improved harvesters may be adjusted so as to cut the crop very close to the surface of the ground. There is a prejudice, that is not without foundation, that one inch of the straw at the base is worth two at the top of the plant, but the roots themselves are of little value for lint. With proper care the straw may be delivered from the machine sufficiently straight for all practical purposes, and the amount wasted by being tangled is much more than compensated for by the cheapness of the process compared to hand labor.

The proper period for harvesting the straw is a point of great importance. When gathered for the lint alone the seed should not have become fully ripe, but if gathered too soon there will be great waste in the scutching and hackling, though the fibre may be very fine; whereas, when too ripe, the fibre, though of greater weight, is also coarser and more harsh. When the seeds begin to turn brown, and the stalk is turning yellow for about two-thirds of its length, the crop is considered sufficiently ripe for harvesting. It is desirable to keep the buts of the gavils as snug and even as possible; in all the operations, therefore, attention should be paid to this point if the crop be designed for the preparation of long fibre, which is much the most valuable. The flax should be set up as soon as possible that it may dry thoroughly, and at the same time shade itself to a degree from the scorching sun, which injures the fibre. The bundles should be made quite small. Dickson considers exposure to the sun very injurious to the fibre.

Rippling consists in separating the seed bolls from the straw; it is performed either at once in the field, or it may be done in the barn during the winter. In Ireland a great deal of the flax is immersed in the steeping pool without having the seed separated. This is a most wasteful plan, and should never be allowed. The loss to the Irish farmer is estimated by Mr. Ward at from £3 to £4 per acre. Rippling is performed by drawing the heads through a coarse heckle, made of iron or steel teeth, or pointed rods, that are set in a solid block of wood. The workmen seize small handfuls or streiks firmly near the but end, and draw them across this comb. The apparatus, if in the field, should be placed upon a large winnowing sheet, or the space around may be smooth and tramped hard to receive the seed; or the rippling may be done on a tight barn floor more comfortably, and with greater economy of time during the winter, but in case of stacking or storing in the barn we must guard against the injury from rats and mice.

One of the best methods for separating the seeds from the straw, when we desire to keep this straight, is to pass the heads through plain rollers set pretty close; the bundles may be spread out and allowed to pass between them, or they may be held, as in rippling, but kept in the direction of the axis of the rollers, the heads only passing into the bite, when the bolls are crushed and the seeds separated.

The crop should not be allowed to remain in the field any longer than is necessary to have it thoroughly dried, when it should at once be stored away in the barn, or carefully put up in stacks, and these should be made sharp and covered with straw, or even thatched, so as to exclude the rain entirely.

With regard to the choice of seed it should be of a bright, brownish color; it should feel cold and oily to the hand, and should be heavy. The European authorities tell us that the seed from Holland ripens sooner and yields a greater quantity of fibre than most others; they say that American seed produces good flax; that from Riga is coarser in fibre, but more productive in seed than any other, and is adapted to a great variety of localities. It is supposed by some that this Russian seed, coming from a poor soil, feels the improved condition of better land, and produces a luxuriant crop, which will incline to be rank. They think that if it be resown upon the same land after the interval of a year it will produce the best quality of fibre, but that it becomes degenerated afterwards.

It is also considered very important that the seed to be sown should all be of the same age, that it may vegetate evenly, and thus all the plants of the crop will start together. Some farmers think that old seed will produce the best lint.

FARMING OUT THE SEED.

It is a very common practice in some parts of this country for those who have oil mills to furnish flaxseed to the farmers, with an agreement that they shall have the refusal of the seed produced. This custom has a tendency to encourage the culture of flax for the seed alone. In this case it may be the interest of both parties to use as little seed as possible, so as to produce as large a proportionate yield of seed as can be obtained.

From a series of data based upon the amounts of seed issued in this way by the dealer, and the returns made to him by the farmer, it appears that in the fertile valley of the Miami, in Ohio, the yield was only seven bushels and three-tenths per acre last year, 1864, though in one case, where a single bushel of seed had been sown upon two acres, the yield had been thirty-two bushels, or sixteen bushels per acre.

On the contrary, we are assured that, by proper management and under favorable circumstances, even larger crops than this last mentioned have been harvested, besides a heavy yield of good long straw, so that it is not considered impossible to combine the profitable cultivation of flax for both its valuable products, and thus it stands pre-eminent among all the competitors for favor both as an oil-producing and as a fibre-yielding plant. There is now a new element in the field encouraging the production of this crop; those who have machinery to prepare the fibre have also adopted the plan of loaning seed to the farmers as well as their predecessors of the oil mills, and it is to their interest to have the farmers sow more seed, and to produce taller straw with better lint.

This is well set forth by a writer in the Prairie Farmer who is thus interested. Mr. Clemens says that "the pursuit of the crop for the seed only will never secure the firm establishment of flax culture. The additional inducement of a production of the valuable fibre is necessary to make flax culture a leading farm interest. Crops of flaxseed may be grown with poor cultivation and thin sowing, when the straw will be worthless from its coarseness and the weakness of the lint, and from the admixture of grass and weeds. To obtain flax of the highest value for the seed only, it is advisable that the cultivation be conducted with special reference to the production of the largest yield of good fibre in the straw. This conclusion is justified by the fact that the average product of flaxseed per acre in those districts, in the eastern States where flax is grown more especially for the lint, is greater than at the west, where the seed only has been sought for, while the quality of the eastern seed, grown with the crop of lint, is also superior. The carelessness of management attendant upon growing this crop for the seed, in connexion with thin sowing, tends to deteriorate the quality of the flaxseed for oil-making, as well as for the production of lint."

Mr. Dodge, in his article in the agricultural report of the department for 1863, p. 103, gives an instance of success in the combined production: "In Henry county, Illinois, upon two acres of prairie land, well ploughed, and sown with one bushel of seed, thirty-five bushels of clean seed and two tons of straw were produced; the straw yielded eight dollars per ton. In Boone county, Illinois, three and a half acres yielded thirty-five bushels of seed and five tons of straw. The net profit was $28 35 per acre.

SUMMARY OF CULTURE.

Adopt a judicious rotation of crops, and avoid the too frequent recurrence of flax, placing it after a cleansing crop, if possible.

Select suitable soil, a good loam of sufficient depth, but not too rich.

Plough deeply in the fall, and leave the soil exposed to the frosts of winter. Plough again shallow, as early as possible in the spring; harrow perfectly level and smooth, removing all roots and obstructions.

Sow, as soon as the ground is in suitable condition, from one half bushel to two bushels and a half of the best and cleanest seed that can be obtained, cover very lightly with a short-toothed harrow, or with a brush drag, draw some very light water furrows, and then roll the land smoothly.

Harvest as soon as the seeds begin to ripen and the stalks are turning yellow; dry as rapidly as possible, set in open shocks to shade itself, ripple the seed, and secure the crop from the weather as soon as dry, and sell the straw to the nearest manufacturer.

HEMP.

This plant, called by the botanists *Cannabis sativa*, has obtained as wide a range as flax, being grown in almost every country from the tropics to the extremes of the temperate zones. Hence, with its excellent fibre, it has long been extensively cultivated and highly valued among civilized nations. Like flax, the hemp plant is composed of a central, woody stem, upon which are disposed very strong fibres, made up of bast cells, arranged parallel to the axis of the stalk, and united together in long filaments. These are covered externally by a coating or epidermis that envelops the whole stalk. Like flax, hemp needs to be treated in such a manner as to separate these groups of bast cells from the external bark and from the internal woody portions. All of these parts being intimately connected together by an agglutinating substance, as is the case with the flax plant, similar means and processes are required for their separation.

Soils.—Hemp is a coarse plant, growing rapidly to the height of several feet, and requires a good, strong soil for its production. Any good, rich, loamy land is adapted to this crop, which is largely cultivated in the rich blue-grass region of central Kentucky, in the limestone prairies of western Missouri, and in the fertile plains of Illinois, but it may be produced in the greatest abundance in most of the States of the great northwest.

In Europe and Asia hemp is found to grow remarkably well upon suitable lands, both in high and in low latitudes, for, being an annual plant, requiring but a short period for its maturity, it finds an appropriate season even in the brief summers of northern Europe, and is very largely cultivated in Russia, which country is indeed as noted for its hemp as Ireland has long been for its linens.

A deep friable loam, especially a rich alluvial soil, with natural or artificial drainage, is best adapted to the production of hemp.

Preparation of the soil.—What has been already stated as a suitable preparation of the soil for flax is equally applicable for this crop, and may be briefly repeated. The ground should be thoroughly and deeply stirred; if ploughed in the fall or winter so as to receive the meliorating influence of the frost, heavy soils especially will be much improved for the reception of the seeds. In the early spring the land should be again stirred, and for both of these crops it is advised that the ploughing at this season should be quite shallow, so as to retain at the surface the mellow soil that has been acted upon by the frost. In this condition it furnishes a fine seed-bed for the crop, which hastens its germination, and it is also asserted by some practical farmers that these plants do best when the deeper layers of soil have not been recently loosened, but have lain still and become partially compacted since the deep ploughing of the previous autumn; still, the roots descend deeply, and they require that land should have been thoroughly broken up at the fall ploughing.

Seeding.—After the spring ploughing, which may be done with any of the cultivators in use upon our farms, the ground may be allowed to lie a few days to receive the genial influences of sunshine. If the land be foul with weed-seeds, as is often the case with fields that are adapted to the growth of flax and hemp, this spring cultivation will have destroyed the first crop of weeds, many of which start into life very early in the season; then by waiting a few days another crop will soon germinate, and these may be destroyed by the use of the drag-harrow, which also pulverizes the soil and thoroughly prepares the seed-bed for the legitimate crop, which should be sown as early as possible after these arrangements and preparations have been completed and the soil is sufficiently dry and warm. The hemp will then have an opportunity to start evenly with the weeds, and by its vigor it will maintain a proper ascendency over them to insure success.

From two to three bushels of fresh seed should be sown, as evenly as possible, upon the recently harrowed surface, and immediately covered with the brush, or with the light short-toothed seed-harrow, followed by the roller, to compress the soil and thus accelerate germination, but neither the harrow nor the roller should be used when the soil is at all wet or sticky, as they will prove very injurious to the crop if used under such circumstances.

With careful preparation of the land as above directed, and judicious selection of good fresh seed, properly committed to such a fine seed-bed as has been recommended, the hemp crop will now take care of itself, and occupy the field to the exclusion of all intruding weeds. Indeed, hemp has been proposed by some agriculturist to be introduced into a rotation as a cleansing crop, to precede flax, for the sake of its destructive effects upon the weeds natural to the soil. While this effect of hemp is acknowledged, the farmer need not be reminded that the great principle of alternation, which should regulate all crop rotations, is here lost sight of, and though, in some of our very fertile alluvial soils, the results might be satisfactory, it would not be wise to pursue such a course of cropping as would bring these fibre crops in continuous succession.

Seed-plants.—In growing hemp for fibre it is sown so thickly as to run up to its full height without any branches. This gives us long, straight, undivided rods, that are evenly clothed with the valuable fibre. When allowed room to develop itself, however, the hemp plant branches at almost every leaf from near the ground to its summit, and these branches produce their inflorescence at the axils of their leaves. Hemp is diœcious, bearing its male and female flowers on different plants, so that a portion of them only are productive of seed. To produce the best result, a portion of land is planted in hills or drills, for the especial object of seed-growing; the plants are cultivated and thinned out to allow of their fullest development. Some farmers only sow a corner of the field thinly, or trust to failures in parts of the crop, where the plants standing thin on the ground will produce seed.

Harvesting.—Hemp was formerly pulled by hand, and this was done at two operations; the first pulling was performed when the male plants had shed their pollen, and were turning yellow. The female plants were left to mature their seed, and were taken at the second pulling.

The male stalks were ready for steeping as soon as dried; but the female plants were first divested of their seeds; if the seed crop was not wanted, all was pulled or cut together. The female plants require about three weeks to perfect the seed after blossoming, and they may be allowed to stand until the lower seeds begin to ripen, when they should be carefully pulled or cut, and the bundles set up in shock to dry. These seeds shatter very easily, and if not carefully handled much will be wasted. They are nutritious food for birds, and produce much oil, but are chiefly preserved for seeding.

The original method of pulling hemp has given place to cutting, at or near the ground, with heavy knives made for the purpose. These are crooked on the edge, and bent towards the shaft of the handle in such a way as to sever the stalks near the ground when thrust against them by the harvester with a rapid stroke. Hemp-cutting, though a great improvement upon pulling, is still hard work, and the usual length of the stalks requires a wide space to be cut, upon which the crop may be spread to dry. Care should be taken to keep the but-ends even as the stalks are laid down and taken up.

When the crop is of moderate height, and has been sown so thickly as to be of slender growth, farmers often prefer to use the common grain-cradle for harvesting hemp. A careful hand, who carries his scythe low, and cuts a level swath, may do excellent work in this way, but many workmen will waste too much of the best portion of the stalk, by leaving a high and uneven stubble. Then again, cradling hemp is very hard work, and we turn hopefully to the reaper to solve the difficulty by substituting horse-power for human muscle. Harvesting machines are easily adapted to this crop by a modification of the platform, suiting it to the length of the stalks of an average crop of hemp.

After the crop has lain upon the surface long enough to dry, the leaves will chiefly fall off as it is taken up to be tied in bundles of moderate size, which should be set up in shocks to dry perfectly before being stacked.

The proper period for harvesting may be known by the condition of the male plants, which, very soon after blossoming, cast their leaves, and the stalks begin to turn yellow, while the female plants continue green, and the bunches of seeds at the axils of the leaves near the top increase in size and weight. The crop is then ready for the knife.

Hemp is considered an exhausting crop; and so it is, for it removes from the soil a considerable portion of inorganic matter, but these substances, as shown by analysis, are not abundant in the fibre, which is taken off of the farm, but are chiefly found in those portions of the plant which constitute the refuse, and which may be returned to the soil as manure. Unfortunately, in our country little attention is ever paid to this restoration for the sake of maintaining the fertility of our soils.

Fortunately for our unphilosophical and wasteful system of agriculture, the hemp crop makes its own return to the soil to a certain extent, in the falling leaves and in the stubble and deeply penetrating roots, that when cut are in full vigor and remain to decay in the soil, which is left in a very fine condition after this crop. Valuable as is this contribution of carbonaceous matter to the humus of the soil, acting both chemically and mechanically for its melioration, it still does not compensate for the abstraction of the mineral constituents which the crop of hemp has taken from the land, and which a wise agriculturist will restore to maintain the fertility of his soil.

In the fertile hemp-fields of the west, particularly in Missouri, there is no apprehension felt as to the exhausting nature of this crop; on the contrary, many farmers speak of it as an improver of the land, like clover, and they claim that, while its deep roots descend into the lower strata of soil in search of nourishment, they bring valuable elements to the surface; besides which, they add a large amount of carbonaceous matter in the leaves of stubble, which has been gathered by the plant from the atmosphere. Certain it is that many fields have been planted in hemp for twenty-five successive years without apparent diminution of the crop, which continues to produce an average of 800 pounds of clean lint. In the hemp regions it is considered essentially a negro crop, and is esteemed on account of its affording steady occupation to the large farm force during the winter months, when they would otherwise be idle.

The annual production of hemp fibre in the United States, as reported in the last census, amounts to eighty-seven thousand one hundred and ninety tons, of which eighty-three thousand two hundred and forty-seven tons were dew-rotted, and only three thousand nine hundred and forty-three tons were water-rotted. There is a decided preference among the manufacturers for the water-rotted material, and the navy regulations indicate that experience considers this the preferable mode of preparation. But few of our farmers are willing to take the trouble to adopt this process; indeed few have the necessary skill and appliances; but it would be performed to much better advantage by those who make it their especial business, and who have prepared suitable vats for the purpose. Some of our correspondents in Illinois appear to have made extensive vats, with the expectation of rotting largely. This is a suitable subdivision of labor.

From the kindness of Mr. H. F. Driller, assistant secretary of the Board of Trade at the Merchants' Exchange, St. Louis, we have learned the product of hemp in that State for three years to be as follows:

In 1862, arrived at this port	88, 720 bales.	
" arrived at other ports, about	22, 100 "	
Total		110, 820 bales.
In 1863, arrived at this port	68, 131 bales.	
" arrived at other ports	17, 000 "	
Total		85, 131 "
In 1864, estimated at this port	74, 150 bales.	
" estimated at other ports	20, 100 "	
Total		94, 250 "
Total in three years		290, 201 bales.
Average per year		96, 733⅔ bales.

Kentucky and Missouri are the two leading States in which this crop has always been of considerable importance.

Farmers generally complain of hemp that it is a hard crop to deal with, on account of the manual labor which it requires, but it is also urged that it is uncertain in its results because of the fluctuations of the market value. Its chief value is for cordage, bagging, and sail-cloth, but the fibre is very similar to that of flax; the ultimate cells are almost identical under the microscope, and it is applicable to the preparation of linen cloths. The manufacture of bagging and bale-rope in Kentucky having been mostly suspended, since the withdrawal or suspension of the demands of the cotton-fields, the extent of the crop has also been diminished, and the fibre has been largely worked into tow, and shipped in the bale to eastern and European factories.

George M. Campbell, of Lewistown, Illinois, writes that he has grown hemp for more than twenty years—first in Kentucky, and afterwards in the prairie State—and that he finds the latter produces the best and largest quantity of lint. He says that his crops average 1,000 pounds per acre, and that one season he obtained the unusual amount of 1,380 pounds. He thinks Illinois could supply the world with this fibre, if the farmers would turn their attention to its culture.

He prefers a rich deep loam, which is well prepared with the plough and harrow, when he sows five pecks of seed per acre, and harrows both ways. If dry or cloddy, he also rolls. With what he calls a drag-hook he cuts half an acre a day. When cured, he ties and shocks the stalks till dry, when it is stacked.

He advises cutting as soon as the blossoms fall, but the seed crop is planted in rows, and the seed plants are left for the seed to mature, when they are to be cut and shocked, and left three weeks to cure.

MACHINERY.

When they were considering the subject of treating the flax-straw by any of the chemical operations to which it has been subjected for the purpose of aiding the separation and preparation of the fibres, whether these consisted of dew-rotting, water-rotting, or other more scientific or more elaborate processes, the commission endeavored to set forth the great importance of a proper subdivision of labor, so that the farmer, with his manifold and pressing cares, might be relieved from the responsibility of conducting these delicate operations, for which, indeed, he is not always qualified. Here again we desire to urge upon those engaged in making arrangements for further treatment of the material by the mechanical handling of the straw, and its conversion into the beautiful fibre, the great advantages that will result from a separation of these duties from those appropriate to the farm. Indeed it is so apparent to us that the rotting and breaking of flax are truly manufacturing processes, requiring skilled labor and experienced management, that the continuance of their assignment to the farm laborer can only be viewed as a remnant of those peculiarities of the early stages of civilization which are here and there found to cling to us in an advanced condition of society. In former times the farmer, with the assistance of his family, was obliged to produce the raw material, to prepare it for manufacturing, to spin, and to weave it upon his own premises; but as we advance from such a primitive condition, the better subdivision of labor is progressively introduced, and we believe, as stated on a previous page, that the farmer's duty should always end with the harvesting of the crop, the separation of the seed, and the delivery of the straw to the manufacturer. In portions of Belgium, to which country we may well look for the highest degree of development in the preparation of flax, since there the finest fabrics are produced, we find that the ownership of the crop is transferred from the agriculturist to the manufacturer so soon as its prospective value can be safely estimated, and this is immediately after it has blossomed in the field; so that the farmer's duties and interests terminate at a still earlier period than that we have recommended to our countrymen.

Notwithstanding our urgent desire for a proper subdivision of the labors of the production from those of the preparation of flax, and other textile plants, we know that in many parts of the country, where flax and hemp may be profitably grown by the farmer, the mechanic has not yet made his appearance with the needed machinery for operating upon the product. Indeed, the raw material is not to be found in sufficient quantities to justify the erection of large establishments for its preparation in many regions where it is and should be grown. Therefore we congratulate those isolated farmers who may be induced to cultivate this class of crops upon the fact that our ingenious mechanics have already provided for their wants by inventing and erecting farm machines, of moderate capacity, and at reasonable expense, which will enable individuals so situated to utilize their products, and put them into a condition that will bear transportation to market, or that will readily prepare them for home consumption.

In early times the most rude and simple apparatus was used in the preparation of these fibres, and we find remnants of these barbaric customs still remaining. In some parts of Europe the flax is broken by women, who hold the straw across the top of a post and crush it by beating with clubs; and it is claimed that in this way they prepare the nicest and softest flax.

Laying the straw upon a hard floor and beetling it with a maul or beetle, the face of which is grooved, is still recommended as the initiatory process of breaking. In some parts of Ireland the straw is spread across the hard road, and crushed by the wheels of carts that are passed over it preparatory to its being taken to the scutch-mills.

In Egypt, where we expect to find remnants of primitive modes of work, it is found that, after water-retting, the natives crush the straw with flat stones, and then strike it against a wooden post to free the shives. And yet the early Egyptians made cambrics that were finer than the modern fabrics.

The breaking of these plants consists essentially in so comminuting the woody materials, and separating the interstitial matter and the enveloping epidermis, that the filaments, or groups of true bast cells, may be set free from the matters with which they were associated in the straw. The original brakes consisted of wooden blades or jaws that closed into one another in such a way as to crush the boon or woody matter into shives, while the more resisting harl or fibre was liberated. The adhering portions of woody fibre, and the remaining interstitial matter, as well as the remnants of the outer covering or epidermis, were next separated by the process called scutching. This consisted in beating the handfuls or streiks of fibre with a blunt knife while it was held over the sharpened edge of an upright board. Finally, after being cleansed as perfectly as possible by these means, the filaments or bundles of cells were still further subdivided, and the loose portions that had been separated as tow were removed by drawing the streiks through elastic pointed wires, which constitute what is called the hatchel. This is a combing process, and is applicable only to the preparation of what is known as long-line, or the normal condition of the finished flax product. All of these several processes are performed by hand labor, but the inventive genius of the age has brought its mechanical appliances to the aid of the laborer in each of these processes, and we now find a multitude of contrivances to substitute manual labor. Many of these are admirable, and some of them are adapted to the use of the small farmer, who is thus enabled to prepare his crop for market, where, formerly, the formidable amount of hard work that was required of him prevented its being converted into any useful condition, and it was wasted or burned upon his farm, and sometimes cast into the mire-holes of the public highway. A few of these machines will be mentioned in this report, some of which have been found to produce satisfactory results in actual practice under our observation.

The multitude of inventions that we find in this department of labor-saving machinery may be classified not only as small and great machines, adapted severally to the farmer, or to the manufacturer, but they may be divided into two great classes according as they are calculated for the preparation of the perfect long-line flax from straight straw that has been carefully handled, or for the production of the confused mass of fialments, commonly known as tow, which can be separated by these appliances from the tangled straw. This is the common result of the flax crop in most parts of the country where it is grown especially for the seed, cut by the scythe, or by machinery, tramped out by horses, or otherwise threshed, and left in a confused mass, from which it could never be extricated in the form of long-line, but in which, nevertheless, lies a valuable product that may be separated in shorter filaments, and used in the production of important manufactures. These last are the tow machines which have come into use extensively within a few years in the flax-producing regions, fitting the crop for transportation. The necessity for some suitable machinery to aid and relieve human labor in breaking and preparing the fibres of flax and hemp was very early felt, and efforts were made to supply the deficiency. Of this there is manifold testimony in the collection of models at the museum of the Patent Office, where every conceivable application of power is represented

Some inventors contented themselves with applying machinery to the old fashioned brake; others used beaters and stampers of various kinds; but most of the inventors, and those are among the most successful, have adopted the application of rollers, which are generally fluted; these flutes are coarse and fine, and of varying form, so as to crush the boon as the straw is passed through them. In all of them it is somewhat difficult to preserve the parallelism of the stalks of straw during the process so as to keep the fibres straight, and thus avoid tangling and waste in the subsequent processes of its preparation. These machines break up the boon, but generally leave the broken pieces, called the shives, entangled among the fibres, from which they must next be separated.

One of the earliest plans adopted for the application of power to this purpose was based upon the principle of the old bark mill, rolling and dragging a wheel round a pivot upon a table or floor that received the flax which was thus crushed, but left full of shives, which were difficult to separate. A modification of this was introduced in the hemp brake of Kentucky, which consisted of a platform of strong triangular pieces of hard wood laid like the radii of a circle, and having spaces open between them. Upon this circular table a large conical fluted log of wood was made to traverse by a horse walking round the outside periphery. By this arrangement the shives were broken, and the turning of the hemp loosened them so that they fell through to the ground below.

Of all the various machines that have been attempted to be introduced for breaking flax and hemp, those which apply the crushing power of fluted rollers appear to have been the most successful, and yet among these there is a great diversity. Some have very coarse flutes, and some have them exceedingly fine; some revolve slowly, and some with great rapidity. In some machines the straw is passed repeatedly through a single pair of rollers, while others, being made of a number of pairs, effect the breaking while the material is passing once through them. In some of these multiple roller brakes the gearing is so arranged as to make them all traverse with the same speed, and in some it is accelerated in the forward rollers which thus tear up and shorten the fibre; these will not make the long-line.

Many, indeed most of these machines, require a considerable power to drive them, and they are generally found in flax mills, where also the scutching is done by machinery, in a simple arrangement, by which four or five swingling knives are placed in the rim of a pulley about thirty inches in diameter. Several of these sets of knives are attached to one shaft, which is made to revolve rapidly, bringing the blades close to the scutching boards where the workmen hold the flax that is to be operated on.

Mr. C. Beach, of Penn Yan, New York, has invented a machine for grinding up the straw, and thus separating the fibres. The straw is first cut, then passed under a wheel, within a cage, that rubs off the fibre, and a strong draught of air blows out a large portion of the shives and dirt. It is claimed for this machine that it is equally adapted to unretted as to retted flax, and that it will clean from one to two tons of flax straw in ten hours. It requires fifteen horse-power, and costs $1,000. As operated at Toledo, Ohio, there appears to be a great waste of fibre.

Crowell's flax brake and scutching machine is a combination of fluted rollers that is said to be adapted for retted or unretted flax straw, leaving the fibres clean and fine, either broken into short lengths for carding, or in full length for long-line, as may be desired, taking a ton or more of straw in ten hours, from which six hundred pounds of clean fibre per ton is said to have been produced. This, we think, is too large an estimate.

Randall's brake is a very successful application of fluted rollers, and is used with great satisfaction in many of the flax mills of the country.

The most successful application of machinery to this subject that we have seen is the arrangement of fluted rollers, with an oscillating motion backward and forward, but advancing more than it retrogrades. This is the Mallory & Sanford machine, which they call "a portable flax and hemp dresser." Owing to the peculiar form and motion of the rollers the boon is crushed into shives of less than a quarter of an inch in length, and the harl is rubbed off from the straw with very little breaking of the filaments, while at the same time the shives are nearly all shaken out of the flax which is broken and scutched at the same operation, and appears to need very little after scutching to finish it. This machine saves a great deal of fibre; indeed, there is scarcely any found with the shives which are nearly clean, instead of being, as they are often seen, a tangled mass of filaments and shives about the brakes.

The latest modification of this apparatus, wherein the rollers are arranged in a vertical series fed from above, was tested in the presence of the commission with very satisfactory results, and they do not hesitate to declare that the work was performed rapidly and well. The apparatus was new, and therefore some allowance should be made for its working capacity. The large machine is said to require a driving force equal to two horse-powers, and its capacity for work is estimated at one and one-eighth tons of straw per day. The makers of this machine in its later or upright form, with a succession of fluted rollers placed horizontally and set one above the other, when they use two breakers and one finisher combined, all feeding from above, claim that they can produce one thousand pounds of clean fibre per diem, with the assistance of four hands to the brakes, one hand to scutch, and two boys to assist.

As originally constructed, we have heard it objected to these machines that their mechanism involved a hard motion, and apprehensions were felt that the machinery might give way. At an establishment in Pennsylvania, it was stated that four scutchers were needed to cleanse the fibre produced by three workmen, running three thousand pounds of straw each day through one machine. We cannot help thinking that this result, so different from our own observations, and from the testimony of many practical workmen who have adopted these machines, must have arisen from a want of experience in the laborers, and from their attempt to put through too much straw; and that, had they attempted to break less, they would have found the scutching a small matter, with revolving knives.

Messrs. Mallory & Sanford's machines have been recommended for breaking straight straw for the preparation of long-line, and as being equally well adapted for the breaking of the most tangled flax, that it comes from the threshing floor. It is also claimed that they will separate the shives from green or unretted straw more perfectly than any other apparatus. Specimens on exhibition, and others broken in our presence, are entirely satisfactory evidence that such breaking can be done where desirable, though at the expense of a partial rupture of the filaments themselves, which, in the preparation of long-line, would be productive of a larger percentage of tow or tangled fibre than results from the handling of properly retted straw.

In the preparation of short fibres this partial rupture of the filaments is a matter of no consequence, but, on the contrary, the breaking without previous retting, and its attendant staining of the fibre, is considered a great desideratum by those who desire to manipulate the fibres in their processes of cleansing and disintegration to which they subject this material in preparing it for spinning upon cotton machinery. It is found much easier to bleach and prepare the fibres of unretted, than those of retted straw, and the result is much more satisfactory.

Before dismissing the consideration of the Mallory & Sanford machines, which have given the commission such satisfactory results, and which present great encouragement to our farmers who have heretofore been deterred from flax-growing by the labor attendant upon the preparation of the fibre, the commissioners desire to mention an additional appliance to these brakes, by which the most tangled mass of straw has its stalks straightened out, and presented to the fluted rollers at a right angle, so as to be most perfectly acted upon in its passage through the machine. By this means the efficiency of the brakes, when acting upon tangled straw, is greatly increased.

Scutching consists in separating the loose shives and dirt, but also results in the removal of a considerable portion of the fibre, as coarse tow; the first exposure of the broken flax to the scutching knives removes the most of the shives and makes the coarse tow; the second scutching gives a more valuable tow product; but the next or heckling process produces the fine tow, which consists of the tangled and broken filaments that are combed out of the streiks of flax as they are subjected to this instrument. Heckling is almost exclusively done by hand. Heckled tow contains very little shives.

Rowan's scutcher is a series of metallic beaters which revolve with great rapidity on the periphery of a drum, in close proximity to a breast or plate of iron, over which the workman holds the streik, so as to expose the ends alternately to the beating process. The work is done rapidly, and the cleaning is very well performed, but with the production of a large amount of waste tow. This machine is also used as a brake, but appears to waste a great deal of fibre, which falls with the shives. The advantages of this machine are, small space occupied, and rapid work.

One of the most promising scutching arrangements we have seen is that of a model of Mallory & Sanford, which consists of a vertical drum four feet in length, composed of clamps for holding the streiks of flax. These are made to revolve very rapidly after being charged with the fibre. The centrifugal force beats the flax against the edge of an upright scutching board that is fixed near the periphery of the revolving drum of clamps. When the ends of flax are cleaned the machine is stopped, the clamps are removed, loosened, and the flax is shifted so that the other ends of the streiks shall be exposed to the scutching process. It was found in experiments before the commission that this machine, with one scutching-post, would clean both ends in fifty seconds, and by applying four upright scutching-boards, and four clamps to each drum, it was estimated that the whole charge would be cleaned in half a minute.

In confirmation of our favorable impressions of the Mallory & Sanford machines, we subjoin some extracts from the report of the special committee on flax machinery of the New York State Agricultural Society. This committee report:

"That they carefully examined the machine presented by Messrs. Mallory & Sanford, New York, and tested it under a great variety of circumstances.

"Experiment 1st. Ten pounds three ounces of unretted straw, precisely as it came from the field, was passed through the breaking machine. The time occupied was two minutes fifty seconds, and the weight after breaking was six pounds ten ounces. The scutching process occupied six minutes, and the flax weighed after scutching just two pounds.

"Experiment 2d. Ten pounds of half retted flax (dew-retted) was passed through the breaking machine; the time occupied in the process was two minutes fifty seconds, and the flax weighed five pounds. It was scutched in nine minutes and twenty seconds, and weighed two pounds three ounces.

"Experiment 3d. Twenty-one pounds one ounce of thoroughly retted (dew-retted) flax straw were passed through the machine in three minutes fifty seconds, and weighed nine pounds. The broken straw was scutched in eight minutes thirty seconds, and weighed four pounds fourteen ounces. With the ordinary facilities of a factory, two men could do with ease what it required four men to do at the trials.

"The average work of the machine during these three trials was 1.158 ounce per second, which at ten hours work per day would be equivalent to 2,668 pounds of flax straw.

"The total weight of broken straw in these three experiments was twenty pounds ten ounces, which was scutched in twenty-three minutes fifty seconds, which is equal to 0.772 ounce per second. Running steadily for ten hours, a scutching machine will dress 1,737 pounds of broken flax-straw.

"It, of course, would be difficult to work the machines regularly as fast, or to do as much work with them as was done at these trials, but we have no doubt that the brake could run through 2,000 pounds of straw daily, and that two scutching machines would dress the flax as fast as it was broken by the first machine. Six-horse power would probably be amply sufficient to run the brake and the two scutchers.

"The unretted flax in these experiments yielded 18.9 per cent. The half-retted yielded 21.9 per cent. The well-retted yielded 23.1 per cent. of dressed flax.

"The day devoted to these experiments was a very rainy one, and the straw had lain upon the ground for several hours; it had therefore imbibed much moisture, and was in a very bad condition for dressing. If the experiment had been tried in a clear, dry air, much better results would have been obtained."

In conclusion they say:

"1st. That the machine of Mallory & Sanford does more work, with less power, than any other.

"2d. That it detaches more of the worthless from the valuable portions of the straw than any other.

"3d. That it wastes less of the fibre. On a careful examination of the shive after the experiments, we could not detect a single particle of the fibre.

"4th. It is cheap and durable and not dangerous to either life or limb. The cost of the largest machine is $355; the second size, 255; the third, $155.

"5th. It does not require skilled labor to operate it. This remark applies to the brake, and not to the scutcher.

"6th. It requires but a very small space; the largest size occupies but four feet square and weighs 1,100 pounds."

McBride's machine is in operation at Delaware, Ohio; as a scutcher it is very efficient and ingenious. The flax is applied in the bite or twist of a double, endless rope, which receives the streik at one side, carries it through the scutcher, where it is well dressed throughout; during its passage, the rope shifts its hold of the flax by the torsion action, so that all is scutched and delivered to the workman at the other side of the machine, who lays away the bundles of clean flax. This machine will dress from four hundred to six hundred pounds a day.

Mr. Mc Bride has also constructed a machine for treating tangled straw, by which he says he can dress from three to four tons of rough straw per diem, and which, he thinks, will produce from one to one and a third ton of clean fibre, at a cost of half a cent per pound. This machine is to cost about five hundred dollars, and, he thinks, will produce 30 per cent. of clean fibre from retted straw.

Several of the machines already noticed are adapted to the preparation of long-line or of tangled tow, according to the condition of the flax straw, whether it has been carefully handled and kept straight from the time of harvesting, or has been left in a tangled and confused mass by the harvesting machine, and afterward by the threshing operation and subsequent treatment.

Since, in a large majority of cases in this country, where flax has been grown or the seed alone, and little or no care has been bestowed upon the straw, this material is in a tangled condition, it becomes a matter of the highest importance to provide apparatus that can take this product and reduce it to a marketable condition; receiving it in the bulky form of straw from the neighboring farmers, machinery is needed to break and clean the fibrous product, which can then be baled and compressed so as to adapt it for transportation to market.

Many of the machines already mentioned will work equally well with tangled or with straight straw, and lay in their claims to public favor for this purpose; but there are others which are essentially tow-machines. One of the first of this class was introduced by Mr. Allen, of Boston, who claimed the production of "fibrilia," or shortened filaments of flax and hemp.

The extended culture of flax in some portions of our country for seed alone has also yielded an immense quantity of the fibre-bearing straw, which it is desirable to utilize so as to add to the wealth of the nation. For this purpose machinery has been supplied in addition to the flax-brakes already in use, and which were especially adapted to the preparation of long-line. These machines have been constructed for the purpose of breaking and of cleaning the tow, without having any regard to the length of the fibre, and in some instances purposely calculated for shortening it, by the arrangement of pickers and beaters, and also of alternating rollers, that revolve in common with increasing speed upon the advancing sheet of fibre as it passes through the machine.

A great variety of apparatus is employed for this purpose, but one or two of the inventions need to be noticed.

One of the most powerful of these tow-machines is that of S. A. Clemens, now at Chicago, Illinois, the capacity of which is such that it requires two active men to supply the raw material upon the feeding-apron, and the product of pretty well cleaned tow amounts to about a ton per diem. Mr. Clemens has long been engaged upon flax inventions.

G. F. Davies & Co., of Dayton, Ohio, have put up a machine which possesses the merit of cleaning tow in a very thorough manner by purely mechanical means. The fibrils are broken and divided, and reduced to a commendable degree of fineness and shortness, so that the inventor feels confident that this substance, which he calls "erolin," or flax-wool, may be spun on cotton machinery. That it will work well with wool has been demonstrated. This machine will be more particularly described in the section on manufactures.

CHEMICAL.

When we come to investigate the details that properly appertain to this subdivision of our subject we must again observe what is the natural condition of the agricultural product which is to be dealt with, its composition, and its condition as it comes from the field, and thus we shall be prepared to appreciate the difficulties that lie in the path of improvement, and to understand the object of the various processes to which the material is subjected.

The round stalk of flax or hemp is composed of a woody heart or central portion, which is hollow. Around this column, closely packed together, and in immediate contact with the woody matter to which they are intimately attached, we find the delicate and strong fibres that give value to the plant. Outside of these is the exterior integument or skin, called the epidermis. These fibres are composed of regular bast cells, united together into filaments or bundles of cells, which are connected with other filaments, and also cemented to the adjacent tissues by a nitrogenous substance that has been called gluten; it is an albuminous compound, which is extremely difficult to remove by mechanical agencies.

When these stalks have been exposed to the action of the weather for some length of time, the bast cells are found to be in a state of partial separation, and the long fibrous material, which is gathered by the birds for the construction of their nests, was no doubt very soon collected by man and applied to his purposes.

This slow and uncertain separation of the fibres must have attracted attention, and there is little doubt that artificial means for accelerating and regulating the process were very long ago applied; and we now find very primitive races of men making use of similar products of many plants, which are treated in different ways to induce them to part with these interesting bundles of cells or fibres, to be applied to economic purposes.

It is almost universally conceded that some process is necessary to prepare the dry straw before attempting the separation of the fibres; a partial decomposition is to be effected to set them free from the aglutinating material that attaches them to the woody matter or boon constituting the stem.

This is generally effected by the process called retting, and is done by exposing the straw to moisture, with or without artificial heat. Water-retting or steeping is done by immersing the straw in tanks or pools of soft water, in which a degree of fermentation is soon set up, causing the decomposition of the nitrogenous matters, and rendering the woody portion short and brittle, so as to be easily broken and removed, while the more tenacious fibres have resisted the decomposition and retain their strength and value. Dew-retting more nearly resembles the natural process of disintegration which is often observed in many fibrous plants that have been exposed to the weather where they grew.

The process of retting may be considered under three different heads. In the first, the separation of the fibre is effected by fermentation simply. An incipient decomposition is made to separate the parts. This is steeping, or water-retting and dew-retting. In the second, the liberation of the fibre is due to the abstraction of the azotized extractive principles by the agency of chemical solvents, which are chiefly alkalies. In the third, simple water is used, either heated or introduced as steam.

In the first method fermentation is carried on at the expense of the matters contained in the plant, either originating within itself, or introduced from without. In either case offensive and noxious products are generated by this process of retting. In the second method the combining matters are removed by the aid of chemical ingredients; and by the third process the whole of these substances may be preserved in a state that is useful, and that may be applied as a valuable feeding material.

The process of steeping, including also dew-retting, is the one generally adopted over the country, and the commonest and most ancient mode consists of dew-retting. The straw is spread out upon the grass, and exposed to the natural moisture of dews and rains, or it is carefully watered by artificial means, so as to have a supply of moisture sufficient to set up and maintain fermentative action within the tissues of the plant. This is a tedious process, requiring several weeks, and in cold weather a longer period; and yet, with all its uncertainties, it is a favorite method, particularly when conducted in the winter season, and many manufacturers prefer snow-retted flax. The period required for natural retting will depend upon the heat and humidity of the atmosphere, and in a dry season this will be very much extended, and will require from three to six weeks.

The usual method is that known as water-retting, when the flax-straw is immersed in tanks or pits constructed for the purpose, where the liquid may be at rest, or very slowly changed by the ingress of a small stream of water. It is advised that the water used for this purpose be soft, and that it be collected in a reservoir and allowed to stand for some days before being admitted to the straw to be acted upon by it. Slowly moving streams of water are sometimes selected for the rotting-pools, in which the flax is introduced and left until the desired decomposition is effected. In Belgium, where retting constitutes a distinct branch of the trade, wooden crates, twelve feet long, eight feet wide, and three feet deep, are made, which, when filled with the flax, are carried into the stream and weighted down, and left to be retted, and removed from the water so soon as sufficient decomposition has taken place. This is done chiefly in the river Lys, the water of which stream is believed to have superior qualities, so that flax is brought from a great distance to be retted in it, and the product is made into the finest linens, shirtings, cambrics, and damasks. Nothing peculiar has been discovered by analyses. A similar arrangement has been contemplated by a flax company in the northwest, who are to pack their straw in large crates, to be transported into the water on wagons from which they can be unloaded, left there till retted, and then removed by the same wagons and transported to the drying grounds.

In the tanks or pools, whether these be in the open air or under the cover of buildings, the flax is placed nearly upright, inclined, but loose; the water is let in, and the straw is weighted down to keep it under. This weight often needs to be increased during the progress of fermentation, which is indicated by the appearance of scum upon the surface of the liquid, and by the escape of bubbles of gaseous matters extricated below, and by the rising of the bundles above the surface of the water.

Constant care is required in this process, that it be not carried too far, and result in the destruction of the valuable fibre as well as that of the foreign matters associated with it. Close attention must be paid to the condition of the straw, and at this stage repeated trials should be made to ascertain if it be sufficiently retted, when it must be immediately removed from the vat, for a little too much retting will destroy the value of the fibre. Experience is necessary to enable the workman to decide when the proper period is reached, and this matter is usually intrusted to one who has made himself an expert, and who has the necessary judgment. If the fermentation have not been carried far enough, the fibre will be coarse and harsh; but, if overdone, though soft and fine, it will be tender, and there will be great loss in tow when the flax is heckled.

Steeping in pools is not so slow and tedious a process as dew-retting, but still considerable time is required, generally from ten to fourteen days, according to the temperature; but in streams, which are still colder than the ponds in which the fermentative action affects the temperature, from two to three weeks will be required. In all cases much depends upon the quality of the water and upon the temperature. Impurities, such as lime and iron, are considered injurious, and thought to retard the fermentation as well as to injure the fibre.

Schenck's process depends upon the use of hot water, by which the fermentative process is hastened, and yet it may be controlled. By this plan a saving of time is effected, as from seventy-two hours for the fine qualities, to ninety-six for the coarse, is all that is needed, instead of two or three weeks. This process will be explained in detail upon another page.

Chemical methods.—Many plans have been devised for dissolving out the extractive matters of the straw by the use of chemical agents, both acids and alkalies; even weak solutions of these substances are found to have this desired effect. Their action is accelerated by temperature. The Chevalier Claussen patented a process for this purpose, which will be considered in detail in the section of this report which will be devoted to the consideration of the claims and merits of flax-cotton.

All of these processes for the separation of the filaments from the wood and from one another will be understood when we recollect the nature of the interstitial substance that unites them. Being nitrogenous, it acts as a ferment when exposed to a gentle heat and moisture, either in the retting vat or in the open field. The elements of decay are present, only awaiting circumstances favorable to the establishment of that process. In the case of chemical agencies their action depends upon the solvent power which alkalies exercise upon the intercellular matter combining the cells and cell-bundles into the fibres and filaments that we desire to separate.

In the processes next to be mentioned, though a separation be effected, it is important to recollect that certain elements of destruction are still left in the fibre thus treated, which are liable at any future period to undergo fermentation if they be subjected to circumstances favoring such action.

Hot water.—The use of simple solvents, such as water or steam, remain to be considered as agencies to remove the foreign matters from the fibre and to cause its ready separation from the stalks or boon. By the use of such means we find the process accelerated, and as we have no fermentative action, we not only avoid the noxious and disagreeable effluvia and exhalations, but we save the use of expensive and sometimes dangerous chemicals; there is less prospect of injuring the fibre, and the products of the operation are found to be valuable. This is called Watt's method, and will be fully described on another page.

This method presents a great advantage in saving of time, as it only requires thirty-six hours from the commencement until the flax is dried and scutched ready for market. There is also claimed a great saving of fibre, for the product was found to be 18 lbs. of fibre per cwt. of crude straw, or 26½ lbs. per cwt. of the steeped and dried straw, which by this process had already been divested of a large portion of its original matter, washed out with water.

Hitherto the first four processes in dealing with the crop of flax have been the separation of the seed from the straw, the steeping of the straw, and the drying afterwards, and the separation of the fibre by breaking and scutching. These operations have been agricultural, whereas they ought to have been manufacturing processes. It is manifest that all of them may be performed much more systematically and economically in the routine of a factory, with practiced hands, than could be done by the slovenly laborers of the farm.

Mr. Ward urges the Irish farmer to confine himself to growing the flax and to harvesting it in proper condition; when the crop should pass into other hands, who, with more efficient aid, would convert it into a better quality of fibre. If the farmer performed his part judiciously, which he is more likely to do by omitting subsequent processes, manufactories could be introduced which would be beneficial to him. If the straw be not carefully harvested its fibre will be lessened in value to a large extent; this loss no subsequent treatment, however judicious, can possibly obviate. If, therefore, an improved method of preparation be introduced, it must, in a great measure, depend upon the co-operation of the farmer.

From report of Juries at the International Exhibition 1851.

"Schenck's method has been introduced into Ireland and found economical of time and labor. The Royal Society at Belfast recommend it highly. Mr. McAdam, secretary of this society, gives the following account of it:

"Simple wooden sheds contain the vats and drying shelves. In one end of the buildings are four vats; these are made of inch deal, fifty-six feet long, six feet broad, and four feet deep. There are false bottoms perforated with holes; underneath these are steam-pipes crossing the vats and having stop-cocks, to let on or cut off the steam as required. This is generated in a small boiler, which also works the two hydro-extractors, which drive off a portion of the water as the flax comes from the vat. The flax is packed in these vats on the butt end, half sloping, only one layer deep; then the water is let on, while a frame on top confines the straw in its position. The steam is let in by turning the stop-cock, and the water is eighteen or twenty hours in becoming heated to eighty-five or ninety degrees; when fermentation commences no more steam is required, but the process continues forty hours, or sixty hours from the commencement, when the flax will be perfectly retted. If the water be heated before it is put into the flax, or if the temperature be raised above ninety degrees, the process is not hastened, but the fermentation is rather retarded. The gradual heating of the water is necessary if we wish to preserve the quality and color and to have a uniform retting.

"When thus retted the flax is taken out and the vat is emptied and cooled for the reception of a fresh charge of straw, water, and steam as before. As taken from the vat, the flax is placed in the hydro-extractor, where it is rotated rapidly to displace the water by the centrifugal force. From thirty handfuls placed in this apparatus twenty pounds of water are expelled in from three to five minutes, so that a few hours suffice to treat the contents of one vat, amounting to two tons of the flax straw. The flax is dried of its remaining moisture in the summer by spreading it upon the grass, but in winter it is spread thinly upon lattice shelves, protected by a shed that is heated by steam pipes; the shed should hold the contents of one vat daily; when dried the flax should be made up into small beets or handfuls suitable for feeding into the rollers of the breaking machine.

"Such an establishment can ret about ten vats per week, equal to twenty tons of straw, producing two and a half to three tons of fibre, thus making 120 to 150 tons of flax ready for market annually, the produce of 400 or 500 statute acres.

"The saving in time accomplished by this process is not attended by any depreciation of quality or loss of material in the manufactured article. This is thus corroborated by the Belfast Society. The doubts raised as to Schenck's process were, 1st, that the yield of fibre would be less than the ordinary mode of steeping; 2d, that flax so prepared would be weakened; and 3d, that linen made from it would not bleach properly. Experience has proved that the last two are altogether baseless. As respects the first objection, we are of the opinion that, either by the common method or by Schenck's, the yield of fibre will be lessened if the fermentation be allowed to proceed too far. The uniformity of temperature insured by the latter would induce the belief that the yield of fibre should be increased. This is borne out by two experiments. In the one conducted at Lisburne by Mr. Davison in 1847, 112 pounds of flax straw, after steeping and drying in the ordinary way, gave twenty pounds of scutched fibre; and 112 pounds steeped by Schenck's process and dried gave twenty-four pounds, an increased yield of twenty per cent. In another experiment 112 pounds of straw gave, by the old process, fourteen pounds five ounces, and as much, by Schenck's process, yielded seventeen pounds eleven and a quarter ounces, or twenty-three and a half per cent. in favor of the latter. As respects the quality of the fibre the result was equally favorable to the Schenck process. In the first experiment, the flax steeped in the ordinary way spun to ninety-six lea yarn, that by Schenck's spun to one hundred and one lea. In the second, the ordinary gave sixty lea, Schenck's seventy lea."

Watt's method.—The flax straw is delivered at the mill dry and with the seed. The seed is separated by metal rollers and afterwards cleaned. The straw is placed in cast-iron close chambers, laid upon a false bottom of iron, and when the doors are closed tightly steam is thrown among the straw. The first effect is to drive off certain volatile parts that, with the water, are caught in the condenser placed above, and returned upon the straw; as this fluid accumulates, with portions of the extractive matter from the straw, it is drawn off from time to time. After being thus treated from eight to twelve hours, during which the resinous matters are removed from the straw by the water, it is taken from the chamber and passed through rollers that separate most of the water and split it longitudinally and crush the boom. It is then dried and in a few hours it is ready for scutching.—*Condensed from Society's report.*

The chairman of the committee of the society for the promotion of the growth of flax in Ireland gives the following account of the result of his investigations:

"A quantity of straw was taken weighing 13¾ cwt. After removing the seed, which, when cleaned, measured 3¾ imperial bushels, the remaining straw weighed 10 cwt., 1 qr., 21 lbs. It was then placed in the vat and subjected to the steaming process for eleven hours; after steeping, wet-rolling, and drying, it weighed 7 cwt. 11 lbs., on being scutched the yield was 187 lbs. of flax fibre, and of scutching tow 12 lbs. 6½ oz. fine, and 35 lbs. 3 oz. coarse. The yield of fibre in the state of good flax was, therefore, at the rate of 13½ pounds from the hundredweight of straw, with the seed; 18 pounds from the hundredweight of threshed straw; 16¼ pounds from the hundredweight of steeped and dried straw, equal, respectively, to 12, 16, and 14½ per cent. The time occupied in the actual labor in the processes after removing the seeds from the flax was 13¼ hours, beside the eleven hours consumed in steaming and the time spent in drying. The scutching by four stands occupied six hours sixteen minutes. Thirty-six hours is supposed to be the time necessary to perform all the processes, reducing straw into clean fibre. When sent to the spinning mills to be heckled and valued it was declared to be quite satisfactory to the hecklers, and worth from £56 to £70 per ton.

"The committee conceive that the most prominent and novel feature of this plan consists in the substitution of maceration or softening for fermentation. In the steeping of flax, both by cold and hot water, the gum is separated by being decomposed, while on Watt's system the maceration simply loosened the cuticle and gum, which are further separated mechanically by the crushing, and which, after the drying of the straw, readily part with the wood in scutching."

The water from these vats is found to be nutritious instead of noxious, as is the case with common retting when it becomes putrid from decomposition. It is only an infusion of the gums, and is used with the chaff of the seed bolls for feeding swine, and thus may be returned to the soil in the manure they produce instead of becoming a nuisance.

The following is a statement of the amounts of labor and time occupied in the process:

Process.	Persons.				Hrs.	Min.
Seeding	4	men,	8	women	1	15
Placing in vat	3	do	4	do		15
Cleaning seed	1	do	0	do	3	00
Taking out of vat	2	do	3	do		30
Wet-rolling and placing in dry room	1	do	16	do	2	20
Rolling for scutching	0	do	11	do	1	8
Strieking for scutching	0	do	7	do	4	47
Total	11		49		13	15
Scutching	4	do	0	do	6	16

Professor Hodge stated to the British association for the advancement of science that—

"This new method which is in operation at the extensive works of Messrs. Leadbetter, Belfast, appears to offer striking advantages. It is peculiarly adapted for rendering the separation of the fibre a manufacturing operation. No disagreeable odors are evolved, and if experience confirms the expectation of the patentees with respect to the quality of the fibre obtained, and if the cheapness of the plan be demonstrated the new process will contribute largely to the extension of flax culture in this country. The utilization of the residual liquor is another argument in favor of Watt's plan."

Experiments as to the comparative value of fibre prepared by steeping in the old way, and by Watt's method, give the following results: Watt's process in one set of experiments gave forty-five per cent. more of scutched fibre, and was considered worth £10 more per ton. In another set of experiments the green straw yielded twenty per cent. more of scutched fibre; the dry straw yielded seventy-five per cent. more of fibre.

Breaking without retting.—The commissioners have found several machines that will break and clean the unretted flax straw, and they desire to say a few words upon this subject, as obviating the necessity of this troublesome and expensive process, would appear to be a great desideratum in the culture and production of fibrous plants. In a valuable paper upon this subject by O. S. Leavitt, in the Patent Office Report for 1861, the following statements occur:

"In 1812 Lee took out a patent in England for a machine and process for breaking and working flax straw in the natural or unretted condition; and so important did Parliament consider the invention that the peculiar privilege was accorded to the inventor of having his specification filed for seven years in the secret archives of the government. This plan contemplated making linens entirely by the dry process. The Irish linen board expended £6,000 in their endeavors to introduce it into the flax districts. In 1817 the same was patented by Hill and Bundy. Other similar attempts were made on the continent, and all failed for the following, among other reasons:

"1st. The breaking machines were very imperfect; greatly inferior to those which have been of late worked with better success in this country.

"2d. The flax, broken out and cleaned in the most perfect manner, in the unretted condition, is coarse, harsh, and totally unfit for fine yarns, on account of the great cohesive force of the glutinous matter connecting the filaments so firmly that no heckling, brushing, or other mechanical means can separate them sufficiently for fine numbers. What may, in this condition, appear to be but a single filament, will, upon close examination, prove to be a bundle of filaments, cemented together by the incrusting matter.

3d. It was found that in attempting to divide the harls sufficiently many were ruptured, making a far greater proportion of tow than by the retting process, while the tow was of a very inferior quality—merely wide harls, with more or less adhering shives. Many harls were torn off abruptly, making what the spinners call stumpy ends, and the whole very harsh, and only suitable for inferior rope-yarn.

4th. By neglecting, as many did, to boil their yarns or goods properly in an alkaline solution, the azotized incrusting matter, when exposed to moisture, would cause the goods to mildew and decay more rapidly than when made from retted flax; but this was not the main cause of failure in working unretted flax, as many have alleged."

With the improved brakes now in use we have seen unretted straw broken very nicely, though there is always an amount of tearing of the filaments that must damage the material for the preparation of long-line; even if the fibre be exposed to the solvent action of alkaline solutions, the amount of tow is necessarily increased. For some of the processes to which these fibres are now exposed in their preparation for spinning as shortened fibres, however, we conceive that these objections are overruled, seeing that our brakes are more perfect; the design is to prepare and to use shortened fibres; and in the later operations of disintegrating the filaments, the material is exposed to suitable solvents of the incrusting or interstitial matters which are entirely removed.

Mr. Ward gives an account of a mill at Trebolgan, Ireland, where seven hundred hands are employed, and where the flax is broken in the dry way.* The flax is first taken from the stack to the mill, where it is seeded, by passing the straw through rollers and then beating it against timbers. It is then dried in a room artificially heated, and passed through the breaking machine, which prepares it for scutching. When the shives have been separated by the scutcher, and the fibre is brought to the desired state, it is tied up in bundles. This is the largest mill in Ireland, using an engine of twenty-five horse-power. The tow is also cleaned by machinery and rendered marketable. The proprietor, Mr. E. B. Roche, has a great advantage in the combination of this factory with his farm, as all the refuse may thus be consumed. The corn-barn is attached to the mill so as to have the use of the steam-power for threshing and winnowing. Near the engine are arrangements for cooking food for the cattle, which is done with the waste steam, by means of which from ten to twenty tons of mangold wurtzel may be prepared at once. The condensed steam is saved to mix with the flax bolls, as a very rich food. The shives from the straw thus treated in the dry state without retting are not only useful as fuel, but are found to be nutritious, and are valuable as food in combination with the steamed roots, with which they aid digestion. An oil mill, in addition, is all that the establishment needs to make it complete.

*Condensed from Ward's treatise.

The Belfast society say in regard to this method:

"It is sufficiently obvious that so simple a mode of obtaining flax fibre as its mechanical separation from the stems of the plant must have been the earliest methods adopted when this substance was first used for textile purposes. It is probable that accident first made known the fact that by immersing the flax stems in water, when above a certain temperature, the fibre could be divested of impurities by the decomposition of the foreign matters, which, with the woody portion of the stem, are united to it. In 1815 the Irish linen board adopted the dry preparation, then brought forward by Mr. Lee, and their records show that its principle was almost identical with Donlan's. After expending £6,000, the board abandoned it on account of insuperable defects. In 1816 Mr. Pollard, of Manchester, proposed to make an article from flax by a dry method which could be spun on cotton machinery. This also fell to the ground. The committee state as their opinion 'that the fatal defect of the dry methods is the retention by the fibre of the gummy and resinous matter incorporated with it. This, being subject to fermentation at moderate temperatures if moistened, and to decomposition by alkalies and acids, is not only useless, but absolutely pernicious, if thus retained, since, in the process of manufacture, it is exposed to these agencies.' And further they state that the matter may be summed up thus: 'In the retted flax a nearly pure fibrous matter is produced, and the material is thus in the fittest state for spinning even yarn and making good linen. In the dry worked flax, along with the fibre is combined a foreign substance, which must be got rid of afterwards, to the detriment of the spun and woven fabrics.'"

The following very interesting view upon this subject is taken from the reports of juries at the London exhibition:

"During the last few years great efforts have been made to extend and improve the manufacture of this valuable fibre in various parts of the world. The increase under the last head in the preceding table for 1849 is chiefly due to the importation of flax from Egypt. It must be remembered that in addition to the above-mentioned quantity of flax annually imported, the manufacturers of England have consumed rather more than a quarter as much again, cultivated in various parts of the British empire, chiefly in Ireland. This proportion has also considerably increased during the last twenty years, and a most marked improvement in the quality of the flax itself has also been produced; a change in great measure to be traced to the persevering and most praiseworthy efforts of the Royal Society for the Promotion and Improvement of Flax in Ireland. The value of flax depends, in part, on the climate and soil in which it is cultivated, and in part, also, on the mode in which the fibre is prepared, on the care and skill in which the process is conducted, and on the constant and vigilant attention which is paid to it through the various stages of the operation. According to its quality, its value varies from about 40 pounds to 180 pounds per ton.

Another circumstance which has given a considerable impetus to the cultivation of flax, and is likely to produce, ere long, even yet more marked effects, is the introduction of the late R. B. Schenck's new process of steeping.

"Many different modifications and peculiar modes of retting are followed in the various flax districts of Belgium, Holland, and France, and in different localities dissimilar modes of retting have long been in use, often involving very considerable variations in principle. Thus, at Courtrai, the flax crop is dried in the field and stored for some months in barns before it undergoes the process of retting in the river Lys. In the district of Waes it is retted immediately after being gathered, the green stems being at once thrown into pits of stagnant water. As, however, the whole operation, in every kind of water retting, depends on the amount of fermentation produced, (which must be enough to insure the decomposition of the glutinous matter, but not enough to cause any injury to the fibre,) the process is necessarily slow, tedious, and very uncertain, especially towards the close of the operation, because then the flax must be most carefully watched, in order to put a stop to the fermentation as soon as the desired effect is produced. A slight change of tempature, or a few hours' exposure, when the fermentation is complete, may produce the most disastrous effects, the fibre being, in fact, ruined. Dew-retting is, of course, even slower than water-retting, depending, as it necessarily does, on the nature of the season, and being greatly retarded by long continued dry weather. In the very dry autumn of 1810 it was found impossible to prepare flax by this method, and recourse was obliged to be had to other methods of retting."

"During the last half century various attempts have been made to effect the separation of the fibrous from the woody portion of the flax stem by chemical and mechanical means. In several cases the results at first appeared to be very promising; but in every instance it was soon found that there were insuperable practical objections, which more than counterbalanced the advantages. Among chemical agents solutions of sulphuric acid, caustic potash, caustic soda, quicklime, and soft soap were all in turn tried and discarded; and among mechanical processes the ingenious contrivances of Mr. James Lee and Messrs. Hill & Bundy shared the same fate.

"In 1817, and, therefore, before the publication of Lee's specification, Messrs. Hill & Bundy took out their patent for machinery for breaking and preparing raw flax and hemp. The rival claims of these two inventors were investigated in 1817 by a committee of the

House of Commons; but whatever may have been the comparative merit of the two processes in the course of a very few years both were relinquished and forgotten. Since that time various other ingenious mechanical arrangements have been devised, but hitherto they have had very little success.

"Schenck's process, for which he obtained a patent in 1846, is undoubtedly a very important improvement. It consists merely in steeping the flax stems in warm water, heated artificially to the temperature best suited to fermentation. By this simple means the operation is rendered rapid and certain, all uncertainty from fluctuations in the temperature and weather is avoided, and the whole process is entirely under the command of the manufacturer. The temperature best suited for this purpose is about 80°, or from 80° to nearly 90°; above this point the process proceeds too rapidly, and the fibre is almost sure to be more or less injured. The time required is from seventy to ninety hours.

"From the facts and evidence brought forward by various independent exhibitors, it appears satisfactorily proved that the warm-water steeping increases the percentage of fibre obtained from the flax stem over that obtained by the old modes of retting by nearly one-fifth; and that, whilst the fineness and spinning qualities of the fibre are increased, the strength is in no way weakened or diminished, unless the process be permitted to proceed too far, an effect which need never happen, from the complete control over it which the manufacturer has throughout. Although there is no doubt as to the practical value of the use of warm water in flax-retting, yet the introduction of Schenck's process is far from removing all the difficulties of the flax manufacture. Much still remains to be effected, and it is by no means improbable that ere long a yet more perfect process may be devised.

"It is interesting to observe that the use of warm water in the preparation of vegetable fibre is not altogether new, it having been long employed by the Malays, and by the natives of Rungpoor, in Bengal. The process adopted at Bencoolen is stated by Dr. Campbell to consist in steeping the stems of the hemp in warm water, in which it is allowed to remain for two days and nights. The old German process called 'Molkenrost,' sometimes used in preparing the finer sorts of flax, is also, to some extent, an application of the same principle. In this mode of retting, the flax was steeped for four or five days in a warm mixture of milk and water, and thus the desired degree of fermentation in the flax stems was produced. This operation must be distinguished from the more modern one, in which sour milk was used in order to give a good color to linen, a process introduced by the Dutch towards the middle of the last century. The linen was boiled in a weak alkaline lye, and subsequently treated with sour buttermilk, for the purpose of aiding in removing the alkali, and dissolving the earthy impurities present in the fibre. Occasionally, also, salt of sorrel was used for the same purpose, and in 1775 Reuss states that sulphuric and muriatic acids might be used for the same purpose; but that being too costly, they had not as yet come into general use. Of course, all processes in which boiling, or even hot, water is used are quite different in their mode of action from those in which only warm water is employed. When boiling water is used it is with a view of dissolving and removing the useless matters which incrust the fibrous part of the plant, whilst, on the other hand, warm water is used to soften them, and to aid in their putrefaction or decomposition, through the agency of fermentation. In 1787 much interest was excited in Ireland by the publication of a plan for improving the retting of flax by the action of hot water. In this scheme it was proposed to scald the flax stems in boiling water to soften them, and to remove a portion of the extraneous vegetable matters which they contain, and it was conceived that after this treatment the subsequent retting of the flax would be more rapid, certain, and manageable, so that time would be saved, the noisome process of pond-retting be obviated, and the result be to yield a stronger and whiter fibre. The minute and careful experiments of Hermbstaedt, on the chemical principles involved in the retting of flax, (made about the beginning of the present century,) threw much light on the whole subject, and to some extent indicated the influence of temperature on the success of the operation."

Aid of chemistry.—Without the aid of chemistry it would have been impossible for textile fabrics to have attained their present development. The bleaching of cotton and linen was not much practiced in England until about a century since; before that time they were sent to Holland, where the operation of bleaching consisted in steeping them in potash for a few days, afterwards for a week in buttermilk, and then exposing them for several months on a meadow to the influence of the sun and moisture. A great improvement was made in Scotland, by substituting sulphuric acid for sour milk; and the immediate effect was to reduce the time from eight to four months. In 1785 a French chemist suggested the use of chlorine as a means of hastening the process, and in the last year of the eighteenth century a compound of this gas, with lime, was introduced by Tennant, of Scotland. The development of the cotton manufacture now became immense. By a happy adaptation of other chemical processes, in conjunction with the bleaching power of chlorine, the time required for the whitening of cotton and linen fabrics was at once reduced from months to hours, while the miles of outstretched calico, defacing the verdure of country districts, disappeared, the whole operation being carried on within the small space of an ordinary factory. The bleaching of calico now consists of a chemical operation of great precision.*

In the last edition of Ure's Dictionary of Arts and Manufactures we find this branch of the subject very fully handled. The writer does not recommend the use of mechanical means without retting, because of the loss that must ensue afterwards in the processes of bleaching, &c., and for other reasons. The brief abstract, of various attempts to break unretted stock, refers the first to Lee, of England, in 1815. Pollard, at Manchester, resorted to a similar plan in 1816 with no better success. In France and Belgium similar plans were tried, and found impracticable. In 1850 and 1857 Donlan revived the project, but the same fatal objections prevented success. The fibre was loaded with impurities that made the apparently greater yield, all of which had to be got rid of afterwards. It is admitted that the "dry separated" material may be useful in manufactures where no bleaching is required, and where strength is needed. To the remaining forcible objection that the elements of decay are present in the fibre, it is claimed that such material may be used in the preparation of coarse fabrics like tarpaulins, that are to be invested with a protecting coat of tar, or for such as may be subjected to the kyanizing process.

With all these facts before us, we could but look with hesitating approval upon the claims of Mallory & Sanford, that their machines could break unretted flax. The specimens before us were quite satisfactory, it is true, excepting that we found some breaking of the harls, and a harshness arising from the presence of the dry glutinous matter among the fibres; but the boon had been thoroughly broken up, and the shives were well separated from the fibre both in the contributions to the museum and in green unretted stock that was broken upon the machine before our eyes. The rupture of the filaments must result in an increase of tow in the scutching and heckling processes, and, moreover, the elements of destruction would, to a certain extent, still remain among the fibre, ready to cause a change whenever exposed to the requisite degree of heat and moisture, so that the use of flax from unretted stock appeared to be limited to a few subordinate branches of the arts. Our attention was next directed to the use of this material in some of the different modes of preparing flax cotton, and we are happy to be able to report most favorably upon the results so far as they have been reached, for it appears that the unretted fibre is much more easily treated in the processes of disintegration, and that the product needs no additional bleaching, whereas the blue or gray tint consequent upon retting is known to be very difficult to eradicate.

At the International Exhibition held at London, in 1862, the jury make the following remarks in their report upon flax and hemp: "These important fibres are exhibited on a large scale, and in many instances the samples show the results of admirable management. Both have been prepared by all the various methods which have been invented for separating the fibres, except the empirical one, which, in 1851, led a majority of the jury to award a medal to Chevalier Claussen."

Belgium stands first, with its beautiful flax fibres; then northern France, Italy, Russia, and Hungary. Hemp is best shown by Italy; next, Hungary, Russia, France, and Germany.

From Canada, (Toronto,) cold-water retted, middling quality, mill-scutched, and being ripened for seed, is not very strong.

From Newfoundland tolerably good, but much injured by a very injudicious operation, namely, dressing it with oil, a practice which is calculated to depre-

* Watts's pamphlet.

ciate it rather than to raise its value in the eyes of those skilled to judge such materials.

New South Wales—*Linum angustifolium*, (native.)—The jury believe that at no distant period it may become an important product of the colony. Also from Tasmania, Queensland, and Victoria, the same.

Hemp.—Among the French hemps was one from Messrs. Leoni & Cobleng, who have introduced a practice of preparing it without retting, using mechanical means for disintegrating the stalk and separating the fibre from the bark and medullary matter. The hemp so prepared appeared to be of a very useful quality, but it requires long and extensive experiments to prove that the strength and durability of the fibre are unimpaired by this process.

Italian hemp ranks highest in the exhibition; irrigation used.

Garden hemp of Italy, fibre six feet long, the color light and bright, and the fibre beautifully soft and flexible.

They represent the product of the European provinces of Russia to be—flax, 165,000 tons; hemp, 103,000 tons.

Export of Russia, annual average, from 1846 to 1860:

	Tons.
Flax cleaned	55,777
Tow and codilla	10,747
Hemp cleaned	44,087
Tow and codilla	20,001
Hempen yarn for cordage	19,980
Total	150,592

200 tons go eastward.

The high character of this product is owing to water-retting, which is universal, and to hand-scutching; no machine process is used.

The finest flax has been produced in Russia, equal even to the Courtrai of Belgium.

	Tons.		Tons.
In Austria, in 1860, the amount of hemp grown	50,000	Flax	100,000
Excess imports over exports	2,400		3,000
Totals	52,400		103,000

Spain, very short staple.

They found that Schenck's process of steeping in hot water is employed with advantage in Silesia.

What generally struck the attention of the jury were the fibres, yarns, and cloth of attractive appearance and superior quality obtained from ordinary flax treated by the Belgian process of Lefebure. The fibres thus prepared keep the regularity, the brightness, and the strength which are characteristic of superior finished yarns. They are refined, divided, and prepared in such a manner that the yarns and cloth made from them are sufficiently white for partial bleach, without being creamed. The jury found some tow yarn as fine as 150 leas from France, and some English still higher. There were also some yarns 520 leas, very fine; 350 is limit of fineness, generally used for practical purposes. They report great progress in mill-spun products since previous exhibition, especially by the French.

In Courtrai they are superior in hand-spun yarns, reaching 800 and 1,000 leas, but these are only used for the most expensive laces.

M. Alcan, the reporter, on behalf of the jury, explains why the flax manufacture has remained almost stationary, while the manufacture of some other etxtiles has wonderfully increased:

"We notice, in the first place, that though flax is a material most easily adapted for spinning yarns, being produced by hand labor quite equal to silk in fineness, and though the raw material of flax in the state of fibre is about the same price as the better kinds of cotton, the yarns produced from flax by machinery, taken in equal length for the same weight of fibre, appear to cost the most of all. We must also acknowledge that it is with the greatest difficulty that flax-spinners have been able to produce by machinery yarns of an extreme fineness, though still inferior in this respect to the fineness of the cotton yarns. As a principle the fundamental operations for the spinning, except perhaps the preparation of the raw material, are the same for all fibrous substances. The combing or carding, the drawing and spinning, constitute, without any important distinction, these various operations, still such will cost much more for some one of these materials than for others, even though this material may not possess a nature deficient in spinning qualities.

"The cause of this difference is that the more costly fabric is produced from material which is worked with greater practical difficulty, and requires more effort to complete; this is especially the case with the flax, the machinery for which must be decidedly stronger than that used for cotton, and the whole flax-spinning system must also have much more steam power applied, in consequence of the flax fibre not being sufficiently purified and freed from all heterogeneous substances, which, of course, present an obstacle to the sliding or drawing, the base of all spinning operations. On the present occasion we shall endeavor to give some explanation on the subject of steeping flax, this being the principal process by which more or less softness or purification of the fibre may be obtained.

"The great fault of the flax fibre is the excessive quantity of gum, which is not extracted by the present steeping process; when a new process shall have been discovered to remove completely this objection, there is no reason why flax fibre should not be spun as easily and as fine as cotton. It is to be hoped, also, that by such improvement we may eventually obtain a class of yarns more elastic, and that the cloth made from them may weave more readily, and in the end give greater satisfaction and durability. If we pass from the flax fibre to that of hemp and other similar substances, we find the hemp inferior to flax in softness and minuteness of subdivision, making it more difficult to spin; we find also that China-grass has the same defect in a much higher degree, while it is also much more costly. If jute manufactures have made such rapid progress it can be easily accounted for by the low cost of material, combined with a considerable amount of spinning quality.

"We may remark, before concluding these reflexions, that great attention is now being given to the flax-steeping process, and in consequence the real cause of the difficulty of the fibre for spinning, as explained above, has thus become every day more generally known. We may hope, therefore, that at no late date the process of steeping will be improved to an extent equal to the great progress which the other manufactures, dependent on the aid of chemistry, have lately made. The Lefebure process, and the products thus prepared, as well as some other attempts in the same direction, constitute an important step, which causes us to anticipate some advantageous results from a more perfect and rational mode of steeping. Having so fully referred to the steeping process, the importance of which can scarcely be exaggerated, we may remark, in conclusion, that the greatly enhanced cost of flax during late years has caused a considerable advance in the cost of all kinds of pure linen goods, which fact has, without doubt, in some degree, contributed towards the want of advance in the linen trade, which has already been referred to. By extending the cultivation of the flax plant to some other countries, greater cheapness in the cost of the raw material may be attained. We believe the north of Europe is well adapted, by climate and by cheapness of labor, as well as inexpensive soil, for a greater extent of this cultivation, and can hope so desirable an object will not be lost sight of."

Letter from E. Towne.

UTICA, N. Y., *February* 22, 1864.

The sample marked 1 was manufactured from fine tow, as made by flax dressers, which contained nearly fifty per cent. of shives and dust; the latter were mostly separated by a machine called a willow, or duster, but leaving some shives so firmly attached to the fibre that it was next subjected to the picker, which removed most of the balance of the shives, and also broke or shortened the length of the fibres. The cleaned tow was then boiled in an alkaline ley for eight hours, then, after being well washed, was steeped in dissolved chloride of lime twelve hours, then drained, then put in sour liquor for two hours, then washed in clean water, then the boiling, steeping, &c., in new-made liquor repeated.

If, at this stage, the fibres be not found of desirable fineness, they may be further divided by soaking in a strong solution of bicarbonate of soda, and then in a sour liquor. It is deemed best not to divide the fibres too much in the earlier stages of bleaching, as thereby they would be weakened so much as to break more in bleaching.

After being dried, the matted fibres are separated by passing through a picker, or strong cards, made for the purpose.

The loss in weight by full bleaching clean dew-rotted tow, including the loss in dust and light particles, is about thirty-seven and one-half to forty per cent.