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DOMINION OF CANADA

DEPARTMENT OF AGRICULTURE

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A REVIEW OF THE STATUS AND POSSIBILITIES OF FLAX
PRODUCTION AND MANIPULATION IN CANADA.

BY

Jas. A. MacCracken.

PUBLISHED BY AUTHORITY OF

Hon. MARTIN BURRELL, Minister of Agriculture, Ottawa, Ont.

OTTAWA

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HISTORY AND PRESENT OPPORTUNITY.

The beginnings of flax culture in Canada date from the time of the pioneers. The flax plant accompanied their footsteps to help furnish apparel as naturally as wheat came with them to furnish food. Flax has played that very rôle with every migrating race in history.

Until the advent of machinery and rapid transportation, all the operations required on flax between sowing the seed and weaving the cloth were performed by hand, as is the case in certain communities even to this day. This was true of Ontario farmers, as of all others. The farmer was his own grower and manufacturer.

An idea of how extensively flax has been cultivated for fibre in Canada may be gathered from the following table:—

PRODUCTION OF FLAX AND LINEN IN CANADA

Year.	Upper Canada. Ontario.	Lower Canada. Quebec.	Total.
1734.....			92,246 lb. fibre
1827.....		1,313,600 lb. fibre	
1861.....	37,055 yds. linen.....	1,021,433 yds. linen..	
1871.....	25,502 " "		
1891.....	{ 5,477 " " 40,760 cwt. fibre for export.		
1915.....	16,000 cwt. for export (estimated).		

For various reasons that need not be discussed here, machinery has been slower in displacing hand-labour in flax working than in the case of most other products of the soil. The result is that the least progressive of the great nations (judged on the score of machinery), is by all odds the greatest producer of flax fibre. That country is Russia. Russia supplies over 80 per cent of the flax fibre that enters commerce.

The duration of the pioneer, or home-manufacturing, stage in flax culture was very short in Ontario. What with the age-old, peculiar prejudice against flax as a soil exhauster, the lack of machinery for harvesting flax, and the growing preponderance of machine-woven as against homespun garments, the Ontario farmer commenced to grow flax for seed production, approximately on the scale and after the manner of cereals, that is, in a rotation, or else grew no flax at all.

At this point some enterprising men built flax mills in small centres in the south-western peninsula of Ontario, and thereby made it possible for the farmer to continue growing flax for fibre. These mills proved so successful in the early stages that by 1871 they had increased in number to about thirty-five, and by 1891 to probably forty. Among the advantages they offered to the farmer were:—

- (a) quick cash returns guaranteed on rentals; or
- (b) a ready market for flax straw in the sheaf.

In spite of crude methods, rough machinery, and lack of adaptability to changing conditions, these flax mills prospered so long as there remained plenty of flax workers of the first and second generations of immigrants from flax-working

countries like Ireland, Holland, and Germany. Even in the face of growing difficulties, however, a majority of the mill operators failed to see the immediate necessity of such redeeming measures as better processes, more extensive machinery for field and mill, and government co-operation for marketing and cultural instruction. As a result, the number of active flax mills had dwindled by 1910 to fifteen, and the area under fibre flax to about 5,000 acres.

Ireland, likewise, has suffered a marked decline in flax production within the past half century. The acreage under crop in that country has fallen from 194,823 in 1870, to about 50,000 in 1915. However, in spite of widening spheres in the use of cotton, jute, and hemp, there has arisen in recent years a lively demand for a flax fibre approximating in quality the better grades originating in Belgium and Holland. The exceeding devastation attendant on the invasion of Belgium by the Germans has merely added urgency to this situation.

A few Canadian farmers and flax men have been quick to catch the lesson and profit by the opportunity. As this is written, the tide of flax revival is reaching the remoter portions of the former flax area of southwestern Ontario. Already the number of flax centres that promise to resume activity during 1916 is approaching thirty.

NEW PHASES OF THE INDUSTRY.

With this revival, better cultural methods and newer manufacturing processes will probably be put into practice. Just as a generation ago the tendency toward centralization took the form of one mill for farms within wagon haul, so now some mill men propose to carry this principle still further by handling at a central mill the flax crops grown about various towns and villages connected by railway with the central plant. The advantages of this system have been proven in Belgium and Ireland, in reference to both retting and mill operations. The central retteries on the river Lys in Belgium handle flax from points in Germany, France and Holland. By this method, more systematic management, economical equipment, and other advantages are available to offset the expense of baling the flax straw and of rail haulage from contributing stations to the central plant.

The advantage of this system to the farmers remote from mills is obvious. Heretofore, for those beyond hauling distance by team, there were no profitable arrangements for marketing fibre flax.

IS FLAX SUITABLE TO OUR SOIL AND CLIMATE?

This question involves not only the consideration of absolute suitability in itself but indirectly the related issues connected with cultural methods, rental prices, labour, machinery, business enterprise and markets. Supremacy in any given sphere of endeavour depends on the second set of considerations more nowadays than ever before. In point of absolute suitability for flax, the soil and climate of Ireland are probably no more favoured than those of England, where for other reasons flax crops have practically disappeared. To balance the disadvantage of higher cost of labour and living conditions than exist in Europe, Canadian flax growers potentially enjoy cheaper and more uniform land, more uniform crops, and greater economy of manufacture by the wider use of machinery. It is through such factors nowadays that success in any industry is usually determined.

These factors aside, we are convinced that the soil and climate of the Great Lakes and St. Lawrence regions of Canada and western British Columbia are well suited to fibre flax culture. Hundreds of fields of fibre flax, true to the highest standards of quality, have given birth to this conviction.

In strength, Canadian flax has repeatedly been declared equal to the better grades of Irish flax, and in the qualities that please the spinner of the finer yarns various specimens of Canadian fibre, carefully worked, have won a high reputation.

CUSTOMARY CROPPING METHODS IN ONTARIO.

TONNAGE METHOD.

During the first few decades of our present system of co-operation between farmer and factor, the farmer handled his own crop for the most part, and sold the straw, seed on, at the mill. This constituted the first step in advance of the home-working stage. Certain conditions arose, however, to make this method lose favour, and to shift the initiative in flax-growing from farmer to factor. The reasons for this change were:—

(a) Diminished areas of new lands, these being mistakenly thought to produce the best flax.

(b) Increased labour expense at flax harvesting, compared to the effective harvesting of other crops by machinery.

(c) The growing prevalence of diversified farming whereby the produce of the farms was largely consumed at home.

The flax man, be it said, was too often forced to choose between inferior straw and a shortage of crop. The importance of more careful harvesting of flax than of other farm crops was hard to impress on the average farmer of that day.

STRAIGHT RENTALS.

For such reasons, the tonnage method gradually gave way to the straight rental system whereby the farmer rents his available fields, tilled, at a fixed price per acre, and in some cases agrees to perform the seeding and hauling of the harvested crop to the mill. This arrangement relieves the farmer of all responsibility after the land is tilled, and assures him of a fixed compensation, usually paid at harvest time.

But because of certain human peculiarities, the rental price for all sorts of fields in a given locality ordinarily becomes the same; so that under this system there is less inducement for the landowner to offer his best fields for a flax crop. Other difficulties of various kinds make the straight rental system only relatively satisfactory. At some flax mills, a combination rental and tonnage arrangement has been recently introduced, and found to give the best satisfaction.

THE COMBINATION METHOD.

In this arrangement, the farmer is paid a fixed price per acre and so much additional when the tonnage reaches a certain figure. Thus, at one mill, \$12 an acre is the ordinary amount guaranteed, this being raised to \$14.50 when the yield of straw, seed on, reaches 2½ tons per acre.

The main recommendations for this form of contract are:—

(a) Compensation according to quality of soil and care in cultivation.

(b) Better flax for the mill operator.

(c) More interest in the crop on the part of the farmer.

THE RENTAL SYSTEM—WHY ADOPTED.

The farmer's choice of a crop occasionally depends on forces entirely beyond his control. Certain conditions dictate to him in this matter. The universal cropping of flax on new land is an example of this rule. Flax bears well the task of subduing virgin soil. Flax pulled by hand can be harvested, no matter how rough or stumped the surface of the field. Flax gives sure and early returns.

Of late our farmers have been confronted by the harvest labour problem. The withdrawal of thousands of seasonal labourers for war purposes aggravates this situa-

tion. In such a pass the farmer looks about him for some means of devoting a field or two to paying purposes that will relieve him of labour responsibilities, especially at harvest time. From this motive many contracts for flax rentals have been made.

Spring ploughing the second year after sod frequently discloses a potential scourge of wire worms. The farmer knows that a cereal crop would go down before the pest. He learns that flax is practically immune from attacks of the wire worm.

Such influences as the above are outside any ordinary system of farming that has to do with crop rotation. As a matter of fact, Ontario farmers, unlike their European brethren, have never planned to keep flax as a permanent crop. One reason for this has been the lack of a well-organized system of up-to-date mills. Without mills, operated either by co-operation among farmers, or by separate interests, there is no market for flax, just as without sugar factories there can be no demand for sugar beets, but the reasons for the farmer's lack of attention to fibre flax are chiefly the following:—

- (a) Flax is supposed to impoverish the soil.
- (b) Nothing is returned to the land, either in the way of stubble or as manure.
- (c) Flax is vexatious in the matter of harvesting,—it being the tradition that fibre flax must be harvested by pulling.

THE FLAX FIELD—ITS CHOICE AND CULTIVATION.

IS FLAX UNDULY HARD ON THE SOIL?

On the first of these objections, which dates back at least two thousand years, there is a great deal to be said. On the whole, we are inclined to accept the reports of scientific investigators rather than traditional opinion. Below are given tables prepared to show the mineral requirements of both seed flax and fibre flax. The former is from a bulletin by Prof. H. L. Bolley, of the University of North Dakota, the latter from one issued by the Dominion Department of Agriculture.

COMPARATIVE DRAFT on the Soil by Seed Flax and other Crops.

TABLE A.

Crop.	Nitrogen.	Phosphoric Acid.	Potash.	Lime.	Silicon.	Ash.
	lb.	lb.	lb.	lb.	lb.	lb.
Wheat, 20 bushels.....	35	20	35	8	116	210
Barley, 40 bushels.....	40	20	38	9	72	216
Oats, 50 bushels.....	50	18	45	11	75	205
Corn, 65 bushels.....	75	20	60	12	90	200
Peas, 30 bushels.....	—	25	60	75	10	240
Mangels, 10 tons.....	75	35	150	30	10	350
Potatoes, 150 bushels.....	40	26	75	25	4	125
Flax, 15 bushels.....	54	18	27	16	3.5	87

COMPARATIVE DRAFT on the Soil by an average acre of Fibre Flax, one of Wheat,
and one of Oats.

TABLE B.

Flax.	Nitrogen.	Phosphoric Acid.	Potash.
	lb.	lb.	lb.
For the seed, 840 pounds.....	26	14.86	9.28
For the straw, 2,000 pounds.....	20	9.00	28.00
Total.....	46	23.86	37.28
Wheat.			
For the grain, 1,500 pounds.....	28.50	12.68	8.54
For the straw, 2,200 pounds.....	12.03	4.96	20.57
Total.....	40.53	17.64	29.11
Oats.			
For the grain, 1,700 pounds.....	32.13	10.48	8.05
For the straw, 2,200 pounds.....	13.90	4.74	24.83
Total.....	46.03	15.22	32.88

The variations in the above figures, chiefly in respect to the potash, are, in our opinion, to be attributed to two causes:—

(a) The straw of the seed flax, as gathered by Professor Bolley, formed a smaller proportion of the total weight examined than was the case with the fibre flax tested in table B. Though Professor Bolley does not give the various weights of straw, we presume that, as usually happens, the proportion of seed flax straw to total weight in his experiments was less than in the case of the wheat, oats, barley, etc. The straw of flax, it will be noted, requires more plant food than the seed.

(b) Fibre flax, at the period of harvesting, i.e., before full maturity, is in possession of more potash and nitrogen (though less phosphoric acid) than when fully matured. Prof. Harry Snyder, of the University of Minnesota, investigated this question about twenty years ago, and prepared the following table of results:—

TABLE showing Rate of Absorption of the Food Elements from the Soil by Flax, and the Formation of Organic Matter.

—	Total Mineral Matter.	Total Potash.	Total Phosphoric Acid.	Total Lime.	Total Nitrogen.	Total Organic Matter.
	p.c.	p.c.	p.c.	p.p.	p.c.	p.c.
Before bloom.....	60	55	35	32	55	40
In full bloom	88	90	70	64	80	75
Seeds well formed.....	100	98	98	98	100	95
Ripe.....	98	95	100	100	98	100

Turning to actual cultural practice, we are on somewhat safer ground when we hear through Professor Bolley that wheat does better after flax than after wheat. Mr. William Forrester, of Mitchell, Ont., a flax grower of over forty years' experience, records two excellent successive crops of fibre flax on the same field. Mr. Howard Fraleigh, of Forest, Ont., tells the writer that it is not uncommon for him to rent a field of rich sod two years in succession. Frequently the second crop is considerably better than the first. Professor Bolley reports having grown a disease-resistant type of seed flax year after year for sixteen years on the same land with satisfying results.

On close examination it is not difficult to discover why flax should be wrongly stigmatized as a robber crop. Its facility in withstanding the debilitating effects of excessive fertility has exposed it to the charge of exhausting that fertility.

The objection that nothing is returned to the soil after a flax crop is of small or great moment according to the proportionate area of the farm under this crop, and to the nature of the allied branches of farming undertaken. Generally speaking, the diversified methods in southern Canada are capable of affording a regular place for flax in crop rotation without impairing the fertility of a soil. This is a matter, however, that depends too closely on individual conditions to admit of general conclusions in the space at our disposal.

SOIL SELECTION.

The flax plant is not at all fastidious regarding the character of the soil, providing cultural methods and weather conditions are satisfactory. In flax croppings in Canada, it usually turns out that the type of soil is, of many factors, the last and least taken into account. This happens, not because flax growers are indifferent to the character of the soil to be employed, but because practically all the clean arable areas within the flax-growing region are suitable as to soil for this crop. It is interesting to note that the very field an Ontario flax farmer might reject for flax, on the ground of an excess of sand, is the very field that in certain moist climates, or in moist seasons in Canada, would likely give a high yield of excellent flax. The explanation of this is that a light type of soil frequently supplies for the flax plant the loose, friable condition it prefers. Experiments conducted both in the state of Washington and in Ireland many years ago demonstrate the suitability of light soils for flax in moist, equable climates.

ANALYSIS of three kinds of Soil that were found to be highly favourable for Flax Culture in Ireland.

(From "On Flax" by W. Charley.)

	No. 1.	No. 2.	No. 3.
	p.c.	p.c.	p.c.
Silicon 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.....	0.06	0.25	0.31
Carbonate of lime.....	1.09	0.53	1.67
Magnesia and alkalies, with traces of sulphuric and muriatic acids..	0.32	0.25	0.45
Organic matters.....	4.86	6.67	9.41
Water.....	7.57	11.48	8.73
Total.....	99.78	99.58	100.11

ANALYSIS of Celebrated Flax Soils from Russia, Belgium, Holland and Ireland.

(From "On Flax," by W. Charley.)

Per cent of Silica.	Russia Average of two samples.	Belgium Average of two samples.	Holland one sample.	Ireland Average of two samples.	Ireland Slob land of Lough Foyle.
	p.c.	p.c.	p.c.	p.c.	p.c.
Silica.....	82.21	83.93	60.94	69.32	79.36
Lime.....	0.45	0.35	0.36	2.36	1.19
Alumina.....	6.93	1.29	5.66	7.81	3.31
Iron.....	Traces.	Traces	6.04	0.45	7.49

In the Great Lakes region of America, because of somewhat greater range of temperature, less uniform moisture, and an occasional drought, the light soil is at a disadvantage. It has been frequently noted, moreover, that flax seed sown on light soils of "new-breaking" woodlands occasionally suffers during heavy rains from being washed down the steep slopes of the knolls into the hollows.

A prominent Ontario grower asserts that the only lands barred by him are mucks and white clays. As to all other types of soil, his only stipulations are freedom from weeds and proper cultivation.

CULTIVATION.

Granted that, in our climate, the most suitable soil is actually the well-drained, fertile clay loam, we must see to it that this land is cultivated so as most closely to

Photo by courtesy of Howard Fraleigh, Forest, Ont.
A Belgian Flax Grower broad casting by hand.

approximate the mechanical condition of a sandy loam. Therein lies one of the secrets in flax cultivation. On such lands and on clays, deep fall ploughing after all crops, except perhaps corn or roots, is the best practice. Depth is emphasized for the reason that, when possible, the delicate filaments of the flax root penetrate almost as deeply below the surface as the stem rises above it. Hoed crops have already entailed what fall ploughing on stubble or sod provides, an assurance of a solid moisture-retaining foundation for the seed bed. The frosts of winter are the silent but sure pulverizers of loams and clays. After such preliminary preparation, double discing, thorough harrowing and rolling in the spring will make the ordinary land fit to receive the flax seed.

Where the clods still remain stubborn, extra precautions are necessary. Some Canadian farmers use the stiff-tooth harrow, upside down. In European countries, where labour is cheaper and more plentiful, women and children go about with wooden mallets pulverizing the resistant lumps when dry. This practice is mentioned, not as a method for Canadians to adopt, but merely to emphasize the importance attached to the necessity of a very fine seed bed for flax.

When weeds are encountered in the crop preceding flax, careful farmers harrow the field immediately after harvest so as to cause germination of any existing weed seeds. The late fall ploughing rids the ground of these. On rich land that is being cleared of weeds over a period of years, a corn crop, thoroughly cultivated, is found to be the most suitable to precede flax.

FERTILIZERS.

There are few complaints of a soil being too rich for flax. An excess of humus, however, produces an over-growth of wood at the expense of fibre. Though flax is spoken of as the pioneer crop, the best fibre flax is actually grown on old lands. The element most commonly wanting in lands too poor to produce good flax crops is potash. Experiments conducted under the supervision of the Irish Department of Agriculture over a period of twelve years are summarized as follows:—

(1) The use of potassic manures, e.g., kainit, muriate of potash and sulphate of potash, gave profitable increases. Kainit and muriate of potash, which showed almost equal merits, gave better results than sulphate of potash.

(2) The winter application of kainit, and also muriate of potash, gave almost similar results to those obtained when these manures were applied at the time of sowing. The time for applying either of these manures may, therefore, be left to the convenience of the growers.

(3) The application of agricultural salt was not remunerative.

(4) Phosphatic manures, applied either singly, in combination with a potash manure, or as part of a complete mixture, encouraged the growth of weeds at the expense of the flax, and their use was almost invariably attended with a loss, and very frequently even with smaller yields of scutched flax.

(5) Profitable increases were in many instances obtained from the slow-acting nitrogenous manure, rape meal, when used in conjunction with kainit. The results, however, varied to such a degree in different seasons, that the use of this mixture could not be recommended in preference to dressings of either kainit or muriate of potash.

(6) The addition of the nitrogenous manure, sulphate of ammonia, to muriate of potash gave, on the average of all centres, profitable increases in three seasons out of four. Owing to the variations in the results obtained at different centres and in different seasons it was not possible to make a definite recommendation as to the use of sulphate of ammonia.

In Japan also, it may be noted, flax growers have discovered that the use of phosphates is of practically no benefit to flax. The common form of fertilizer used by the Japanese directly for flax is liquid manure.

If one sought to replace the mineral constituents consumed by an average acre of flax he would have to buy, according to the late Dr. Hodges, of Queen's College, Belfast, the following materials:—

	Pounds.
Muriate of potash	30
Common salt	25
Burnt gypsum	34
Bone dust	54
Sulphate of magnesia	50

Where mixed farming prevails, as in southwestern Ontario, barnyard manures constitute the main form of soil enrichment. These have ordinarily been found ample to maintain the average farm in a satisfactory condition. One precaution must be taken in applying barnyard manure for flax. The manure must be well composted. This effect is usually secured by applying the manure for the crop preceding flax. Coarse, undecomposed manure applied to the flax crop directly produces an uneven stand and fibre of poor quality.

SEED AND SOWING.

The exact reasons why Canadian flax growers, like those of almost every other flax-growing country except Russia, have never been able to evolve successful strains of fibre flax are uncertain. It seems fatuous to admit that the thing is impossible. Russian growers use Russian seed year in and year out, never going farther than to the next province to secure a fresh supply. Various field investigators in America have found reason for believing it feasible for us to develop our own seed.

It is quite possible that fibre flax growers, finding final seed-ripening in the stand to be incompatible with fibre production, grew neglectful of their seed plots, and thereby founded their opinion on crops from undeveloped seed, which naturally proved incapable of producing vigorous plants. Such a misconception probably explains the false notion still current in parts of Ireland—that fibre production and seed production cannot be carried on together.

It must be noted that the Russian method of saving the seed is far more careful and painstaking than ours. Cleaned flax seed rapidly deteriorates unless thoroughly dried and freed from dampness. The Russians remove portions of the stems at the seed end and tie these uniformly about a pole in the field. When air-dried, they are removed to a moderately heated room and thoroughly dried, before threshing.

About twenty-five years ago Professor Wollny, a European experimenter, discovered that by heating flax seed for twenty-five days at a temperature of 110° F. both more seed and more fibre resulted—a normal increase being about 25 per cent.

There seems to be no reason why Canadian growers cannot create characteristic types of Canadian seed. The task seems simple in view of the success of Professor Bull, of the University of Minnesota, in evolving Minnesota No. 19 fibre flax from Minnesota No. 25 seed flax.

We must point out here a recognized drawback that seems due entirely to the practice of using imported seed. Fibre crops in this country invariably suffer unduly when a drought occurs. European strains of flax are less accustomed to droughts. Professor Bolley has succeeded in creating a disease-resistant type of flax. It remains for some Canadian to attempt the development of a new Canadian fibre flax better suited to our conditions than any we now have.

The importance of seeking Canadian seed rests far more in the prospects of improving the length, quality, uniformity, and hardiness of the plants than in the mere matter of the cost of using imported seed every few years. The average crop of 200 acres to a flax centre requires, however, when sown at the rate of 84 pounds to the acre, 300 bushels. At the normal price of imported seed, \$3.50 a bushel, this means an expenditure of \$1,050. At present, imported seed costs between \$5 and \$6 a bushel.

BLUE BLOSSOM AND WHITE BLOSSOM FLAXES.

The fact that, in Ontario, white blossom Dutch seed grows several inches longer, ripens two weeks later, and yields several bushels more seed per acre than does blue blossom Dutch seed, is of great consequence to flax growers. However, the advantages may quite easily be overestimated unless flax men take care to avoid mixing the two kinds. Some foreign authorities have declared that the fibre of white blossom is less plentiful and poorer in quality than that of blue blossom. Canadian flax men have not yet had time to come to any conclusion as to the soundness of this opinion.

Nor is the matter of comparative qualities at all vital to us now. For the purposes to which our flax is devoted the difference between the fibre of white blossom and that of blue blossom is probably so slight as to be negligible.

GERMINATION AND RATE OF SEEDING.

The loss caused by an uneven stand of fibre flax is so great that the connection between germination and rate of seeding needs careful study. To say that Canadian growers sow at the rate of 84 pounds to the acre means nothing definite unless one knows what percentage of the seed so sown is capable of germinating. If one grower sows 84 pounds of 95 per cent seed, and a second 84 pounds of 80 per cent seed, there will likely grow on the former's field, ninety-five plants to every eighty in the latter's. These illustrative differences in germinating power represent actual average differences between Dutch and Russian seed, according to Dr. J. Vargas Eyre, in the *Journal of the Board of Agriculture*, London. The reason for this difference is supposed to be the Russian practice of oven-drying the seed. Dr. Eyre recommends that on the basis of 84 pounds 100 per cent seed to the acre, one-quarter bushel extra should be added for each 10 per cent drop in germinating power.

Germinating tests are easily conducted. If groups of 100, not specially selected, seeds be sown between strips of moist sod or wet cloths and set in a warm place, a few days will suffice for the germination of the viable seeds. From these tests, the germinative power of the whole lots can be determined.

SEED CLEANING.

Owing to the fact that flax, because of its slender rootage and thin crown, is not a good weed fighter, extra precautions are necessary in cleaning the seed for sowing. Certain weed seeds, from similarity in shape and size to flax seed, do not separate readily. Such is the seed of false flax. Other seeds, like wild mustard and Russian thistle, are globular in shape and hence are not so much affected by the blast of air in the fanning mill as are flat seeds. These facts are mentioned to emphasize the need of careful cleaning by means of various types of screen, and sometimes of cleaning by pouring the seed from a scoop across the blast of air. Every Ontario flax mill uses a hand-made seed cleaner, and a few have installed the excellent Clipper mill, which separates the seed into four divisions according to size and weight.

SOWING.

The shortness of our growing season, ninety to ninety-five days, as compared with that of European flax countries, 100 to 110 days, makes it important to get the seed into the ground just as soon as possible after the awakening of vegetation in the spring. Time lost at the beginning of the season is rarely compensated for at the close. A backward spring usually involves a short season. We have, however, discovered no record of the exact loss in final yield of flax caused by each day's delay in seeding after the land is fit. In the case of oats (the worst sufferer among cereals), each twenty-four hours' delay in seeding is said to diminish the final yield on the average about 56 pounds of grain to the acre.

Although flax once frozen is permanently injured, there are few records of loss from this cause in Ontario. In the few known cases, the damage was usually done

in June, and we can ordinarily make no provision against June frosts. On the other hand, there are numerous examples of low yields due to a curtailment of the growing season, which would have been offset by earlier sowing. It is regrettable that flax is usually relegated to the last place in the order of sowing.

So vital a matter is timely sowing that flax growers will do well to keep in touch with a few skilful hand sowers to supplement the work of the broadcast seed drills. A good hand broad-caster working one-handed, can cover from 6 to 10 acres in a day of ten hours, and from 12 to 15 acres when using both hands in sowing. The capacity of an ordinary 8-foot broadcast flax seeder, operated by a horse and man, is about 18 acres a day.

An important advantage of hand broadcasting over machine sowing is that a man's tracks leave no deep pits in which seed may be lost or buried too deeply for a uniform growth to result. Unless the hand work is well performed, however, the use of the drill is to be recommended.

Though the best flax is obtained from fields (chiefly in Europe and Japan) on which no horse is allowed after the seed is sown, the prevailing Canadian practice has been to cover the seed with a harrow.

WEEDING.

The proper time for weeding in the culture of flax is before the weeds appear. The following influences, however, favour weed infestation to such a degree that constant attention to the subject is necessary:—

(a) The carrying of weed seeds by washing, wind, and animals.

Examples.—Milkweed, sow thistles, burrs, bindweed, Russian thistle.

(b) The retention of vitality for years by certain weed seeds when deeply buried in dry soils.

Examples.—Wild mustard and penny cress.

(c) Deceptive resemblances between pairs of seeds, of plants, and of blossoms.

Examples.—False flax seed and plant with true flax seed and plant. Wild mustard flower and salad rocket flower.

(d) The indigestibility of certain weed seeds and their occurrence in barnyard manure.

Example.—Tumbling mustard.

(e) Changeable shapes and exteriors of weed seeds.

Examples.—Evening primrose, black bindweed.

Flax, moreover, like the grasses, is sometimes blamed for the introduction of certain noxious weeds. The time to prevent trouble of this nature is during the operation of seed cleaning.

In Canada it has been customary to conduct one thorough weeding on crops of fibre flax before the plants have attained a height of 6 inches. The day selected should be a fairly dry one, when neither will the foot prints of the weeders make permanent impressions on the ground, nor the soil particles be so hard that the flax plant will be crushed by the weeders' feet. At early stages of growth, flax will recover after considerable trampling of a moderate degree, providing the plants are not bruised. Weeders are preferably well-disciplined children of light weight, barefooted or shod with socks or pliable soled shoes. Where possible the direction taken should be toward the prevailing winds, in order that the flax plants may be assisted in regaining a vertical position. Spudding the weeds is more speedy and less destructive to the flax than pulling them.

Late-sprouting weeds are necessarily missed by these regular weeders, sometimes even when two weedings take place. The painstaking flax grower sees to it that such noxious weeds as wild mustard are hunted down before the tell-tale blossoms have been shed.

HARVESTING.

The stage at which fibre flax is ready for harvesting is slightly variable according to the products to be obtained. Generally speaking, the sooner the flax is pulled after one notices the yellowing of the stems and the withering of the lower leaves the finer will be the quality of the fibre obtained. At this stage, however, the seed is still too doughy and immature for successful after-ripening of the same in the shock. Canadian flax men, therefore, ordinarily wait until the lower stems have turned yellow to a point about one-third the distance upward. A growing scarcity of help, especially at harvest time, has caused several growers to start pulling the first fields on the green side, thereby losing somewhat in yield of seed, rather than suffer loss of fibre by over-ripeness of those fields last to be harvested.

A ten-day extension of the harvesting time is afforded by the adoption of both the white blossom Dutch and the blue blossom Dutch flaxes.

FIBRE FLAX AND SEED FLAX.

Fibre flax, shown at the left, has tall slender stalks with few branches; seed flax has shorter, thicker stalks with numerous branches.

That the primitive practice of harvesting fibre flax by hand still obtains in Canada, and nearly everywhere else, is due at least partly, to the fact that in Russia, where the most fibre flax is grown, and hence where the prices are controlled, hand labour for all sorts of farm operations is still the usage. Were fibre flax extensively grown in Canada, it is quite probable that it would soon come to be harvested by machinery, either pulled or cut. Indeed, the lack of a pulling machine may be said to have greatly retarded the industry in this country. Therein is represented a large part of the difference in labour cost between this and European countries.

The arguments favouring pulling as against cutting, apply with still greater point when the flax is short in the stand. The two or three inches of straw lost by cutting does not, it is true, represent a proportionate amount of value fibres. The fibre nearest the root is coarser and less plentiful than that higher up the stem. Indeed, when a flax spinner wants some choice fibre he cuts off both ends of a hand-

A good sample of Canadian fibre flax.

ful and uses the centre but the ultimate loss in value occasioned by a generally reduced length of fibre is of considerable moment. It is, however, erroneous to hold that flax plants cannot be too long. Flax of an extreme length is difficult to handle well with the ordinary mill equipment, and it therefore entails a loss. Medium lengths are preferred, fibre of about 30 inches being most easily handled under Canadian conditions.

Some controversy has arisen as to whether cut fibre can be utilized by the spinner in making the high numbers of yarn. (It undoubtedly gives satisfaction in the coarser yarn.) This is one more of the old traditions about flax that cannot be refuted by the scant data here available. It may be said, however, that certain well-known spinners have expressed themselves as having no fear of difficulty on this score.

In general, the means of harvesting have come to be of the utmost consequence in Canada. An insufficient supply of the right sort of labour is largely the cause of mill abandonment and reduced acreage. For twenty years or more, recourse has been had to the American Red Indian from the various Indian reserves, who, in saving the situation for the time being, merely postpones the inevitable era of machine harvesting. In brief, the Indian has become so indispensable that he must be dispensed with. The fault with him is not the quality of the work he performs, but manifold troubles, such as preliminary coaxing and dickering and disappointment, his lack of responsibility, the coddling he demands for himself and family, his train of paraphernalia, and similar nuisances. While hand pulling is adhered to, the difficulties are not likely to be lessened, owing to increasing acreage and growing scarcity of white pullers.

Even were it possible by hand pulling to harvest all the flax seasonably, the high cost of the operation argues the need of machine methods. As the following table shows, the expense of pulling flax compared to value of the product is unusually high in the scale of ordinary Ontario crops:—

COMPARATIVE Cost of Harvesting Various Crops in Ontario, 1913.

Crop.	Cost of harvesting.	Value of product.
	Per acre.	Per acre.
Fall wheat.....	\$1.56	\$21.78
Oats.....	1.51	16.70
Barley.....	1.48	18.42
Corn (husking).....	2.28	28.60
Flax.....	7.50 (hand pulling)	28.00*

* Figured on the basis of 2 tons of seeded straw at \$14 a ton.

Flax is thus handicapped as a farm crop before it enters the stage of manufacture.

PULLING MACHINES.

The fact that, though inventors in both Canada and the United States have at intervals been working on pulling machines since about 1840, no thoroughly successful puller has been developed, is due, probably, less to the absolute difficulty of the task than to other causes among which may be noted:—

(a) Fibre flax has been confined mainly to the rough-surfaced timber lands, where for years after breaking there has been little demand for machin-

ery. On the other hand, our cereal grains have occupied the more level-surfaced areas. There has therefore been far less demand for machinery in flax harvesting (even proportionately to the magnitude of the crops) than for grain harvesters.

(b) The weeds and dirt pulled with flax when a machine is used are an inconvenience. Machines have no power to separate short or inferior flax from long flax, good or bad.

(c) In America, genuine flax operations have been centred about small mills, with no co-operative spirit among them.

(d) When flax becomes lodged, the task of pulling by machine is extremely difficult, if not impossible.

(e) The demand for a pulling machine has not been strong until recent years.

It is therefore unreasonable to expect that any flax-pulling machine should have attained the efficiency of the self-binder. Relief to the extent of a machine that would pull all the clean standing flax, leaving to hand pullers the task of gathering the remainder, is, however, a boon that appears to be within the grasp of Canadian flax growers. At least one machine of Canadian invention, of the old belt-pulley type, has proven in various trials that it can do that. By such means the cost of harvesting would be greatly reduced, and the crops gathered in a more satisfactory condition.

FLAX-PULLING MACHINE.

A pulling device invented by Charles H. Vessot of Ottawa, Ontario, taking the place of the cutting bar on a self binder or grain harvesting machine. The flax is pulled, thrown on the table, elevated, and bound like cut grain.

FIRST GRADING.

As flax spinners hold uniformity of fibre to be of high importance, progressive flax growers have seen the advantage of starting the grading process in the harvest field instead of only later on at scutching time in the mill. The Canadian practice

of leaving water furrows, when ploughing, always results in furrow flax being short, different in quality, and later in developing, than the flax on "lands." While this practice of ploughing flax fields by lands obtains, the flax grower would do well to pay 50 cents an acre extra on condition that pullers keep furrow flax and "land" flax in separate lots. This would enable the flax man to take the first essential step in grading, which of course must continue throughout later operations in field and mill.

THRESHING.

Though harvesting completes the farmer's active participation in flax preparation, it by no means terminates his interest in the working of the flax for fibre. His concern in the operations that follow the delivery of seeded straw at the mill is indirectly almost as intimate as is the flax man's in the cultivation of the crop. Success in the mill signifies more opportunities for the farmer.

Whatever may be the general effect of field-curing on the straw of fibre flax, it is the most effective method of after-ripening the seed so that it can be threshed out and cleaned in the flax mill. The old hand method, by which the thresher passes and repasses the ends of two sheaves several times between two iron rollers that revolve in close proximity in opposite directions, is still the universal flax-threshing process in Canada. A new invention consisting of several consecutive sets of such rollers, through which the seed end of the straw is carried automatically from the feeder's hands, has recently been patented by an American.

The difficulty with many types of machinery for flax processes is that they injure the fibre of the straw. The hand thresher encountering sheaves requiring varying degrees of manipulation to accomplish the removal of the bolls from the straw, can tell at a glance when the requisite work is done. Thus the fibre is saved from undue breaking.

Threshing removes between 30 and 40 per cent by weight of the cured crop. Of the mass of seed bolls, seed, dirt, and waste that falls from the threshing rollers, the percentage of seed is about 40, though this amount varies greatly.

Modern Canadian flax mills dispense with much handling of the straw after threshing by means of endless sheaf carriers and automatic bundle-tiers, but there is room for some improvement in the methods by which transportation is effected between the storage sheds and the mill itself. The time is at hand in factories when every facility and labour-saving device that can be installed is badly needed.

RETTING.

The bundles of threshed flax of inferior length or quality are kept separate from those of higher standards, and follow one of three possible courses. Some are put through a tow brake for the manufacture of green tow, used in upholstery; some are retted in a loose condition like hay, the resultant tow being of a quality suitable for twines; and some are retted in orderly rows, and the resultant fibre extracted in an untangled condition. To determine which method will prove most profitable for a given lot of inferior straw is one of the nice points about flax working. When the labour is skilled it is usually advisable to work into fibre all but the poorest grades of flax straw. In the flax industry efforts at improving the products for sale are well rewarded.

Though straight dew-retting, the usual Canadian practice, is inferior to water-retting, it is the only method that the majority of moderately skilled operators can employ in ordinary surroundings. The chief objections to dew-retting are the short season between harvest and snowfall, the exacting demands made by unfavourable weather, and the unevenness of the fibre obtained. This last-named feature has the most influence on the returns because usually those operators who follow dew-retting (whether here or abroad) are mainly those who find it difficult properly to grade their fibre.

The necessity of preventing entanglement of the straw involves its careful, even spreading in straight rows on suitable hay stubble or meadow sod. Grass sod or hay stubble, because of its comparative cleanness and capacity for holding the most moisture, is the most suitable. Clovers have this objection that the upstanding heads make their way through the flax straw, create unevenness of moisture distribution, and cause delay and confusion in later operations.

As a crop of fibre flax requires about as much surface for dew-retting as it occupied in growth, nearby farmers are usually relied on to allow or to offer the use of hay meadows. The same field may usually be occupied by two or three consecutive spreadings, depending on the favourableness of the season. Run-out meadows appear to be benefited by the residues left thereon during the retting process. An idea of the amount of this nourishment may be had from the fact that during the progress of dew-retting the straw loses between 20 and 30 per cent of its weight. In addition to this, spread flax aids in conserving moisture for the shielded grass during dry autumns, and protects the roots from the scorching rays of the sun.

TWO VIEWS OF A LIFTING CROOK.

Curvature of handle to right (or left) at right angles to direction of crook facilitates the operation of lifting the flax from the spread row into the gather arm to form a sheaf. The crook saves stooping and permits the lifter to gather his sheaf at almost a walking pace. Moreover, it protects the fingers from thistles, stubble, etc. The above crook is adapted to a man about 5' 11" in height.

So variable are the factors that affect the retting process that no stated time between a few days and several weeks can be fixed in advance for turning the rows of spread flax with the long straight poles used for this purpose. Likewise only careful watching can guide one as to the proper moments for lifting the flax and storing

it away for winter work in the mill. Lifting time is one of the critical moments in the dew-retting of flax. A continuous wet spell may carry the process of decomposition too far, resulting in weakened or ruined fibre; and flax lifted damp will be injured by moulds in the shed or stack.

The lifting is usually accomplished direct from the rows on a dry afternoon, or from so-called "wigwams" or stoolings—an emergency operation resorted to when it is necessary to arrest the over-retting of the straw during a continuous wet spell. The use of a properly-bent crook facilitates the lifting.

The retted straw is hauled to the mill yard and stored in stack or shed.

WATER-RETTING.

The abandonment of the early water-retting experiments in Canada is attributable to influences quite apart from failure of processes. One attempt was given up from lack of provision to minimize the additional labour involved, water-retting requiring somewhat more labour than dew-retting. A second failed because of community entanglements and complaints over the unpleasant discharge water. A third waned before "mill sickness" of the men scutching the malodorous water-retted straw. In no case was there an obstacle that should prove insurmountable in the face of a strong economic need of a better process than dew-retting. This need has been felt more and more strongly for years. To-day, when flax fibre is scarce and prices more favourable, no flax man is too dull to realize the advisability of bringing his mill up to the highest state of efficiency.

While the most profitable arrangements for water-retting are admittedly of the central plant type (where brains, money, skill, and power are concentrated), as exemplified at Courtrai, Belgium, and Dromara, Ireland, satisfactory results can be secured in small operations at scattered mill plants. It should not take long study for our Canadian mill forces to be able to water-ret flax straw as well as and more economically than the Irish peasants, and with results far superior to those secured by the Russian peasants. From analyses recently made of various sources of water supply at mill locations, there is little doubt of suitable water (free from excess of iron, lime, and magnesium) being available at many points in the flax area of southwestern Ontario.

Water-retting on a moderate scale at small centres requires no new equipment except tanks or water holes in which to ret the flax, and apparatus for filling and emptying the same.

To ensure success in the new direction without going too far at first, Mr. Howard Fraleigh of Forest, Ont., seems inclined, after some interesting experiments, to adopt what is termed "mixed retting"—a method followed to some extent in Russia. In this system the flax is removed from the water when about half "done," and the retting process is completed on the grass. At Forest the water was held in a tank, several more of which it is proposed to build in 1916. This tank is of concrete, 50 feet long by 15 feet wide by 4 feet deep, and is in two divisions. Each half is designed to hold about $2\frac{1}{2}$ tons of flax straw. The water is pumped from a nearby well by a gasoline pump. The well is 108 feet deep. (The outflow from the retting tank is from below and runs to a public ditch along the highway.)

An analysis of the water from the well showed it to be quite soft, its hardness, expressed in the Clark scale, being 5.25. Rain water expressed in the same scale is 3; upland surface water, 54; and some hard spring waters go as high as 185. Various conjectures have been made as to the cause of such unusual softness in well water. It may be noted that the well is only about 4 miles in a direct line from lake Huron.

Though the Fraleigh process of mixed retting is still to take definite shape, it is proposed to operate, to begin with, somewhat as follows:—

The empty tank is filled with sheaves, placed in a leaning direction. These are weighted with stones to prevent the rising of the flax after decomposition sets in.

MILL AND STORAGE SHED OF THE FOREST, ONT., PLANT.

The entire group of five buildings occupies a spacious quadrangle. Besides the structures shown in the photo the three near by are the granary, driving shed, and Indian labourers' house.

During night time the water is pumped in to submerge the flax. After several days—depending chiefly on the temperature—when the straw is about half-way retted, the water is drained off and the flax carefully removed and spread on an adjoining meadow as for dew retting. Here it is given an opportunity to complete the process of decomposition.

Some advantages claimed for the mixed method, as applied under Ontario conditions, are:—

1. Fewer tanks, less equipment, and smaller meadow area required.
2. Steadier employment for the workmen.
3. Less danger of loss from spoiled flax.
4. Fibre more uniform as to strength, spinning qualities, and colour.
5. As water-retted flax is ordinarily spread on the meadow after removal from the tanks it will be seen that there is no extra labour involved in mixed retting over that entailed in complete water-retting.

FINAL OPERATIONS IN THE MILL.

BREAKING AND SCUTCHING.

The care exercised in growing and retting a flax crop must be supplemented by the skill of the mill-worker in breaking and cleaning it. The operation of removing from the fibre the ligneous or woody part of the straw commonly called shives is the test by which to judge the effectiveness of the preparatory operations.

Properly retted flax of good quality gets rid of a great deal of its woody shive during the operation of breaking. If under-retted, the shive clings to the fibre, and the resultant excessive use of the scutching knives causes an excessive amount of tow and breaking of the fibre. If the shives cling to the fibre in places after the scutcher has done his best, the value of the flax is considerably reduced. Over-retted straw and short mixed in a handful fall into waste at every application of the knives. Moreover, wastage is easily caused on good flax when either the break hands or the scutchers are careless or unskilled. As the function of the breaks is quite as much to reduce the wood into shive uniformly as well as finely, it is important that the man who feeds the break spread the flax out evenly. If this operation is properly performed, the handful requires the least amount of work from the scutcher with the least maceration of the fibre, and so entails the least amount of towage waste. The scutcher should choose small rather than large handfuls, especially when the knives are speeded up high and the flax is a trifle hard to clean. Small handfuls allow the scutcher most easily to expose the centre of his "streak" to the action of the knives and to keep his streak pulled up in order to avoid towage waste. In the reckoning of scutching efficiency, a lower output may (within wide bounds) be quite easily productive of the greater profit for the mill. Fibre scutched at 3 cents a pound is far preferable to fibre scutched at 1 cent a pound, if the former rate meant a loss of only 10 per cent tow and sold for 20 cents a pound, while the latter involved a towage waste of 20 per cent and brought only 14 cents a pound. Such figures, by the way, might illustrate actual conditions in Canada in 1915.

GRADING.

The best workers in flax mills, while constantly aiming at the production of a high percentage of fibre, draw severe lines between qualities, and thereby create several grades of fibre. Mixed qualities in a bale for export mean that the whole bale will be paid for on the basis of the poorest fibre in it. The spinner judges of flax by its uniformity, strength, divisibility, cleanness, colour, and hackling qualities. Hackling divides the fibres into the smallest filaments, and removes the tow and tangled portions. As scutching is the test of previous operations, hackling is the test of everything from the spinner's viewpoint. Flax that hackles 70 per cent into line is considered good fibre.

Because of the comparatively small quantities of flax fibre produced in Canada, there has never been any official general grading of Canadian flax fibre, though one Ontario mill has practised it on a commercial scale. In all other countries, grading is established either by custom or by law. Russian flax is distributed among upwards of a dozen grades, and stringent government laws are in force to prevent fraudulent mixtures. Canadian flax fibre manufacturers will secure the benefits of standardization likewise just as soon as a majority of them can practise grading their fibre for the market, and thereby create Canadian standards.

As previously mentioned, sorts or qualities are most effectively secured when a start is made at harvesting time. In Canadian mills, the average foreman should become capable of completing the work of grading as the fibre leaves the scutcher's hands. Any fair judge of scutching is in a degree a grader. The ability to separate various qualities of flax into uniform lots should not be beyond the ability of the average intelligent foreman. An examination of the handfuls is, moreover, the foreman's best means of gauging the skill and thoroughness of his workmen. To illustrate the bearing of grading on prices for dressed flax fibre, compare the following possible transactions:—

Six 150-pound bales of mixed Canadian flax would bring, let us say, 18 cents a pound in the spring of 1916. The price paid for this lot would be \$162. If these six bales had been graded into six bales of various qualities, the prices would probably be as follows: No. 1, 25 cents; No. 2, 24 cents; No. 3, 23 cents; No. 4, 21 cents; No. 5, 20 cents; and No. 6, 18 cents. In this condition the same flax would bring \$196.50. The additional revenue created by grading would be \$34.50. Only a small portion of this would be needed to offset the extra labour and precautions taken in grading.

MILL CONDITIONS.

In emphasizing the importance of skilful scutching it must be admitted that vast improvements in the heating, lighting, and ventilating arrangements of the average Ontario mill are badly needed. Scutchers gravitate toward the best working conditions—the mill where the air is kept comparatively dustless and fresh by suction fans, where steam-heating pipes permit the men to work without coats or mitts, and where plentiful light permits close scrutiny of one's work. The mill with enthusiastic workmen soon becomes the mill with skilled workmen. To retain these and attract others there must be the smallest possible number of idle days. Toward this end, the drying room for retted straw is a new step in advance. Mr. Fraleigh's mill at Forest, Ont., has a drying room inside the mill building. This has sufficient capacity to carry operations over any ordinary period of winter thaw.

The better grades of Canadian flax fibre have for years found a market in the thread mills of New England. Inferior lots and tows have been sold largely of a Canadian twine company.

Recently, inquiries have come from Irish flax buyers with a view to buying Canadian flax straw in baled form and transporting it across the ocean for manufacture in Irish mills. Only very high prices would make such arrangements profitable.

The lack of official grading practically confines our market to those spinners who by long experience understand Canadian mill conditions.

SEED FLAX.

Wherever the flax plant has accompanied the pioneer into the Central Plain of North America it has been grown for seed alone, or almost exclusively to this end. Flax in our Prairie Provinces is primarily the pioneer crop, by which the settler achieves not only the subjugation of the prairie sod, but in addition secures a con-

siderable revenue from the sale of flax seed. In such cases, however, the virgin fertility of the soil scarcely makes up for the imperfect tilth obtained and the late seeding usually practised on new lands.

Though the flax plant, in all its varieties, never entirely loses its partiality for a fine, rich soil and abundant, even moisture, it is in the yield of fibre rather than in the quantity of seed produced that the effects of the lack of such conditions appear. What to some plants would mean extinction of life causes with flax chiefly a change of character. Thus the great seed-producing areas of the world—Argentina, the steppes of Russia, India, the northwestern United States, and northwestern Canada—are regions of only moderate rainfall, while the great fibre lands are favoured with a heavier precipitation.

This tendency of certain areas to specialize on seed production and to ignore the fibre is partly due also to the wholesale methods followed in new countries, to the limited demand for poor flax fibre, and to the fallacy that because the fibre of seed flax is not ordinarily suitable for fine spinning it cannot therefore be utilized by the spinner at all.

FLAX STRAW.

It is to the credit of flax that satisfactory returns have been obtained by the western farmers without any revenue at all from the straw. This refers to new lands, on which flax is frequently the only possible crop. When farms have settled down into an era of crop rotation, justice to the plant demands that the straw be made to contribute its proper share of revenue.

This might be accomplished by attention to the following:—

1. Closer cutting and more careful handling and threshing of the crop.
2. Heavier sowing than at present practised.
3. The introduction of high-yielding types of fibre flax, or selections toward the same end, from varieties already being grown.
4. Harvesting at an earlier stage—depending somewhat on after-ripening to secure a crop of seed.

In support of the contention that the saving of the fibre is compatible with a higher yield of seed, I give below comparative results in Ontario and Saskatchewan for the period 1910-14, the flax for fibre area in Ontario being, of course, included:—

Average yield of seed in Ontario...	...bushels.	19
" " " Saskatchewan...	..."	10
Average yield of straw in Ontario...	...tons (estimated).	1½
" " " Saskatchewan...	...ton.	¾

Of course the fibre produced in Saskatchewan under what might be called seed-flax conditions, in so far as climatic conditions affect it, would probably not be so valuable as that produced in the fibre fields of Ontario, but neither would the cost of producing and saving this fibre be nearly as great. The demand for flaxes of all qualities is now so strong (and likely to remain so for several years) that inviting prices are being offered for fibre of a grade normally not considered on the market. For example, only recently an Ontario flax manufacturer stated that he was selling scutched flax from green (not retted) straw at 10 cents a pound on board cars at his own station.

Recent investigations in Minnesota indicate an effort to gain for flax a permanent place on old lands in that state by turning the straw to some account. If only from its salvage character there is a good deal to be said for this movement. It is probable that if more attention were paid to the study of how to supply the desired material for these markets, and some effort made to develop new ones, a valuable industry might be established.

USES OF FLAX STRAW.

Upholstering Tow.—Though furniture makers are by no means confined to flax tow for upholstering material, its durability and its cheapness make it the most common substance used. Other articles within the range of competition with this tow are excelsior, sea-grass, and southern moss. Prices on these materials, as given below, indicate in some measure their positions in the upholstering trade:—

Excelsior.. . . .	\$20 00	a ton, f.o.b., Buffalo, N.Y.
Sea-grass.. . . .	35 00	"
Flax tow.. . . .	35 00	
Southern moss.. . . .	7 cents	a pound in bale lots.

Flax tow is the material commonly used in upholstering the medium grades of furniture. According to a big tow manufacturer, whenever the wholesale price of medium tow on the Chicago market goes beyond \$25 a ton, the demand gradually shifts to some of the cheaper materials. This was exemplified some years ago, according to this same manufacturer when, on the price of flax tow rising to \$27 a ton, the consumption, in one year, declined from 18,000 tons to 4,000 tons.

The raw supply of these several competitive materials is said to be practically inexhaustible. Sea-grass is a product of the ocean, and southern moss is gathered by negroes in the Southern States.

The preparation of tows for the upholstering trade is a rather simple and inexpensive matter. In Minnesota, the Dakotas, and Montana there are numerous tow-mills in the hands of tow dealers, threshermen, farmers, and insulation board manufacturers. The equipment of a new mill (exclusive of power) costs about \$2,500, and the building, measuring 60 feet by 40 feet, may be cheaply constructed.

Such a mill, operated by six men, would have a capacity of about 10 tons of flax straw a day, and an output of about 5 tons of tow. In addition to this there would be a considerable salvage in seed and chaff.

The supply of flax straw for tow mills is secured both by team haul from nearby farms, and in a baled form by railway from points farther away. When the straw for a tow mill must be transported more than 100 miles, the success of the undertaking is somewhat problematical.

Some idea of freight rates on flax straw and flax tow in Minnesota is supplied by the figures, given herewith.

TABLE of Railway Freight Rates on Baled Flax Straw and Tow.—Car Load Lots.

Distance.	Rate per Cwt.
	Cents.
20 miles.. . . .	5·1
50 "	6·5
75 "	7·7
100 "	8·5
200 "	11·8
300 "	13·4
400 "	15·0

A certain railway that enters St. Paul and Duluth, and makes through rate connections with a Canadian railway, offers a special inducement to shippers of flax straw and flax tow. This consists of a reduction in rates so as to give all points on the line that would be chargeable at a rate between 15 and 20 cents a hundred weight, the benefit of the 15-cent rate.

In some cases, threshermen operate a portable flax baler throughout the winter. They go about from farm to farm buying the loose straw in the stack at about 50 cents a ton. Frequently farmers haul in their straw to a baling outfit at some railway siding. For straw delivered in this way the ordinary price in the States mentioned is between \$2 and \$3 a ton. The baling press in general use costs about \$450. There is also a smaller press on the market at \$200.

OPERATION OF TOW MILL.

The tow mills mentioned are equipped in many cases with self-feeders which handle, practically without any hand labour, the bales of straw as they come from the car. The tow breaks are immense 36- or 48- roll machines of tremendous capacity.

Flax put through one set of breaks produces No. 2, or coarse tow. That given two operations is called No. 1, or medium, the difference in market value being about \$1 a ton. Finer grades are sometimes made by repeating these operations.

From the breaks the flax is carried to a kicker or cleaner which removes most of the small particles of chaff and shives and passes the fibrous material on to its destination, the tow-baler or manufacturing process, as the case may be. The chaff and shives are carried on to cleaning mills. These, by several operations, remove the particles of flax seed and clean all foreign matter from the remaining chaff.

At one of these tow mills the value of reclaimed seed from flax straw, it was stated, was sometimes sufficient to defray the entire cost of baling and shipping the straw from farm to tow mill. Several men were busy attending to the bagging and disposal of broken and inferior flax seed, which was pouring in an almost constant stream from the cleaned-seed chute at the time of inspection. In another quarter the information was volunteered that the cleaned chaff had a market value of \$6 a ton, and was used as a base in stock food by concerns that utilize the by-products of breweries and distilleries.

Flax Insulation Board.—It is in the newer uses of flax straw that we find the best prospect of profit for our western flax farmers. The growing scarcity and rising prices of good, convenient building materials, coupled with the suitability of flax straw as a complete substance for this purpose, has given rise to a new industry in Minnesota—the manufacture of building and insulation materials.

Great quantities of these products are annually disposed of by two companies operating large factories at St. Paul and Winona, Minn. The St. Paul company claims to be contemplating the erection of a factory at some suitable point in western Canada. They seek not only to move nearer the plentiful supply of flax straw in Saskatchewan, but to build up a market for their products in Canada. These two companies consume about 30,000 tons of flax straw annually. This means the product of upwards of 100,000 acres of seed flax as now harvested. Both companies operate their own tow mills at St. Paul, Winona and a few other points—the St. Paul company manufacturing a big surplus of tow for the upholstery trade.

Rather extensive processes and closely patented machinery are features of these plants. Flax forms practically the only raw substance used. Briefly, the treatment consists of bringing the flax to a semi-liquid condition and moulding it under heavy pressure to the desired form.

Linen Rugs.—A small but growing demand for flax straw comes from Duluth, where a large plant is devoted to the manufacture of linen rugs, exclusively from flax fibre. In this plant upwards of 5,000 tons of flax straw are consumed annually. The price paid for baled straw at the plant is now about \$8 a ton. For baled tow of good quality the company pays \$25 a ton, and for baled fibre flax tow of extra quality, \$50 a ton. But little of the last-named product is used.

The buyer informed the writer that straw had recently been bought from shippers in eastern Montana and transported to the Duluth mill—a distance of over 500 miles. From many years' experience in the handling of flax straw, the buyer expressed the opinion that the straw from new lands was ordinarily superior to that from lands longer cultivated.

The manager of this firm speaks of seeking a site for a branch factory somewhere in western Canada.

In this plant there is much complicated machinery; and various intricate processes are required before the finished rug is produced. The visitor is not permitted

to see very much. There is said to be a good demand for linen rugs, especially for use in porches and for other outside purposes. Special recommendations made for them are that they are durable, reversible, and washable. Various beautiful weaves are turned out. In size the rugs vary between the dimensions of a small hearth rug and large pieces 20 feet to a side, and in prices from a few dollars each to over \$30 apiece.

Western Flax Straw for Linen Towels.—Though the flax straw as at present produced in western Canada is not marketable in great quantities for fine spinning purposes, it must not be overlooked that such material is spinnable into the coarser yarns, and is even marketable in times of scarcity like the present. The manager of a small linen mill in Duluth, whose speciality is coarse linen towels, told the writer that he could afford to pay 6 cents a pound for good western green tow. This he would ship to Dundee, Scotland, for treatment, and have it reshipped to him in the form of coarse yarns. He figured that out of 100 pounds of tow he would get 50 pounds of yarn, which would make his yarn 12 cents a pound in addition to the freight and expense of treatment at Dundee. Suitable yarns imported from Europe were now costing him 20 cents a pound. In normal times he could afford to pay 4 cents a pound for suitable tow.

Flax for Binder Twine.—In view of the failure of a big twine company to persevere in the use of green flax for making binder twine, it would be unwise to suggest similar undertakings. The company in question claims to have expended \$1,500,000 at a flax twine plant in St. Paul, where 60,000 tons of western flax straw were consumed annually for several years. Neither of the two reasons assigned in as many quarters for the abandonment of these operations seems wholly satisfying. In the one case the manager of the fibre department stated that the flax twine bands would frequently rot away on the sheaf during a prolonged wet period at harvest time. In another case it was stated that grasshoppers and other insects made special raids on the flax bands, in spite of the deterrent poison treatment applied to the twine during manufacture. It was also stated that retted fibre of any kind was unsuitable for making binder twine, because retted fibre would not strip satisfactorily from the knotter.

By the student of flax operations, the above-mentioned failure can scarcely be accepted as proving conclusively the uselessness of the best western flax straw *carefully sorted and handled* as a material for binder twine. It seems more reasonable to suppose that if twine of sufficient strength and good tying qualities can be made from flax straw, and that more cheaply than from sisal and manila hemp, the common materials used, a profitable market could be developed for it in limited quantities, if only for irrigated grain areas.

Throughout the flax industry to-day one is struck by the almost universal fact that the more pretentious the plant which undertakes new processes the less successful it is. This is frequently to be explained by the fact that the promoters of the company are not sincerely working for the success of the process, but rather toward success in exploitation. Failure is, however, sometimes attributable to the fact that those who know most about the handling of flax are not consulted in time by the men in control. No other textile industry, I believe, is strewn with so many wrecks for which preconceived ideas (supported by no guiding practice) are responsible.

FLAX FOR PAPER MANUFACTURE.

Several big companies have been promoted with a view to using flax straw for paper manufacture. None, so far, has continued in operation for an extended period. The exact causes of failure do not seem to be generally known. According to a recent bulletin issued by the United States Department of Agriculture, flax tow can be profitably used as a substitute for the flax waste, formerly the raw material used exclusively in the manufacture of counter boards. Such a market, fully developed, would require about 20,000 tons of flax straw, or 10,000 tons of flax tow, annually. The same bulletin places the value of rags annually imported into the United States

for the manufacture of writing papers, at \$2,000,000. It is probable that one of the chief factors in developing the wider uses of flax straw for such products as paper and twine will rest in the quality of the original straw.

MARKETING CANADIAN FLAX STRAW.

Before our Manitoba and Saskatchewan flax growers can undertake to supply the markets at St. Paul and Duluth, much lower freight rates will have to be offered by Canadian railroads serving that territory. Under the existing combination rates between the points in these provinces and the above cities, there is little chance of Canadian shippers competing with shippers from eastern Montana, let alone with those from points nearer market, in North Dakota and Minnesota.

To show how serious a handicap this is, comparative tables of rates from border points and inland Canadian cities to St. Paul are given below. The rates to Duluth are approximately the same, in some cases exactly so. Under Canadian regulations, baled flax straw is placed in the seventh, and baled flax tow in the fifth classification. TABLE of Railway Freight Rates on Baled Flax Straw and Baled Flax Tow in Carload

Lots Between Places Named.

From	To	Distance.	Freight Rates (in cents per cwt.)	
			Flax straw.	Flax tow.
		Miles.	cts.	cts.
Noyes, Minn.....	St. Paul, Minn....	391	14.7	14.0
Winnipeg.....	"	458	24.0	38.0
Northgate, N.D.....	"	553	20.0	20.0
Regina, Sask.....	"	708	43.0	69.0

Were the combination rates determined on the basis charged by the United States railroads, Canadian shippers would have the following tariffs on flax straw:—

Winnipeg to St. Paul.....17.2 cents per cwt.

Regina to St. Paul.....25.6 " "

So long as flax tow and flax straw are classified differently under Canadian regulations, the rates on tow will be proportionately higher.

The establishment of flax-using industries in such Canadian centres as Winnipeg and Regina would minimize the importance of the rate question, but cost of transportation for such cheap bulky material as flax straw and flax tow will always be a matter of first consideration.

FEEDING VALUES.

In the meantime, vast quantities of flax straw, probably 200,000 tons, are going to waste annually in western Canada. If this substance could be proven to possess satisfactory feeding values, the problem of its profitable disposal would largely solve itself. This is a much disputed point. The theoretical side of the question is presented in the table given herewith. It was prepared by Professor Snyder, of the University of Minnesota, nearly twenty years ago.

COMPOSITION of Flax Hay and Flax Straw Compared with other Crops.

—	Water.	Ash.	Fat.	Crude Protein.	Crude Fibre.	Nitrogen Free Extract.
	%	%	%	%	%	%
Flax hay.....	15.30	5.50	3.1	15.00	32.00	30.10
Clover hay.....	12.25	6.78	2.97	12.67	24.05	41.08
Timothy hay.....	12.32	5.11	2.38	6.07	30.62	43.50
Flax straw.....	4.86	3.18	0.89	5.02	48.00	38.05
Wheat straw.....	7.41	9.22	0.96	3.25	40.89	38.27
Oat straw.....	8.36	9.00	1.40	4.06	38.07	41.11

It is seen that while flax straw possesses practically as generous proportions of life-sustaining materials as either wheat straw or oat straw, its high fibre-content involves the question of its digestibility. Professor Bolley, who has devoted considerable time to this subject, reports that "flax is a valuable asset in feeding stock. It is important that the stock should be well salted and have free access to a good water supply, and that the straw should be fed in association with other types of roughage."

As to flax hay (usually frosted flax cut before maturity), its feeding value as shown by the analysis given in the above table is borne out by the testimony of countless farmers throughout the seed flax areas.

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