Canada. Parl. H of C. Select Standing Committee on Agriculture and Colonization, 1909/10.
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OF THE

SELECT STANDING COMMITTEE

ON

AGRICULTURE AND COLONIZATION

SECOND SESSION, ELEVENTH PARLIAMENT

1909-10

PRINTED BY ORDER OF PARLIAMENT

OTTAWA
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(M. S. SCHELL, Esq., *Chairman.*)

Messieurs:

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Blain,
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REPORT

The Select Standing Committee on Agriculture and Colonization present their Fourth Report as follows:—

Your Committee have had under consideration during the current Session of Parliament the subject of Agriculture, and appended hereto is the evidence presented to them in connection therewith.

All of which is respectfully submitted.

M. S. SCHELL,
Chairman.

HOUSE OF COMMONS,
April 5, 1910.

RECENT FARM CROPS IN CANADA.

HOUSE OF COMMONS,
COMMITTEE ROOM No. 34,
WEDNESDAY, December 1, 1909.

The Select Standing Committee on Agriculture and Colonization met this day at 11 o'clock, a.m., the Chairman, Mr. M. S. Scheil, presiding.

The CHAIRMAN.—We are pleased to have with us this morning at our first session Dr. Wm. Saunders, Director of Experimental Farms, who, as usual, will communicate to us information of interest and value. The subject of Dr. Saunders' address this morning is: 'Recent Farm Crops in Canada.'

Dr. WM. SAUNDERS.—Mr. Chairman and Gentlemen, I am very glad indeed to have another opportunity of meeting the Committee on Agriculture and Colonization of the House of Commons, and giving some account of the work being done throughout the great Dominion of Canada in reference to the advancement in agriculture. The subject I propose to speak on this morning, as mentioned by the Chairman, is that of 'Recent Farm Crops in Canada.' This field is rather too large to cover in a single address and I propose therefore to limit my remarks to the question of cereal crops—that is the crops of wheat, oats and barley—and to present to you a few facts in regard to these very important crops and their bearing on general agriculture in Canada. The farm crops of the Dominion are matters of great concern to our people. To the larger portion of the population who are engaged in this industry it is a question of vital importance, and all other industries are more or less affected by the quantity and the quality of the crops, because they all influence the volume of returns of the country.

FIELD CROPS IN 1908.

The field crops of the Dominion for 1908 occupied 28,505,693 acres and they are said to have given yields which estimated at average local market prices, would reach the value of $432,532,000. The crops of 1909 were larger than those of 1908, but the full particulars have not yet been received so that they cannot be given with the same degree of accuracy as in the case of the latter year.

By Mr. Henderson:

Q. Does that estimate apply only to cereals?
Q. No, it applies to all farm crops.
Q. It is the value of the entire crops?
A. I should have made that clear. It covers all farm crops.

WHEAT.

Wheat, which is perhaps the most important of cereals will first claim our attention. The approximate estimates for 1909—as made on the 31st August by the Census and Statistics Monthly—give the following figures as the approximate return for the wheat crops in all the provinces of the Dominion except British Columbia. The figures are as follows:—

WHEAT CROPS IN THE DIFFERENT PROVINCES FOR 1909.

—	—	Bushels.	Average Yield per Acre.
Manitoba	Spring wheat	52,903,000	18·84
Saskatchewan	"	85,566,000	23·22
Alberta	"	8,062,000	26·52
Alberta	Winter wheat	2,754 000	34·00
Ontario	"	13,946,000	24·00
Ontario	Spring wheat	2,207,000	17·70
Quebec	"	1,648,000	16·40
New Brunswick	"	381,000	19·50
Nova Scotia	"	412,000	20·20
Prince Edward Island	"	507,000	19·42
Total for Dominion		168,336,000	21.39

By Mr. Wright:

Q. The figures you have given nearly all relate to spring wheat?

A. Yes, in all cases excepting Ontario and Alberta, and I gave the crops of winter wheat for these provinces. Outside of Ontario and Alberta winter wheat is not grown to any great extent, indeed its cultivation may be said to be still in the experimental stage.

By Mr. Sproule:

Q. This statement, if I understand correctly, is taken from reports sent to the department during the present year; it could not be the results of the threshing?

A. It is the result of the opinions of a very large number of correspondents from every part of the country compiled under the direction of Mr. A. Blue, Census Commissioner. The figures are subject to final revision, which is generally made in December. The final result is not expected to vary from the statement very much, because there are so many actual returns embodied in these estimates.

By Mr. Owen:

Q. How many acres did you say were seeded in wheat all over the Dominion?

A. I have not the figures available to make that calculation. I gave a statement of the total area of land in farm crops in 1908. That includes all sorts of crops. The total yield of wheat is 168,000,000 bushels as against 124,000,000 bushels in 1908, showing an increase in one year of 44,000,000 bushels, with an average yield for the whole Dominion of 21·39 bushels per acre.

WHEAT CROP IN SASKATCHEWAN.

Much of this increase has taken place in the northwestern provinces and the larger part of it, more than 42,000,000 bushels, came from the province of Saskatchewan. In that province the acreage under crop has more than doubled within the past two years. I have here a map of the province of Saskatchewan on which the surveyed lands are shown. There are about 86,000,000 acres of surveyed lands in this province ranging from this point (indicating on the map) down to the international boundary, in rows of townships. There are thirty-six sections in each township and each section is divided into four homesteads of 160 acres each.

When the two northern provinces of Saskatchewan and Alberta were carved out of what had been known hitherto as the Northwest Territories, Saskatchewan was given a land area of 242,332 square miles—about 155,000 000 acres—and a water area of 8,318 square miles. To Alberta was given a land area of 251,180 square miles—

nearly 161,000,000 acres—with a water area of 2,360 square miles, each province extending from the 49th to the 60th parallel of latitude, a distance of 760 miles. One half of the province of Saskatchewan, including the more southerly portions, which are held to be best adapted for agricultural purposes, has been divided into nine crop districts of nearly 10,000,000 acres each, 86,826,240 acres in all. That land is being rapidly settled. These nine crop districts include about fifty-six per cent of the land area of the entire province. The actual acreage under wheat in 1908 was 3,703,563, less than five and a half per cent of the whole area contained in the nine crop districts. From that limited acreage in 1908 there were 51,000,000 bushels of wheat harvested. The exact acreage for 1909 is not yet accurately known, but it will probably be about 4,000,000 acres, or about 5 per cent of the total area of the surveyed crop districts of Saskatchewan. From this relatively small area over 85,000,000 bushels of wheat have been harvested. The yield over that whole province, 23·22 bushels per acre, has been very satisfactory. The yield would, no doubt, have been larger but for the drawbacks—there has been more or less hail, some frost, and more or less of the grain has no doubt been seeded in a very unsatisfactory way. The new settlers, in the rush for a crop, have kept ploughing longer in the autumn than they should have done, and they have used their land in a rough condition. These combined circumstances would necessarily reduce the average crop.

By Mr. Sproule:

Q. Is that the crop of 1909 or 1908 you are speaking of?

A. 1909.

Q. That is when the average was 23·22?

A. Yes, the average was very fair, much better than the crop of 1908, which was very low, and is said to have been the lowest yield had since the settling of the country. The conditions which applied in 1909 would no doubt apply in 1908 also, that is hurried farming and poor treatment of the land, which, with an unfavourable season produced such an unusually low return.

Improvement in farming methods is taking place rapidly. There are many agencies at work with the object of giving farmers the information they need as to how to handle their land. In connection with the Experimental Farms we have circulated a large number of pamphlets in which information as to the proper treatment of the land is given, so that new settlers will soon become informed as to the best way of cultivating the soil, when the average yield per acre is likely to increase materially.

WHEAT CROP IN ALBERTA.

In Alberta the average yield of the spring wheat was 26·52 bushels per acre, and the average of the winter wheat was 34 bushels. The spring wheat of Saskatchewan should, in yield per acre, be almost on a par with the spring wheat in Alberta. Although the climate is somewhat different, and the land is perhaps a little more subject to frost, yet, I think that the disadvantages in climate are not nearly so great as to account for such a difference in the yield as is reported in the figures for the past year, which give to Alberta, in spring wheat, the advantage of 3½ bushels per acre.

The acreage under crop in Saskatchewan was much greater in 1909 than it was in 1908 owing to the very large influx of settlers for the two or three years previous. The fact that there was a gain of 42,000,000 bushels in one year shows an enormously rapid growth in the production of wheat, which speaks very well for the future of that province.

POSSIBILITIES OF WHEAT GROWING IN THE NORTHWEST PROVINCES.

Some speculation has been indulged in as to the possibilities of wheat growing in Canada, and whether it would be possible to grow in this country a sufficient surplus to supply all the wheat and flour needed by the mother country, which, estimated in

bushels of wheat, runs from 200 million to 250 million bushels per annum. From the rapid progress recently made in the Northwest it seems not unlikely that Saskatchewan alone may eventually be equal to this task, indeed, I should not be surprised if it reaches that figure within another ten years. The growth of population will be one of the governing factors in this case, and the fact that more than 60 per cent of the total number of homesteads granted in the Dominion, during the past four years were in Saskatchewan speaks well for the progress of this flourishing province. There were 23,321 entries in 1905, 26,984 in 1906, in 1907 there were 18,413, and in 1908, 20,804. These figures show that population is rapidly flowing in.

Other elements are also important in connection with this computation. Manitoba's crop of wheat was this year nearly 53 million bushels, and the area there may be largely extended. Alberta must also be reckoned with. There is a comparatively small area as yet under cultivation, from which this province produced in 1909 over 10,000,000 bushels of wheat. When a reasonable proportion of its 161 million acres is broken up the results no doubt will be almost incredible. I have a map of Alberta here from that point of this year's crop of wheat which are very fine and plump. part of the province. The upper northern part is almost an unbroken area as far as agriculture is concerned and there is very little wheat grown in that country excepting that which is produced along the Peace river.

CROP GROWING IN THE PEACE RIVER DISTRICT.

I wish to call your special attention to Fort Vermilion, on the Peace river, which is about 400 miles in a straight line from Edmonton, as I have some samples here from that point of this year's crop of wheat which are very fine and plump. Some three years ago, under instructions of the Minister of Agriculture, we instituted a few experiments in connection with the experimental farm work at Fort Vermilion, where we found on inquiry that about 20,000 to 30,000 bushels of wheat were grown annually. There is a fall on the Peace river near that point which affords convenient water power, and the Hudson Bay Company have erected a flour mill there so that they can grind all the wheat produced in that locality and ship the flour made to the more northern posts. They have been paying $1.50 per bushel for wheat to the farmers, which is a very good price, and this has stimulated the growing of wheat in the Fort Vermilion district. Although that is a high price it is profitable to the company, because at that distant point it gives them a supply of wheat from which flour can be conveniently furnished to the company's more northerly stations. In that way the company obtains flour at a much cheaper rate than by bringing it from Edmonton, which is about 700 miles by the ordinary route of travel. I have here for your inspection some samples of wheat that have been grown at Fort Vermilion. This is Red Fife. It is the first sample I have seen of this variety from that neighbourhood, and this year it is very plump and heavy, weighing 63½ pounds per bushel, the yield being 21 bushels 14 pounds per acre. It is a very fine sample of wheat, as you know it must be, to weigh three and a half pounds over and above the standard. Bishop is one of the cross-bred wheats which ripens about ten days earlier than Red Fife. It is a cross between Ladoga, a Russian, and Gehun, an Indian variety, and has produced a very good quality of wheat. Early Riga, weighing 64 pounds to the bushel, which gave a crop of 19 bushels 8 pounds to the acre, is a cross between the same Indian wheat referred to, Gehun, and a wheat from near Archangel, in Russia, known as Onega. These wheats were crossed some years ago and the results are quite promising.

By Mr. Henderson:

Q. Before you get away from this question of average yields. Have you any means of giving us a comparison between the production in Alberta, Saskatchewan, and Manitoba and the neighbouring states to the south? Have we as large, or a larger, production per acre than the Dakotas or the adjoining sections?

APPENDIX No. 1

A. I have some information, which I was going to present a little later on bearing on that point. I have given you the average production for the whole of Canada 21·39 bushels per acre. I have also given the particulars of the crop yields of the different provinces. Some comparisons of these with other countries will be given in a few moments.

By Mr. Chisholm (Huron):

Q. You say the northern part of Saskatchewan is more subject to frost. While the Saskatchewan river flows north and the southern part of the province is much higher than the northern end, would the altitude not make up very much for the latitude?

A. I did not intend to present that point in a very strong light. I said that in the northern part of Saskatchewan the land is perhaps a little more subject to frost than in southern Alberta, that is of early frost. I am of opinion that the difference in altitude goes far towards making up for the higher latitude. In Fort Vermilion, which is north of the settled parts of Saskatchewan, wheat has been produced free from injury by frost although frost has occurred there quite early in the autumn, which one would have thought would injure the wheat. I have the records of the meteorological conditions at Fort Vermilion supplied by the Meteorological Department and it shows that frost has been experienced as early as August 18th and 20th, which naturally one would expect to have injured the wheat. But in those northern districts there is that important difference to which attention has just been called: the altitude is much less as you approach the northern water basins. Furthermore, there is the rapid growth consequent upon the long periods of daylight. That is also an offset against the drawback of a more northern latitude. There are conditions to be considered in connection with many of these facts brought forward, which make one careful in arriving at anything but very general conclusions with the limited amount of information available. Until a few days ago we had no proof that Red Fife would ripen in the Peace River country. We sent our own seed up there which we knew was pure. We know also that this year Red Fife has fully matured there and of a quality which would compare very favourably with this wheat grown anywhere else in the Dominion. Still it would not be safe with one year's experience to say that such wheat can be grown there every year. We know that it has been done this year and the probabilities are that the same experience may be had another year. I think it may be reasonably expected that any varieties of wheat which we grow here at Ottawa can be grown in most seasons in the Peace River country. The fact of a district being so far north is compensated for by these other conditions: the rapid growth, the long period of daylight and the fact that while the altitude is not lower than it is at Ottawa, it is lower than many of the other wheat producing sections in the northwest. The altitude at Vermilion is very much lower, for example, than at Lethbridge, Alta., where they grow some of the finest wheats that can be produced anywhere. Fort Vermilion is 950 feet above sea level while Lethbridge Station is 2,952 feet. I have here a sample of wheat grown at Lethbridge and it certainly is a very fine one.

By Mr. Thornton:

Q. What is the length of time between seeding and maturity?

A. About one hundred and three, to one hundred and ten days for wheat, and about one hundred days for barley and oats. Seeding usually begins about the latter part of May, and the grain is cut from the 18th to the 25th of August.

In his recent report Mr. Robert Jones, in charge of the experimental station, writes as follows:—

'The spring of 1909 was late and very slow in opening and seeding was not general until May 15th and was not finished until May 28. Cold weather prevailed

all through May and germination of the seed sown was very slow. On the night of June 3rd a frost occurred which cut down squash, melon, tomatoes and cucumbers, but after this fine weather was general and continued throughout July, growth was very rapid and there was every prospect of an abundant harvest. On the night of August 18th a frost occurred which damaged the wheat crop somewhat.'

No evidence of any injury by frost was found in the samples that were sent. Probably the injury was less than was expected.

'Other frosts occurred on August 22nd, 26th, 27th and 28th, but oats and barley were far enough advanced to escape injury, and are quite up to the usual standard. Harvest was general on August 23rd, but stacking was hindered by continual wet weather in September. Apart from the experimental plots on the station, wheat will not probably average more than 17 bushels to the acre.'

That is the estimate of our correspondent as to the yield before the threshing had been done, and until it has been done it is difficult to estimate the yield. Red Fife, as I explained to you, went 21 bushels 14 lbs. to the acre; Bishop, 28 bushels; Early Riga, 19 bushels 8 lbs.; Preston, 26 bushels 8 lbs., and Ladoga, 25 bushels 40 lbs.

By Mr. Jameson:

Q. From what point is your correspondent writing?

A. From Fort Vermilion.

Q. How far south of Fort Vermilion does the Transcontinental railway run?

A. I do not think it goes very much north of Edmonton, and that is 400 miles practically, but I have been told there is a branch line contemplated up there which has been partly surveyed.

Hon. Mr. FISHER.—It has been surveyed all the way.

By Mr. Jameson:

Q. What is the usual route of transportation for that 700 miles?

A. I will point that out to you on the map. Leaving Edmonton here, the first part of the journey is to Athabaska Landing, 100 miles (illustrating on map) by stage, the river is crossed there and then the route follows the Athabaska river to Lesser Slave lake. From there the road leads to Peace River Crossing which completes the drive of 400 miles. At this point a boat on the Peace river is taken and you go down the river 300 miles to Fort Vermilion.

Q. And the grain shipped from that point up there comes out by the route you outlined?

A. Of course no grain can be shipped from such a far distant point with the present means of communication; what we are trying to do there is to get information as to what can be grown in that far distant region, because, if we can establish the fact that valuable cereals can be grown there, such information will certainly affect all the region to the south of that point to a very great extent, and there are more than 100 million acres of land unbroken in that part of the province.

WHITE AND RED SKINNED WHEATS.

By Mr. Henderson:

Q. Is that 'Bishop' wheat to which you have referred a spring wheat?

A. Yes.

Q. It has very much the appearance of a fall or winter wheat?

A. It has; that is due to the fact of its having a white skin. A white skinned wheat is unpopular inasmuch as you cannot get as good a grade for it as for a red-skinned wheat. The white wheat may be just as good in quality as the red, but it has to take a lower grade than the red under our present system of grading. I suppose that distinction has been made in order to meet special conditions, hence in

wheat breeding we throw aside any white skinned wheats no matter how good or promising they may be—when I say throw aside, I mean as far as the Northwest is concerned. In the east, white wheats of good quality can be sold at good prices to local millers who know their true values, and this is encouraging to those who desire to grow white skinned varieties. White Fife in the maritime provinces is one of the most popular wheats grown. In the Northwest there is very little of it grown because, unless it grades at the very top, and it is not often it does, there is no other grade for white skinned wheat.

WHEAT AREAS IN ALBERTA.

With regard to the districts where wheat can be grown in Alberta we know that in the southern part the winter wheats are grown very largely. We had in 1908, on the experimental farm at Lethbridge, 24 acres of winter wheat which gave an average of 54 bushels 11 lbs. to the acre, a yield not often reached. One of our new varieties of wheat, the Marquis, which is a cross-bred wheat, equally as good as the Red Fife in quality, and a red skinned variety, was grown at Brandon last year when four acres of it averaged 52 bushels to the acre. The Red Fife there, although a very good cropper, did not yield that much. In addition to the area in the neighbourhood of Lethbridge and about Cardston there are large districts from about Pincher to High River where very fine winter wheat is grown without irrigation. Then from Calgary to Edmonton we have a country where there is a considerable quantity of wheat being produced, although oats is a much more common crop. Nevertheless there is a large area being worked into wheat growing there, the district about Edmonton is becoming very well settled and there will no doubt be a much larger production of wheat through that area in the near future. We had samples of spring wheat last year from Lesser Slave lake, from the Mission there, where they grew a number of sacks of it; this was 'Bishop' wheat, and they liked it very much; they are distributing this variety there among the settlers. At Peace River Landing, also at Dunvegan, wheat of good quality has been grown. So that we have information from these different points in Alberta giving some particulars in regard to the capabilities of portions of these enormous land areas and we hope shortly to test varieties of wheat still farther north so that we may get additional information in regard to the agricultural capabilities of that great country as rapidly as possible.

By Mr. Jameson:

Q. What would you regard as a fair average return from that territory?

A. It would be premature to form any opinion as the country has not even been surveyed and there is not much information concerning it available.

Q. What would you say per acre?

A. Last year the average yield of wheat is said to have been about 24 bushels per acre in the Peace River district, about Vermilion. This year our superintendent there estimates the yield at about 17 bushels per acre; although all the yields reported at the experimental station are higher than that. You will find particulars of the work we have done in connection with the Fort Vermilion station set forth in the Experimental Farm report for the year ending March, 1909. The work done this year cannot appear until the next report is issued. Our minister is very anxious to have more experimental stations dotted about this northern country and to have us carry on all the experimental work we can. We know that the efficient work which is done under the experimental farm supervision will give us facts that we can rely on and we are most anxious to gain further information in regard to that country as this is probably the last large area of land left in Canada suitable for settlement. There are large districts yet unsettled in the organized provinces, but we cannot expect to have very much arable land in the unorganized territories. We may discover localities where the climate is better than we anticipate but I do not suppose the country

will be such as to attract settlers in large numbers. The plan adopted at Fort Vermilion, under the instruction of the minister, has been to rent a piece of land from one of the most reliable of the older settlers, and to pay him so much for the use of his land and for the time he spends in growing these crops. Then he sends to Ottawa such samples as can be carried by mail of all the products desired and furnishes information in regard to all other crops. The crops tested there this year cover six varieties of wheat, four varieties of barley and the same of oats. We have tested also Indian corn, turnips, mangels and potatoes. The yields of these products are just about as good as they are in any part of Saskatchewan, and, although below those in the east are still very encouraging. For example, the yield of potatoes has run from 370 to 412 bushels per acre. Our representative there has also tested alfalfa and so far has succeeded fairly well with it. It remains to be seen whether alfalfa will stand the winter there. The temperatures reached in winter are sometimes very low, occasionally as much as fifty below zero at Vermilion. Such a temperature is rather severe for alfalfa. At the station there we are also testing different varieties of clover and grasses, a number of vegetables, and a few other things, such will throw light on the climate and give valuable evidence of the nature of the district to those who are thinking of going there to settle.

By Mr. Donnelly:

Q. Have your experiments in the vicinity of Vermilion been confined chiefly to the valley of the Peace river?

A. The land in question is outside of the actual valley. The valley of the Peace river at that point is very narrow and shallow and the river banks are not high. In many parts the land slopes down to the river. Our station, from the account I have of it, is about three miles from the river and consists of fairly level land.

USE OF THE 'PACKER' IN ALBERTA.

By Mr. Schaffner:

Q. It seems to me that the experiments so far made have been along the line of varieties of grain and you have not done very much experimenting in regard to how to prepare the ground. For instance take packing. That system is quite general in the Northwest and there is a great diversity of opinion among farmers, even with the same kind of soil and the same style of seeding, as to the best time to pack, or harrow, or plough. I may be wrong but it does seem to me that kind of experimenting, which is exceedingly important, has not been carried on to the extent that it should have.

A. No doubt this is very important but you have to remember that none of us had heard anything about packers until three or four years ago.

Q. The system has been in use longer than that.

A. I think not more than four years. Of course we have got packers at nearly all the farms. Two years ago we submitted the results of experiments at Lacombe and results were also available last year. Then we have used packers at Lethbridge and this year they have been used at Indian Head and Brandon. I have not got the results from those places yet. With only one crop in each year you cannot have more than one series of experiments that year. While we are doing everything we can to gain experience and to work out information, it will probably be some years yet before we can draw any decided conclusions. It is not wise to speak very strongly in favour of any new practice with one or even two years' experience; you may have different results altogether as time goes on. I think, however, there is every reason to believe that the packer is a very useful implement and that in the drier parts of the country it is likely to benefit the crop considerably. At the same time I do not feel that we would be justified, with the limited information we have, in recommending every settler to buy a packer. We publish the results we get from experiments

with such implements and show the advantages obtained, and the farmers are generally not very slow in taking these things up. The packer is an expensive implement and rather beyond many of the new settlers. Our superintendent at Indian Head thinks that a substitute for a packer can be found in harrowing the land after ploughing or summer fallowing. The soil packs itself to a considerable extent, if properly harrowed, and then the packer is not so necessary.

Q. I think the farmers have determined the utility of the packer themselves. I believe 90 per cent of the farmers believe the packer is a good implement to use. The point is whether the packing should be done before the grain is sown or afterwards. A great many important farmers would like to see some experiments along that line.

A. Experiments are going on and results will soon be available.

By Mr. Smith (Middlesex):

Q. I think there is a great difference in the nature of the soil in the Northwest, and in the time at which it should be cultivated.

A. A difference in rainfall also materially affects the results obtained from the packer. It is not needed so much where you have a fairly good rainfall so the experience gained in one district might not be the same as another. I do not wish to offer any excuse for not knowing more about this question. We have done our best to gain information and to disseminate it as fast as possible. If our superintendents are in doubt as to the utility of an implement, we do not like to hurry them in the expression of an opinion before they are ready to back it up with facts.

By Mr. Blain:

Q. Are packers used in any part of eastern Canada?

A. Not that I know of.

By Mr. Sproule:

Q. The roller takes the place of the packer with us.

A. Yes, although the roller is an implement which works on a different principle. The roller is used to bring the moisture up to the surface so that the seed will be enveloped in moist earth and germinate rapidly. The packer is used to press the seed down in the soil, but not to form a continuous smooth surface; the machine is so devised that while it presses down the soil considerably it also stirs it again on the surface and leaves it with a thin dust blanket over it so that evaporation is prevented rather than increased. The roller increases the evaporation for the time being, and if you leave the rolled surface untouched in a dry time you leave it in such a condition that the soil soon dries out. It will get dry in a short time unless the surface cake is broken and left in a loose condition.

Q. It leaves the surface irregular?

A. Yes.

By Mr. Schaffner:

Q. The statement you have just made is I think a strong argument in favour of what I believe would be a desirable change, that there should be a number of smaller and less expensive farms established for the purpose of experiment in different districts. That is the proper way to get the information desired by the farmers.

A. We cannot secure the full value of experimental work and have the full time and attention of the superintendent and his men given to it, and at the same time cover a large area of ground with crop without involving some expense, and if we do not have a good man the results are not always reliable, or at least they are not so reliable as they are if we can have a man who devotes his whole time and attention to these experiments. While small stations are useful, I think that both the small sations and the larger farms are desirable, because, with the larger establishments the man in charge of the experiments can devote the whole of his time to the work.

WINTER WHEAT IN SASKATCHEWAN.

By Mr. Chisholm (Huron):

Q. Have you ever experimented with winter wheat in Saskatchewan?

A. Yes, we have experimented with winter wheat almost every year for the last ten years at Indian Head, but we have had very little success with it; the climate there does not seem to be favourable to winter wheat. In 1908 we tried an experiment at Indian Head in regard to the best time of sowing winter wheat. We sowed on August 8th, and on September 7th and again on September 18th. Our experience heretofore had would lead us to expect that the late sown wheat would have given a less yield and the early sown wheat would have done better, whereas in these experiments the results were the reverse. Both of the early sown fields were so injured that they gave an average of only six bushels per acre, whereas the field later sown gave a crop of 29 bushels per acre. If we were to advocate the late sowing of wheat from our experience of that year we might lead people into a very grave error. I doubt if we could repeat that experiment at Indian Head and get the same result as we do not know enough about the circumstances and conditions which brought it about, to enable us to speak with any certainty on the subject.

YIELD OF WHEAT IN CANADA COMPARED WITH OTHER COUNTRIES.

While the average yield of wheat for the whole Dominion is 21·39 bushels per acre, the average of the field crops of wheat at the several experimental farms for 1909 is 36·59 bushels per acre, showing that there is yet ample room for improvement among the rank and file of farmers throughout the country.

With reference to the yields in other countries which I was going to submit to you, while Canada gives for wheat an average of 21·39 bushels, the United States, taking the whole of that country, gives an average of 13·43 bushels, and Great Britain gives 31·14. The bushel of wheat in Great Britain is the same as the bushel in this country. France gives an average for the past ten years of 19·57 bushels, nearly 20 bushels, so that we in Canada are ahead of France in this particular, and in Argentina, which is one of our close competitors, the yield is 14·76. In Germany the yield is 28·25, coming nearly up to that of Great Britain and ahead of ourselves, whereas in Russia it is away below us, the average being 9·05 as against 21·39 bushels in Canada.

By Mr. Owen:

Q. Will not our yield diminish as the years pass by?

A. Not, I think, in this generation. The crops to my mind at present depend more in this country on the conditions of climate than they do—that is providing the soil is in fair condition of cultivation—on the actual fertility of the soil, because there is enough surplus fertility in most of the soils in the Northwest to permit of good crops being grown for many years with good cultivation, providing the season is favourable. In 1899 we commenced some rotation experiments at Indian Head, on twenty-two half acre plots in which series there were five devoted to legumes, namely: peas, tares, red clover, alfalfa, and alsike. These crops were grown in place of a summer fallow in the spring, and ploughed under in the autumn. This added a great deal of nitrogen to the soil, also humus, both very desirable additions, provided the soil has become in any way exhausted. Thus far, however, although the three year rotation has been completed three times, we have not been able to detect any material advantage in the ploughing under of any of the legumes over summer fallow in any of those plots, for the reason that there is so much plant food in the soil that the grain had all it wanted, so, when the season has been a favourable one, both sets of plots have given good returns.

APPENDIX No. 1

By Mr. Jameson:

Q. Is not the low average of Russia somewhat due to the fact that their area has been so very far to the northward?

A. I think it is mainly due to very poor farming. The soil is rich, and of very much the same character as our own prairie soil; but the yield is not only poor in regard to wheat, but it is also poor in regard to other grains. Oats, for instance, average 15·67 bushels in Russia and barley 11·84 bushels. Barley in Canada is 30·55 and oats 38·15. In the United States the average yield of oats is 29·05 and the average yield of barley 25·02 bushels per acre.

These figures show that Canada has no great reason to complain of the crops we get. Although sometimes we are visited by frost and suffer disabilities arising from climate, yet taking one year with another we have wonderfully good results that ought to satisfy us, and make us thankful.

OATS.

I wish now to make a few statements regarding the oat crop. The total yield of oats in Canada during the past year was 355,000,000 bushels, with an average of 38·15 bushels per acre. At the same date last year the estimate was 270,000,000 bushels, an increase in this crop over that of 1908 of about 85,000,000 bushels. The returns for the several provinces are as follows:—

	Bushels.	Yield per acre. Bushels.
Manitoba	59,103,000	42·52
Saskatchewan	88,896,000	48·13
Alberta	39,803,000	48·54
Ontario	105,389,000	33·54
Quebec	44,390,000	28·20
New Brunswick	6,693,000	32·30
Nova Scotia	4,352,000	31·51
Prince Edward Island	6,293,000	34·20

You will see that the yield for Ontario, 33·54 bushels per acre was the highest of the eastern provinces, and in the case of two of the western provinces the yield ran over 48 bushels to the acre. One of our superintendents in Alberta informs me that he has seen a sample of oats this year grown in that province weighing 50 pounds to the bushel. I have never seen oats of that weight myself and I asked him to send me down the sample. He replied that it was wanted for exhibition purposes. He added that the weight was undoubtedly correct, but that he could scarcely credit the fact until he had tested it himself. This shows that the climate there is well adapted to growing oats.

INCREASE OF OAT CROP IN THE NORTHWEST.

By Mr. Schaffner:

Q. Did he say what the variety was?

A. He did not. I have seen myself oats that weighed 48 pounds to the bushel, which is a very remarkable weight as compared with the oats we grow in this district. The average weight of the oats grown in Ontario is not much over the standard of 34 pounds. Sometimes they may run a pound or two over, but taking one district with another it is not often that the average weight goes much over the standard. The difference between 34 and 48 pounds is of course very great. Saskatchewan has led the way with nearly 57,000,000 bushels of an increase, and Alberta follows with a total crop of 40,000,000 bushels, an increase over last year of about 14,00,000 bushels.

Q. What about British Columbia?

A. We have no returns, unfortunately, from that province.

By Mr. Henderson:

Q. Do your returns for Alberta give you the average yield of oats of the entire province, or only for northern Alberta?

A. The average given of 48·54 is for the entire province.

Q. I understand that in the southern part of Alberta oats are not grown very extensively. Perhaps the country is not suited for the growing of oats. I am surprised at the low average because in looking from the train going through northern Alberta as far up as Edmonton the appearance of the crops indicated a much higher yield than 48 bushels to the acre last summer.

A. But you have to include in the average all the crops of the poor farmers with the good ones, and the former are sufficiently numerous to bring the average down.

Q. I think your average scarcely does justice to Alberta.

A. Oats are often grown on the poorest of land on a farm, fields not good enough for other crops. That also tends to reduce the average results. On the experimental farms in the Northwest where oats are grown on well prepared and summer fallowed land we quite commonly get a hundred bushels to the acre.

Q. I understand that in northern Alberta last year they had yields in many cases which reached one hundred bushels to the acre.

A. There were individual yields of that kind undoubtedly, but when you incorporate in the total the yields from poor farms it lowers the average. If you take the average of 48·54 for Alberta and place it against the United States' average of 29·15 bushels the difference is very striking.

Q. The point I wish to make is that I think your average does not give a fair estimate of the possibilities of Alberta, extending from Calgary north to Edmonton.

A. No, I do not think it does give a fair idea of the possibilities of that part of the province, and I look for an increase as the farmers of that province become better acquainted with the best methods of farming, and follow those methods. There certainly should be an increase but probably not a rapid one for the next generation, because there will be so many new settlers coming in all the time, that they will probably keep things relatively very much as they are at present. When the acreage of oats under cultivation reaches 40,000,000 or 50,000,000 acres, as against less than 2,000,000 acres as at present, then the relative importance of this province as a grain growing territory will be amply demonstrated. The question of favourable weather conditions for the crops will for many years be a very important factor in regard to influencing the yield for each year.

By Mr. Kidd:

Q. Do you suppose that late sowing brings down the average?

A. Yes.

By Mr. Chisholm (Huron):

Q. I received a letter from a friend in the west containing the statement: 'That excellent crop of oats I showed you'—I saw the crop myself last summer—'averaged 80 bushels to the acre.'

A. We got 70 bushels of Banner oats to the acre at Fort Vermilion this year, and nearly the same yield for some other varieties.

BARLEY.

I will now give you some facts regarding the barley crop in Canada. The total yield in 1909 was 56,975,000 bushels, 8,000,000 more than in 1908, with an average yield of 30·55 bushels per acre. Manitoba gave a crop of 22,404,000; Saskatchewan, 4,901,000; Alberta, 6,588,000; Ontario, 19,726,000; Quebec, nearly 2,860,000; New

Brunswick, 83,000; Nova Scotia, 225,000, and Prince Edward Island, 188,000. In this instance much of the total increase is due to the increase in crops in the large western provinces. In Saskatchewan there were 3,000,000 bushels over last year, in Manitoba about the same, and in Alberta, 2,000,000. In Ontario, Nova Scotia and New Brunswick the crops were slightly reduced whereas in Quebec and Prince Edward Island the figures were increased. There is one thing that should be borne in mind and that is, that the crops of these useful varieties of grain, oats and barley, are very little exported. Nearly all the crop is kept at home for the feeding of animals, not always in the provinces in which they are produced but as far as the Dominion is concerned, and if not used in the western provinces these coarse grains are shipped to the eastern provinces, where they are used to promote our dairy industry and the production of beef and pork in Canada.

TOTAL PRODUCTION OF BARLEY AND OATS IN CANADIAN NORTHWEST.

By Mr. Sealey:

Q. Do you happen to have there the total production of the coarse grains in the west, barley and oats, in Manitoba and the other provinces?

A. Yes, I have just given most of these particulars but will gladly give them again if desired.

Q. You have given us the particulars, but you did not total it up.

A. In Manitoba the total crop of barley was 22,404,000 bushels, with an average of 22·19 bushels per acre; Saskatchewan produced 4,901,000 bushels, with an average of 35·56 bushels; Alberta, 6,588,000 bushels, with an average of 35·42 bushels to the acre—you will notice that the figures of Saskatchewan and Alberta are very close to each other. Manitoba produced 52,903,000 bushels of oats, with an average of 42·52 bushels per acre; Saskatchewan produced 88,896,000 bushels, an average of 48·13 per acre, and Alberta, 39,803,000 bushels, an average of 43·54 bushels per acre.

Q. I see, that will be over 200,000,000 bushels of coarse grain produced in those provinces as against 130,000,000 bushels of wheat?

A. The oats and barley together have given a total of over 238 millions in the three northwestern provinces, the larger part of our total increase in these varieties of grain coming from the western provinces.

EXPORTS OF OATS AND BARLEY.

By Mr. Armstrong:

Q. Can you give us the export of oats and barley as well as of wheat?

A. I do not know exactly what they are, but the aggregate is quite small.

Hon. Mr. FISHER.—There is, I think, only a small quantity exported, chiefly from the maritime provinces to Scotland?

Dr. SAUNDERS.—Hence it may be said that practically nearly the whole of these coarse grains are retained in our own country and fed to animals, building up the stock industry and helping to maintain the fertility of the soil. The fertilizing constituents are not always returned to the soil in the district from which they are taken, but are retained within the Dominion and serve to enrich the soil generally.

GROWTH OF THE STOCK INDUSTRY IN SASKATCHEWAN.

As indicating how the stock industry is growing in Saskatchewan the production of pork there has increased largely; in 1901 the number of swine in the province was 27,753, and 1908 these had increased to 426,579. That was a very large increase in seven years and with that very large number of animals in the province, a continued increase is assured. There is about the same proportion of increase in the number

of milch cows, and there have been five or six creameries started in Saskatchewan during this last year; there is also a large increase in the number of horses. There is not much breeding of horses as yet, but that will no doubt come very shortly.

By Mr. Sharpe (Lisgar):

Q. How about the production of beef in Alberta?

A. The horned cattle, apart from milch cows, numbered, in 1908, 565,315 and the number of cattle exported was 22,092. Sheep have increased to 144,370 and poultry to 3,411,052. The total value of the live stock in Saskatchewan amounts in the aggregate to over $68,000,000. Hence it will be seen that this province is making substantial headway in the different branches of live stock work and in a short time will no doubt find an outlet for much of the coarse grains produced by feeding them at home.

SOURCES OF STATISTICAL INFORMATION.

By Mr. Wilson (Laval):

Q. I would like to know whether these figures you have given us would be just exactly the same figures as we receive in the general census, or is it an estimate only. Will they have been compiled from information obtained by going from one farm to another?

A. The figures I have submitted this morning have been taken partly from the Census and Statistics Monthly Bulletin and partly from the annual report of the Department of Agriculture of Saskatchewan for 1908. The figures given for 1909 are an estimate made up from the returns of a large number of individual farmers. That is the usual method where early estimates are made, and is fairly reliable. Later, when the returns from the threshing machines are all in, a final estimate is made which is regarded as an accurate and reliable return of the crop, and is usually available in the Census and Statistics Monthly for January. As far as the experimental farms are concerned, we do not gather such particulars except with regard to the crops on our farms, and, as you will have observed from the figures I have given you, the average of wheat there is considerably higher than it is in the Census Monthly returns. That, however, is due to the fact that the one deals with the results obtained by a very good class of farmers, our superintendents of the experimental farms, who are men well versed in agriculture, while the other deals with the results produced by the rank and file of the farmers of the country, included among whom are many who have had very little experience and are poorly informed upon matters relating to agriculture.

By Mr. Cash:

Q. There is one thing I would like to know in regard to the average per acre of wheat in Saskatchewan and that is, whether you have the acreage actually cropped in wheat?

A. The returns of the acreage in wheat in Saskatchewan, is not yet available. I have estimated it on the basis of the crop produced at about 4,000,000 acres.

Q. That is 4,000,000 acres for 1909?

A. Yes, I also pointed out in that connection that this was a little less than 5 per cent of the area of land contained in the nine crop districts which cover the surveyed parts of that province.

Q. Would you mean by that all the acreage under the plough? Or do you mean the acreage under wheat?

A. I am referring to the acreage under wheat only.

Q. The reason I am asking that question is that I understood the average yield of wheat was somewhere near 20 bushels.

A. Yes, the correct figure taken from the Census and Statistics Bulletin was 23·22.

APPENDIX No. 1

By Mr. Douglas:

Q. Do you get those returns from the provincial authorities?

A. We get them from both the provincial authorities and from the Dominion Census Bureau. The return for 1909 are from the Dominion authorities and the returns for 1908 are taken mainly from the provincial authorities compiled from the returns of the threshers.

Q. You get the averages of the figures as to acreage from the provincial authorities I suppose?

A. Yes.

Q. A great deal of the acreage would be devoted to green feed, which would never come out in the returns as to the yield of grain?

A. The returns of the provincial authorities give the acreage of oats that is not threshed. Some people might conclude from that, that those oats were frosted too badly. Such is not the case, however. In very many instances oats are sown and cut for feed, because the farmers depend largely on their crop of oats in sheaf for carrying their horses through the winter. The Dominion authorities do not usually make any estimate of oats harvested in this way for feed.

By Mr. Henderson:

Q. I understand that these averages are estimates of your agents throughout the west?

A. They are the estitmates of the agents of the Census Branch of the Department of Agriculture, and we get our information with regard to the averages altogether from the Census Monthly Bulletin or through provincial sources. The Census Branch of the Department of Agriculture depends for its advance information upon its special agents throughout the country. These agents give the Census Branch personal information and from this evidence the estimates are compiled.

By Mr. Staples:

Q. It appears to me there should not be any great difficulty in getting a correct estimate of the crops of the several provinces in the west, providing you adopt the system of consulting the respective threshers. Each thresher keeps a record of the number of bushels he threshes, and of the different kinds of grain; and while he is threshing on a man's place he has always a little time at his disposal and could inquire how many acres the farmer has under cultivation and how many acres of crops he is keeping for feed in the sheaf. It seems to me we could get a very accurate record if the threshers were communicated with.

A. That I understand is the way the provincial authorities get their estimate.

Q. I do not think the provincial authorities do that, because I have run different threshing machines myself and never was consulted.

A. I am told that the provincial authorities have recently passed an ordinance which compels the threshers to return at the end of the season the results of their threshing. I have not, however, seen this ordinance and do not speak from any personal knowledge.

Q. If so it was never enforced until the present year.

By Mr. Wilson (Laval):

Q. Is Saskatchewan the only province that does anything of that kind?

A. I think the system is in operation over most of the western country. It does not prevail in the east.

By Mr. Parent:

Q. Has the Census Branch got agents in the province of Quebec?

A. I believe they have, but I have no personal knowledge on this subject.

Hon. Mr. FISHER.—I think perhaps the question as to the way the Census and Statistics Bulletin is prepared is a little out of the way of Dr. Saunders' line. The returns are compiled by the Census and Statistics Branch of the department under Mr. Blue, and I shall be very glad a little later in the session, to have that gentleman give a full explanation as to the manner in which the work is done. Mr. Blue is away at present and perhaps will not be back for a month or six weeks. When he returns I shall be very pleased to have him come before the committee and explain the work of the Census and Statistics Branch. This is new work which has only been undertaken during the last few seasons, and perhaps is not exactly perfect yet. However we are doing what we can in the matter, and I shall see that the Committee gets the fullest explanation before the end of the session.

By Mr. Parent:

Q. Do I understand that the information given as regards the province of Quebec was obtained from Mr. Blue?

A. Yes, from the Census Bulletin.

Q. I had occasion to know something about it last year because Mr. Blue wrote to me at that time asking if I could give him the names of some representative farmers in my county who would furnish returns of the crop in their several districts. I complied with his request but I understand that none of the farmers in question reported, and if the same thing occurred in other counties, the returns from the province of Quebec are probably not all that they should be.

Hon. Mr. FISHER.—We get the names of suitable people from the members and others, and we have a large list in the department of persons with whom we are constantly in communication on agricultural subjects. We ask as many as possible of these people to give us reports and those reports come in, although not in as large a number as we would like by any means. We also get information from the secretary-treasurers of the municipalities, and in other ways that we can. I do not consider that the arrangements are yet by any means perfect, but we have issued our information compiled from the mass of these reports and judged a little by other sources of information at our disposal, such as newspaper reports, reports of the companies dealing with procedure, reports of the provincial authorities, &c. All these sources of information are studied and the report as issued is the result of that study. It is not a statistical report in the sense of accurate information. It is an estimate from all available sources of information.

Mr. SPROULE.—Does the province of Quebec send out any sheets to the farmers asking them to report individually the crop they have?

Hon. Mr. FISHER.—No.

Mr. SPROULE.—In Ontario the provincial authorities do that.

Hon. Mr. FISHER.—The methods of gathering statistics in the several provinces are quite different. Ontario, I think, with one or two of the western provinces, is in the lead in that respect, and Quebec and the maritime provinces are behind, I am sorry to say. We get our information as much as we possibly can from every source we can think of and deal with it on our judgment after that. I trust that as time goes on we will be able to perfect the amount and methods of information that we have.

The CHAIRMAN.—I am sure, gentlemen, we all feel indebted to Dr. Saunders for the very complete information that he has given relating to the various cereals grown in Canada. That information will be published in pamphlet form and doubtless will have a very wide distribution.

Certified correct,

WM. SAUNDERS,
Director, Dominion Experimental Farms.

DR. C. GORDON HEWITT, ENTOMOLOGIST, DOMINION EXPERIMENTAL FARMS

IMPORTANCE OF ENTOMOLOGY IN THE DEVELOPMENT OF CANADA.

HOUSE OF COMMONS.
COMMITTEE ROOM No. 34,
FRIDAY, December 10, 1909.

The Select Standing Committee on Agriculture and Colonization met at 11 o'clock a.m., the Chairman, Mr. M. S. Schell, presiding.

The CHAIRMAN.—The programme, gentlemen, which you will see from the notice placed in your hands this morning, is an address by Dr. C. Gordon Hewitt, Entomo-

Evidence of Dr. C. Gordon Hewitt, Dominion Entomologist, before the Select Standing Committee on Agriculture and Colonization—1909-1910.

Please note the following principal errors in the text.

p. 24, line 40. '3%' should be '·3%.'
25 " 26. '*agrotis*' should be '*agrestis.*'
30 " 46. 'and also' should be 'and will also.'
45 " 21. '*spretur*' should be '*spretus.*'
37. '*livittatus*' should be '*bivittatus.*'
47 " 44. '*Anthomy*' should be '*Anthomyia.*'
48 " 14. 'attacking' should be 'attracting.'
" 40. 'into' should be 'at.'
49 " 29. 'worms or grubs' should be 'adult beetles.'
" 30. omit from 'and' to 'beetles.'
" 33. 'grubs or larvæ' should be 'weevils.'

has been done during the past year in Canada, and also, I may say, since the Division of Entomology and Botany was founded in its dual character in 1887, I should prefer to deal in a more general way and try to point out to you how entomological research and science is growing and improving from year to year and its importance to an agricultural nation like Canada. We are finding, as we proceed, that we are more dependent than ever on knowledge which enables us to combat injurious insects, and it is more than ever important in a large country like Canada where yearly large tracts of land are being brought under cultivation. You may not know, but it is a scientific fact, that where you have virgin land, whether it be forest land or prairie land, brought under cultivation, you upset entirely the natural conditions which existed there previously, you upset, what we call generally, the 'balance of nature,' and by so doing you make certain animals change their nature, so to speak. You suddenly find that an animal which heretofore has fed on the native grasses, when it is given large plots of cereals to feed upon, it immediately finds that this new material is an excellent breeding place, and that particular species increase to an inordinate extent, and in so doing they become too large for the natural factors

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The CHAIRMAN.—The programme, gentlemen, which you will see from the notice placed in your hands this morning, is an address by Dr. C. Gordon Hewitt, Entomologist, Dominion Experimental Farms. We are pleased to welcome Dr. Hewitt to our Committee; he is a new man in connection with the experimental work at the farms and we have no doubt he has information which will be most valuable to us. Any information that will help to promote agriculture and add to the wealth of the country we think deserving of the closest possible attention—in fact I think the wealth that comes to the country through agriculture is more than that which often comes from the expenditure of millions of dollars in other ways, which receive popular approval and the approbation of public bodies. I am very much pleased to welcome and to introduce to you Dr. Hewitt.

IMPORTANCE OF ENTOMOLOGY.

Dr. C. GORDEN HEWITT.—Mr. Chairman and Gentleman—I thank you, Mr. Chairman, for your very kind words of welcome to me in introducing me to the Committee. It gives me very great pleasure to be able to come before this Committee in this way and to give some idea of the problems with which, as Dominion Entomologist, I shall be confronted, and also some idea as to the lines of work in which I hope to develop in a still more useful manner the new Division of Entomology. I believe it has been the custom in the past, at these meetings, to give more or less an account—at least that was the custom of my predecessor, Dr. Fletcher—of the work that has been carried on during the previous year. Although I am well acquainted with the work that has been done during the past year in Canada, and also, I may say, since the Division of Entomology and Botany was founded in its dual character in 1887, I should prefer to deal in a more general way and try to point out to you how entomological research and science is growing and improving from year to year and its importance to an agricultural nation like Canada. We are finding, as we proceed, that we are more dependent than ever on knowledge which enables us to combat injurious insects, and it is more than ever important in a large country like Canada where yearly large tracts of land are being brought under cultivation. You may not know, but it is a scientific fact, that where you have virgin land, whether it be forest land or prairie land, brought under cultivation, you upset entirely the natural conditions which existed there previously, you upset, what we call generally, the 'balance of nature,' and by so doing you make certain animals change their nature, so to speak. You suddenly find that an animal which heretofore has fed on the native grasses, when it is given large plots of cereals to feed upon, it immediately finds that this new material is an excellent breeding place, and that particular species increase to an inordinate extent, and in so doing they become too large for the natural factors

which previously controlled them. Under ordinary natural conditions where man has not interfered, you find that animals are kept in the balance, as it were, they have their enemies and they have their parasites, and these keep them in control. Nothing is more true than that in the case of insects, and you find that where man upsets this balance by suddenly introducing a large factor such as cultivation, this balance is upset, and there the trouble begins. Such has been found to be the case in experience. We have a number of examples in entomology of such a disturbance. But that, to my mind, is not the worst evil with which as a new country, Canada is confronted. You have here a country which is, comparatively speaking, free from pests of a very serious nature. We have such pests as the pea weevil, the codling moth, the plum curculio and the Hessian fly, with which I hope to deal later; all these pests occur, but they are not of an intensely serious nature. We have one pest, the San José scale, which is, and has proved itself, of a most serious nature in connection with fruit growing, and for which an Act was introduced some ten or eleven years ago. That is an example of pest which has been imported; you find sometimes when an insect is introduced into a new country that it multiplies to an inordinate extent. You have an example in the United States, there the Gypsy moth and the Brown-tail moth occur for which in 1908 the United States Congress voted $250,000 to help in combatting it. Those are two insects which were quite accidentally introduced, the one was unintentially released by an entomologist in 1868 or 1869 and the other was introduced on imported nursery stock about 1890, and now our neighbours have to spend millions of dollars to control these, because they have come into a new country where they are free from their natural practices. We have the Brown-tail moth in England, but it is an unimportant moth there, kept in control by parasitic agencies; these parasites are little insects which lay their eggs either on the caterpillars or in the caterpillars, and which develop and destroy them. Sometimes their attacks are rather worse than usual, simply because the parasites have rather decreased in number. Take another example, the San José scale, it was first introduced into California, and was first found at San José, and that is how it received its name; it was introduced from China where it occurs in its wild condition, but there it is kept in control by predaceous insects which prey on it, and parasitic insects. For example, there is the Tow Spotted or Twice-stabbed Lady Bird, *Chilocorus bivulnerus* Muls, a native of China, which feeds on the young San José scale and keeps it in control in its natural conditions. The United States Entomological Bureau tried to introduce this lady-bird into America but the attempt unfortunately did not meet with the success that was anticipated. I simply allude to these examples as indicating the enormous importance of guarding against the introduction of these injurious insects. There are some insects which we have not yet in Canada but which occur in other countries; and when we see the serious damage which they are inflicting we must take such precautions as are necessary to keep them out. To be forewarned is to be forearmed, and to be forearmed is to have taken all means you could possibly take to prevent the introduction of these pests. Insects are just as dangerous if not more so, than other enemies; in fact insects are worse. Whereas a large enemy could not get into the country unobserved, insect enemies can. And you have for your consideration this session a Bill which the Minister of Agriculture has introduced, by which he hopes to be able, on the threatened appearance of a pest, to take such measures as shall insure the Department's doing all that it can to prevent the introduction of that pest, and not only that, but to prevent the dissemination within the Dominion of pests such as the San José scale which has already been introduced.

There is another aspect of entomological work, and that is the importance of entomology to other branches of man's welfare than agriculture. Of course in Canada agriculture is supreme, and it is probably the nation's greatest asset. Therefore it will always be important to us as an Entomological Division to pay the greatest attention to those insects of importance agriculturally, that is to the farmers. We have to consider also those insects which are important to fruit growers, and those that

are destructive to the forests, because we shall find in the future, as the natural forests are gradually levelled, we must take such means as shall insure the keeping up of the supply of timber; in other words Canada must really begin to take an interest in afforestation, in which case, and in order to preserve our large natural parks, we shall have to pay more attention to those insects which are injurious to forest trees. I hope to call your attention later to some work which I carried on in England in connection with the Larch Sawfly, one of the most serious pests which is at present attacking the larch trees or tamarack in Canada.

It is also necessary to consider insects which attack live stock and even human beings themselves. By way of an illustration of the growth in importance of entomology during the past years, I might tell you that it was only in 1895 that Colonel Bruce discovered in South Africa that the disease which distroys cattle in large numbers in Southern and Central Africa, the disease known as Nagana, is caused by a microscopic organism which was carried by the Tse-tse fly. Then later, in the beginning of the present decade, it was discovered in Uganda that an allied species of this fly also conveyed to human beings the organism of the disease known as the 'sleeping sickness', which since 1901 has carried off more than two hundred thousand of the inhabitants of that territory. You must have noticed also the immense strides which have been made in dealing with malarial fever, the organism causing which is carried by the mosquito. There is no reason now why the inhabitants of any town or any district should suffer from this disease; in fact during the past few years where remedial measures have been employed such as entomological research has suggested, they have entirely cleared the infected areas of malaria. The Suez canal, which was one of the worst tracts in the world for malarial fever, is absolutely free from it now, simply because the state authorities have followed those methods of control which a careful study of the life history of this insect has indicated. Who would have thought that the mere observance of the method of breathing of the larva, or worm, of the mosquito—that that single observation would have given the key to the greatest controlling agency which we have now in dealing with the mosquito larva; that is, covering the tanks, or other water surfaces, with a very thin film of oil to prevent the larva obtaining air and thus suffocating it. That is merely an example to show you that we never know to what an entomological investigation may lead. People are often in the habit of saying 'This investigation is of no use,' because they cannot see the immediate application of it; and yet probably in a few years it may be found that the observations which were then made can be immediately applied and be of utmost importance.

FEDERAL FUMIGATION STATIONS.

The federal government has already taken, as I said, some steps in dealing with the introduction of at least one noxious insect, and incidentally of certain others. I refer to the San José scale. You have a system of federal fumigation stations arranged right across the frontier begining with St. John, New Brunswick, then St. John's, Quebec, followed by Niagara Falls, and Windsor in Ontario; in the middle of the Dominion, Winnipeg, and in the far west Vancouver; and it is necessary for all nursery stock which is shipped into the Dominion to pass through one of these fumigation stations where the Department of Agriculture has an inspector, a qualified inspector under the supervision of the Dominion Entomologist, who fumigates the nursery stock with hydrocyanic acid gas, and that destroys all life in the way of scale insects, and will thus prevent the introduction of the San José scale. Recently, since taking up my duties here as Dominion Entomologist, I made an inspection of the fumigation stations to get a thorough idea of the system, of the men themselves, and their methods of working, and I must say that I was quite satisfied with their methods. There have been occasional complaints from fruit growers concerning the condition in which their stock had been received, and on investigation I found, as Dr. Fletcher always found when he investigated these complaints, that the fault lay with the consignors and not with the superintendents of the fumigation

stations, that in many cases stock comes packed in a condition such that it never ought to be sent out, and it cannot be expected to arrive at the consignee in good condition.

THE WORK OF DR. JAMES FLETCHER.

I should like in passing to pay a tribute to the late Dr. Fletcher, whom I succeeded, or to the greater part of whose work I succeeded, for he was both Dominion Entomologist and Botanist, but owing to the growth of entomology and also of botany, it is deemed wise—and rightly so, to divide the one division into two divisions. Any one who has carried on scientific work in either of these two subjects knows only too well the difficulty, even in one subject, of dealing adequately with the questions. Entomology itself has grown to such an immense extent that one man alone could only obtain a general idea of the whole field, and with regard to the study of individual insects, it has become an age of specialization. If you take, for an example, the United States Department of Agriculture, in the Bureau of Entomology there they found it necessary to have a specialist for each group of insects, and they have so specialized and divided each group that they have an extremely large division. That merely shows the importance of specialization, and you will see how impossible it was in the great growth of agriculture in this country for one man to keep up the work of the two divisions, as Dr. Fletcher did, in a manner which was so much to his credit. Other persons more competent than I, have spoken as to Dr. Fletcher's work and his personality which was such a great force with him. I can merely speak of him from a professional point of view, and the greatest thing which can be said of him is, that he was the pioneer of entomology—economic entomology as we call it—in this country. Nowadays we call it economic because it is entomology, a pure science, which is applied to man's welfare, and in being a pioneer, as Dr. Fletcher was, in showing the farmers how important the study and control of these injurious insects was for their welfare, he has earned for himself an enduring name. It was one of the most pleasant features of my recent trip out to the coast to meet farmers, fruit growers and provincial authorities in the governments who said, 'Oh, you are the successor of Dr. Fletcher; well you will have a very hard place to fill.' And that was the kind of greeting one received all over the country, a greeting which I think speaks well for his work.

I only arrived in the country in September and took up my duties then, and I should like to say here that it will be my best endeavour to assist in the work of agriculture, horticulture and forestry, and to do what I can towards the promotion of these great assets of Canada to the best of my ability, by the application of scientific knowledge and scientific methods of investigation to all those different branches of man's welfare.

INDIAN ORCHARDS.

Another branch of the work of the Dominion Entomologist which may be of interest to you, is that which is being carried on in British Columbia. A few years ago some of the fruit growers in that province made complaints that the Indians were keeping their orchards in—I might use the expression for want of another word—a dirty condition, that is in regard to insect pests. As you may imagine, they knew nothing of the methods of control, they did not spray their orchards, they simply allowed them to grow rank and wild, and no doubt they were a source of danger as breeding grounds for all pests, and it was very hard on the white man, to use another common expression, near the Indian reserve, to have these pests carried over on his orchard which he did his best to keep clean.

By Mr. Henderson:

Q. Do you not find, even in the province of Ontario, that the same neglect with regard to control of insect pests exists in many instances?

A. I was coming to that point later on.

Q. I have been told that throughout Ontario not more than two per cent of the orchards are sprayed.

A. The percentage is greater than that but I am dealing with the Indian orchards. The Indian Department made a small appropriation, which is officially described as 'For cleansing the Indian orchards,' and this is expended under the direction and supervision of the Dominion Entomologist. There is an inspector out in British Columbia who works for six months in the year—I should like to have him working for twelve months if possible—he carries on the work and we have several spraying pumps which are distributed in the different centres. This man looks after the different Reserves, instructing the Indians how to spray their orchards, and what is of far greater importance, how to keep their orchards in a clean state of cultivation, because, as I was telling them out there, when I found many orchards which are grown up with weeds of all kinds, that if they will keep their orchards in such a filthy condition they cannot expect to keep these pests down. Then I found, as an honourable member here has pointed out, that some of the neighbouring fruit growers did not keep their own orchards in as clean condition as they should. In fact in many places I found the Indian orchards, since this new regime, compared very favourably with many of the orchards of the white men, and it really illustrated the value this work, is to the Indians, because many of them simply require teaching, that is all they need, and that is one reason why I have impressed on the inspector who carries on this work that he should go as often as possible to the Indian schools and instruct the young Indians in these methods of cultivation and spraying. This has already been productive of good, and as an instance I might mention that on one occasion he went to one of the orchards and found some of the trees had been grafted. To find grafted trees in an Indian orchard is rather exceptional, and on inquiry as to the origin of this he found that the grafting had been done by a young Indian who had learned from the inspector when he was at the school, how to graft trees. This shows you the importance of educational work, and that it is by teaching the future generation that we can get the best results.

EDUCATIONAL WORK.

This brings me to another part of the work of the Division of Entomology, and that is the educational work. The late Dr. Fletcher, my predecessor, took a very great interest in this, and he lost no opportunity of going to the schools and giving lectures on natural history—or nature study, as it is somewhat unfortunately called—to young people in various parts of the Dominion. The result is that the masters in many schools are enthusiastic entomologists, and we receive a large amount of material sent to the division for identification. If we cannot identify all the insects ourselves we seek the assistance of other experts and we do our best to help these masters in this educational work, which is of extreme importance. There appears, however, to me to be a danger of some of them becoming entomologists in the sense that they become mere collectors of insects, not realizing the true value of such instruction; whereas the real importance of educational work is not in making a mere collection of insects, but to make as nearly as possible a collection of injurious insects and of beneficial insects, showing the different stages in their life history, and getting the children accustomed to see these and to know how to deal with them, because we shall then have accomplished a really useful service to the future farmers of Canada. I cannot insist too much on the importance of such educational work because I have seen the results of it in many of the rural schools in the Old Country, where they are taking very great interest in the matter, and education in these natural sciences such as botany and entomology is playing a large part in the school curriculum.

NECESSITY FOR CLEAN CULTIVATION.

There is another aspect I should like to deal with in treating of these general topics, and that is the subject of clean farming and clean cultivation. It is no use, in

many cases, for a farmer to endeavour to attack pests by methods which we suggest if he keeps the borders of his fields and the ground in his orchard in a very untidy and rough condition. It is frequently found, as I told you at the beginning, that many of these pests not only feed on cultivated plants, but also feed on the wild grasses and weeds; and you will observe in the case of some injurious insects, that the insect passes part of its life history on the crop, and then migrates to the wild grasses, the rubbish, and the waste on the outside of the field where it continues to feed. In many cases the eggs are deposited on this and the insects migrate afterwards to the cultivated crop. Other insects also, such as the crane flies—or as they are called in the worm stage—leather jackets, in the fly stage use the shelter of the rubbish heaps and the wild growth on the sides of the fields and then the farmer has no means of getting at them. They simply shelter there, and emerge when they wish to lay their eggs in the crops. All this could be avoided if the farmer would only take the precaution of clean farming and clean cultivation. Take another example of an insect which is very injurious in some parts of Canada, the greater wheat-stem maggot, *(Meromyza americana)*. The second blood of that insect frequently passes its life history in what is known as the volunteer crop, that is the crop of grain which comes up after the ordinary crop. Such a crop, of course, should be destroyed. It is only by making note of such things that we are able to take what means we can against these injurious insects. I can say without fear of contradiction, that if farmers would only keep their fields as clean as possible and not leave rubbish lying about, keep down long lank grass and weeds, and if fruit growers who let rubbish, which forms hibernating places and shelters for these pests, accumulate in their orchards—if they would only destroy the rubbish, which they can very easily by burning, they would be liable to suffer far less from the attacks of these injurious insects.

By Mr. Henderson:

Q. What would you say about leaving apples that fall from the trees lying on the ground?

A. I think that is a most careless procedure for any fruit grower. One of the most important things in fruit growing is not only to gather the windfalls, but to gather them as soon as they fall. If he cannot do this himself I should recommend turning some pigs into the orchard; they would soon gather the windfalls for him. To take on one or two instances. In the case of the codling moth the fruit often ripens prematurely and falls to the ground and the worm of the codling moth emerges from the fruit, goes up the tree and spins its cocoon. In the case of one insect, the railroad worm, or apple maggot, almost the only method of destruction of that insect which we have at present is to destroy the windfalls, because the female lays its eggs in the apple, and the maggots feed inside the fruit so that you cannot touch it with any kind of spray. Then the apple falls usually prematurely, and the maggot after feeding a little longer leaves the apple and goes into the ground. If you gather those windfalls as soon as they fall you destroy a very large number of the maggots.

PLANT-LICE.

Having dealt in a general way with the objects of the Division of Entomology and the importance of entomology in Canada, I shall now come to special pests which are at present of importance in this Dominion. The first pest which I might mention are the Plant-Lice, or Aphides. These have been extremely abundant this year not only in Canada but in the United States, in England, and in Europe, and the abundance of this pest is rather difficult to explain. It has some connection with the conditions of temperature and moisture, but exactly what these conditions are, we do not yet know although we are trying to find out. We find that some of the former views that we held are being considerably modified, and that these things do not follow

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such principals as they were considered to. For example, it was believed that a very warm year, or a warm period of a season, was the best condition for the greatest development of plant-lice. As a matter of fact the beginning of this year was not warm and yet we had a very large number of plant-lice. There are so many factors which control these things and we have to discover what those factors are and how they act. The abundance of plant-lice is not a remarkable thing. To a person who does not know how plant-lice reproduce, it is a remarkable thing. I should like to describe briefly the mode of reproduction of these plant-lice. We will begin with the egg stage which remains on the tree during the whole winter. You find them on the apple trees, in the case of the apple aphis, as little black oval bodies near the buds. Then in the spring they hatch. The mother produces young and these young, by a most remarkable provision of nature, are able to reproduce young without fertilization by the male. We call it Parthenogensis, which simply means virgin-birth. And in this way all these females are able to continue producing young without any males being required. The rate of reproduction therefore, is extremely rapid. Not only that, but they reproduce living young ones, so that the reproduced young ones, which immediately after being born are able to begin feeding, in five or six days, reproduce young ones themselves. Thus you will understand how many hundreds of millions of young ones could be reproduced from one aphis in one season if there were no enemies. But of course aphides have enemies, and one of the greatest enemies of the aphis is the larva of the lady-bird which is a small dark grey grub-like creature with six legs, which goes about the leaves and the twigs eating these aphides as fast as possible. And then of course there are parasites and other means of control, in fact, if there were no means of controlling the aphis there would be nothing else in the world but aphides. To continue the life history of the aphis; this method of reproduction goes on all through the summer, that is, this reproduction of living young ones, and then towards the end of the season, in the fall, sexual forms are produced, males and females, and the females then lay eggs which have been fertilized, on the twigs, and in the egg stage the insect passes the winter. Therefore you have the two methods of attacking these aphides, one is to attack the aphides themselves during the spring or summer by some contact wash, or a wash like kerosene which will choke up their breathing pores and thus suffocate them, or you may use during the winter such a wash as lime and sulphur, or lime, salt and water-glass which I found very good in England. It will either destroy the egg or cover them with a thin film of lime that will prevent them hatching.

We have, in addition, a particular species of aphis known as the woolly aphis. This woolly aphis is so called because it produces a woolly secretion, and you will find them often in the autumn on small twigs covered with this woolly substance. This species can be destroyed by using a kerosene emulsion wash. In some localities in Ontario in the southwestern part, I believe, and in the United States, and especially in England and Europe a second form in the life history of this woolly aphis is found which feeds on the roots. Often young apple trees are found to gradually wither away and die, and it is not known what is the cause because nothing can be found on them until they are pulled up, when nodules are found on the roots on which will be seen numerous woolly aphides. Of course this form, being on the roots, is extremely difficult to eradicate or control; several methods have been suggested, and one of these I have found of great benefit although I do not know how it would work if applied on a larger scale; that is to inject carbon bi-sulphide, making four injections around the roots. This chemical is volatile and the vapour kills the aphides around the roots. Another method which has been found to be of great use in the United States, consists in uncovering the earth for about 6 inches deep and about 18 inches to 2 feet from the stem on the tree, thus getting near to the roots. A strong solution of kerosene is then applied, the soil being drenched, with the result that the solution percolating down through the soil destroys the aphides that are living on the roots. Another method is to use either tobacco ash or tobacco wash. All these methods have

been more or less successful in dealing with the root form of the aphis, but of course it is an extremely difficult thing to apply these methods in an orchard of an extent.

By Mr. Henderson:

Q. Does that insect prevail very much in this country?

A. The root form does not prevail very much I find in Canada at present. It occurs in western Ontario, but in Quebec I am told it does not occur at all, which, if true, is very fortunate. It is extremely common in some countries in Europe and especially common in England, and of course we must look for and prevent its spread in this country.

THE LARCH SAW-FLY.

There is one insect which I think will interest you because it is one of, if not the most serious forest insects which exist in Canada at the present time. It is the large Larch Saw-fly. The history of this insect is interesting. It was introduced into America, and was first discovered at the Harvard Arboretum in 1880, and was described by Hagen in the 'Canadian Entomologist' in the following year. In 1882 it made its first appearance in Canada and was recorded by the late Dr. Fletcher. The larva or worm is very like a caterpillar and it feeds on the leaves of the larch or tamarack and strips the trees entirely of their foliage. I have had photographs taken and will consider its history for a few minutes. Dr. Fletcher said in one of his annual reports, 'With this annual defoliation for several years the larches over millions of acres and practically over the whole of eastern Canada were wiped out.' And that was really the case. With the destruction of its food plant this saw-fly seemed to disappear altogether; of course its food plant had been destroyed, and this fact was also recorded by Dr. Schenck when he wrote his account of Canadian forestry. It was rather interesting to me when I found that this saw-fly had appeared again in Canada. It began to become very prevalent just a few years ago, of course the young larches by that time had started to grow again, the tamarack is an extremely common tree in the eastern regions of Canada and grows through Ontario and as far as Winnipeg. I had been making a special study of this saw-fly in England where it had been attacking some very important plantations in the English Lake district, and during the last few years I had studied the life history of the insect and the means of control, an account of which I wrote for the Board of Agriculture. There are different means of control: we have the natural means of control, such as parasites and other animals, and then there are the artificial means of control, such as man employs. I have made up a specimen case here which I thought would interest the members of the committee, showing the general results of this investigation, which, of course, is not complete, as no entomological investigation is ever complete. (Case passed around for inspection of members.) You will see there male and female saw-flies, but the female saw-fly, like the female aphis, lays eggs which hatch out without being fertilized; in fact out of several thousands of specimens only 3 per cent were males, so that you will see it is practically an affair which is run by the female. These females deposit their eggs in slits which they make in the small green shoots at the end of the twigs, and by so doing they kill the terminal shoot. You will see in the case a specimen of the terminal shoot that has been killed by the laying of the eggs by the female. The larvæ hatch out and immediately begin to feed on the green foliage, and they gradually defoliate the entire tree. When they have become full grown they come down the tree into the soil and there they spin a cocoon, a little brown cocoon of which you will see specimens there, in which they remain the whole winter, changing into what we call the pupæ or pre-insect stage in the following spring. The perfect insect emerges as a fly which is a wasp or bee-like insect—it belongs to the same family as the wasps and bees—and lays its eggs again in the early summer on the larch twigs. It is called the saw-fly because the female is provided with a saw by means of which it makes a saw-like incision into the terminal shoot of a twig, which

results in the death of that shoot and prevents its further growth. That, of course, is one of the injuries to the tree. This defoliation of the tree which goes on for several years usually results in the death of the tree. In England, where there are no such virgin forests as you have in Canada, these plantations are of very great economic importance, it is very necessary, therefore, to take what precautions we can to keep down or eradicate this pest. It was on that account that I undertook the investigation and made as careful a study as possible of its life history, and of the parasites and natural means of control.

By Mr. Donnelly:

Q. Does the saw-worm attack other trees besides the larch?

A. No, and that is rather interesting. You may get larch trees and pine trees growing adjacent, and you will find the larch trees absolutely defoliated and the pine perfectly untouched. Sometimes you do find that some insects, for example, the Spruce Bud Worm, will attack other trees than the spruce, as I have found in British Columbia. Of course the parasites are increasing from year to year, which is another interesting point. That often accounts for the sudden disappearance of an insect pest. An insect is a pest for several years and then suddenly it disappears, due often to the fact that the parasites have so increased in number that they have simply eradicated the insect.

I also have discovered a fungal disease which attacks the larvæ after they had entered the ground and formed cocoons. The ground then becomes affected by the spores or germs of the fungus, and the next year's brood when it comes down, is also affected in the same way. Then there is another two-winged fly which is also a parasite on the larvæ. There are, therefore, these natural parasites; but one of the most peculiar means of control discovered was the small field vole, or, as it is sometimes called, a field mouse, (*Microtus agrotis*). It is one of the forester's worst enemies, so that you have there one enemy attacking another enemy. Under these circumstances it was a very delicate question to decide what one should do. However, I advocated leaving things to themselves, not destroying the voles, but allowing them to go on with their very useful work of destroying the larvæ. Their method of destroying the larvæ was very interesting. The vole burrowed into the ground after the cocoons, and, finding one, bit off the end of the cocoon and pulled out the little worm. You can see on one of the photographs some of the cocoons showing the teeth marks of the voles. I caught a number of these voles by means of traps baited with the worms. I then dissected some and examined the contents of their stomachs with a microscope, and found they were feeding almost entirely upon the worms of the fly.

There is another very important natural means of control, namely, the insectivorous birds. The locality where this pest existed was not well provided with bird life, and so it was necessary to encourage this means of natural control. To do so, a large number of nest boxes were made to attract the birds and bring in to the district as many of the insectivorous species as possible. I have brought with me one or two photographs of these nest boxes which I had taken in their natural position. I was only able to see the result of one year's experiments, but in the first year thirty-three per cent of the nest boxes were occupied.

Another method of controlling this insect was to put a tar band round the tree. The district is a very wet one and the larvæ are washed off the trees in large numbers by the rain, and they crawled up the trunks again to feed. By tarring the trees in that way you destroy and catch a large number of the larvæ. These photographs are interesting as showing not only the tar bands, but how the large larches have become defoliated. Looking at the photographs, you would naturally think that it was a larch forest in winter. As a matter of fact the photograph was taken in the summer; the trees were absolutely denuded of foliage.

By Mr. Todd:

Q. Does this insect climb up the larch trees and kill the tops?

A. It usually begins to attack the branches at the bottom. After the flies come out they immediately begin laying their eggs. They lay them on the under branches of the larch and the worms gradually work their way up to the top. There are other insects which attack the top of the larch first and you may get two insects working together.

By Mr. Wright:

Q. Would it not be well to give the ordinary Canadian name of the larch?

A. I am extremely sorry. I thought I said 'the larch or tamarack.'

By Mr. Henderson:

Q. What you are speaking of is the ordinary Canadian tamarack?

A. Yes.

By Mr. Donnelly:

Q. I think these are photographs of what we call the hemlock and not the tamarack?

A. Those are photographs of the European larch. You have two species of the larch. You have the European larch (*Larix Europæa*), and the American larch (*Larix Americana*). The *Larix Americana* is called the tamarack. The *Larix Europæa,* the native larch in the Old Country and in Europe, is only another species and is very similar to the Canadian larch or tamarack. You find the insect feeding indiscriminately on both.

By Mr. Thornton:

Q. The larch shown in the photographs is the Canadian species?

A. No, it is the European. There is another larch known as the Japanese larch. The saw fly feeds on the Japanese larch in the same way. Then of course in British Columbia there is another species known as the occidental or western larch (*Larix occidentalis*).

By Mr. Burrill:

Q. To what extent does this pest prevail in British Columbia?

A. I did not find it occurring in British Columbia. I could not get out all along the lines, but when making a railway journey I cannot help noticing the conditions while travelling through the country. I found the larches all along the line of the C.P.R. as far as Winnipeg, all through the district between here and Winnipeg, attacked by the sawfly. Some of the tamaracks were dead and others will not live very long, and it is very unfortunate because the tamarack is specially suitable for living in some localities, especially the swampy and 'muskeg' regions such as occur in Eastern Ontario.

THE WARBLE FLY.

I now wish to call your attention to another class of insect, and one to which I do not think my predecessor often referred in his reports, namely, those insects which attack cattle. The entomologist, of course, has to deal with insects attacking cereals, with insects attacking vegetable crops, with insects attacking forests, with insects attacking man's stock, such as cattle and other live stock and finally he has to study those insects attacking man himself, which are not the least important. In this country, especially out west where the cattle industry is so important, we must pay attention to one particular insect pest which is a source of great loss to that industry,

and that is the Warble fly, or Bot fly, which is known scientifically as *Hypoderma lineata,* Villers, as the species occurs in America. I have brought here a specimen maggot of this Warble which is responsible for the injury. The life history of this insect is interesting. The female fly which is very little larger than the house-fly, but very hairy in character, lays its eggs on the hair of the cow, or the yearling—it is found that yearlings and two-year old cattle are far more liable to attack than the older cattle. There seem to be two methods which the young maggot, when it emerges from the egg, which is attached to the hair of the animal, may take. One species, the *Hypoderma bovis* appears to have a different method of attaining its final position below the skin. The warble fly to which I refer appears to lay its eggs on the hair of the cattle when they are changing their coat. The eggs are laid in the early spring, and on account of the animal licking the hair the egg gets into the mouth of the cow or yearling. The maggot then bores its way through the æsophagus, as that region of the throat is called, into the spinal canal or other tissues, and after wandering through the tissues of the cow for eight or nine months, it works its way to the flesh immediately under the hide, and lies in the underlying skin. Having reached that place it changes its skin and becomes spiny and feeds for the remaining few weeks of its life on the pus that is formed. It makes a little hole through the hide, and through this it obtains air and forms for itself a tumour-like cavity in the inflamed region. It is, naturally, a source of great irritation to the cow, and it grows until it attains the size of the specimen I have passed around, and at that time it forms a perfect cavity or 'warble' under the skin of the cow. When full grown it perforates the hide by a much larger hole and then the full grown maggot drops into the ground where it changes into a dark brown pupa, out of which emerges the fly in three or four weeks.

By Mr. Smith (Middlesex):

Q. On which part of the body do they lay these eggs?

A. They lay these eggs usually on the legs. That has been found to be generally the case. In the case of the other species, the *Hypoderma bovis,* it has been found by experiment that the larvæ probably do not enter by the mouth, but they work their way directly into the skin. Thus you have the two methods of entrance, direct and indirect.

Q. That kind usually attack cattle and the other kind may usually be found on horses?

A. No, both these species attack cattle.

By Mr. Henderson:

Q. There is a disease in this country known as anthrax, is that disease produced in somewhat the same way?

A. No, that is a disease which is produced by a bacillus—the *Bacillus anthrax.* It is a bacilliary disease just as tuberculosis is a bacilliary disease.

The losses which are caused by this insect may be classified in three categories, first you have the injury to the hides; by these larvæ boring through the hides you get a perforated hide, and if an animal is infested, as they often are, by a number of these maggots you have a much perforated hide which results in considerable loss. It was calculated by Professor Osborne that in the United States in 1880 the loss was $90,000,000 on account of this insect alone; in England the annual loss was estimated by Miss Ormerod at $10,000,000 to $35,000,000.

Q. In hides alone?

A. Professor Osborne, in his estimate of $90,000,000 included the loss which results from the effects on the milch cows; you see these cattle are terrified by the fly; the presence of the fly would immediately send a herd on the stampede, and also the warbles in the animal causes great irritation and loss of vitality which affects the milk supply and also the beef, because wherever the warble has been the beef imme-

diately under that warble has a peculiar appearance which the butchers in England call 'licked beef.' I do not know what they call it in this country, but as a matter of fact it is produced by suppuration and inflammation which the insect causes.

By Mr. Henderson:

Q. Are these diseases of which you are speaking in connection with cattle as prevalent in this country as they are in England, or are they more prevalent in England?

A. The bot fly is very prevalent in England and in Europe, but I have no evidence as yet, as I have not studied this insect in Canada, as to the prevalence of the warble in the western regions of Canada, though, from what I have found in the United States reports, I should not be at all surprised if it were found to be more prevalent than we think. Unfortunately I do not as yet know how prevalent many of these pests are in Canada, because we have had no system of returns. But I should expect it to be quite a prevalent insect in the western regions of Canada. It is common in Eastern Canada. I should very much like to have information from cattle ranchers and other people in the western part of Canada as to the prevalence of this insect, because it is extremely important to know in what proportion it occurs there. That is a point which I should like to bring out, namely, the desirability for co-operation between the farmers and the fruit growers and the Entomological Division.

By Mr. Robb:

Q. Before you get away from that subject, what time elapses from the time at which the cow is attacked by this fly before the warble develops?

A. The time depends of course on the temperature, which varies in the different regions of so large a country as Canada, but it is usually nine or ten months in the cow and three or four weeks in the ground, or it may be even longer than that.

Q. What is the remedy for it?

A. The remedy is a very simple one—squeezing out the warbles during the winter.

By Mr. Smith (Middlesex):

Q. A lot of people have cattle with warbles that come out through the back?

A. That is the one which I am speaking about.

Q. The description you have given does not quite conform with the habits of that warble in Canada. Here it usually comes out in the spring and these eggs are deposited the year before, so that they come out during the winter.

A. They do not usually come out until the beginning of the spring or summer and the maggots remain under the skin until then; the eggs are deposited in the previous spring.

Q. I think they come out in the winter and early spring.

A. As I was about to say, you will find that even in a small country like England or Ireland, their habits are affected by the climatic conditions, and you will find no doubt that even in Canada you may have them emerging in the late winter, if the cows are indoors, and in the spring in another place. It is simply a matter of climatic conditions.

Q. But the point I was wanting to get at is the length of time.

A. In the early summer, you may have them beneath the skin for a few weeks only.

Q. I took exception to that because we do not find it has developed in the summer at all.

A. You do not notice it because it is inside the animal.

Q. They have evidently developed in the winter or early spring. And those eggs must have been laid the year before

A. Those eggs probably were laid in the previous spring or summer, and the maggot wanders about the tissues of the animal for a number of months.

Q. We see the mature fly attacking the cattle in the field during the summer?

A. You have seen them?

Q. Yes.

A. Because the warble fly is extremely difficult to see. It takes a number of months, in the case of the larvæ of *Hypoderma lineata,* which wander through the tissues of the animal, for those maggots to reach their final position, and as I said, these insects are affected very much by climatic conditions. You could not lay down a definite rule as to the duration of the life history of any one insect for a very large tract of country. Take for example the codling moth, which in Quebec has only one brood in the year, whereas in the western regions of Ontario and British Columbia, it has two broods in a year. That is simply a matter of climatic conditions.

By Mr. Henderson:

Q. The warble is not a new pest in Canada.

A. No.

Q. My impression is that I have recollected it for the past fifteen years.

A. I merely called your attention to the warble as an example of an insect which attacks live stock, in a review which I am giving you of Canadian insects which are prevalent at the present time. The most effective method of treating is simply squeezing out the warbles when they are full grown. It is a very troublesome procedure, but in doing so you destroy what will be a future fly, and also what will be a large number of future maggots; and by doing that in the case of cows which are used for milk for dairy purposes, you can destroy all the warbles in the herd. I am not speaking theoretically, I am speaking from practical experience. In a certain district in England the boys at school were taught the life history of this insect and were shown how to deal with it, with the result that they became very interested in warbles. Wherever they could find a warble on a cow they squeezed it out and destroyed it. The result being that in a very few years that district was entirely free from the warble fly. Another method which probably takes less time to do but is not so effective, is to paint the warbles with some dressing or other which will kill the larvæ inside or prevent them breaking, and so suffocate them.

NEED FOR CO-OPERATION.

But, as I was saying before answering these questions, I should like to ask for co-operation in these things on the part of the farmers, and also in the case of fruit pests, of fruit growers. We get very many inquiries about insects, asking what the insect is and what method is to be used to eradicate it, but so far as I can see we do not so frequently receive a reply after some time from the inquirer saying whether he has used that method and with what success. Yet that is what we really want. Surely it is not much to ask if a man has applied a remedy and found it effective, or did not find it effective, or only partially effective, that he report his results. In that way one is able to obtain some idea as to the efficacy of the particular measures in particular localities; and as Canada is such an immense country, having so many different conditions, it is important to know the effects of remedial measures which we suggest under different conditions, because one thing may be successful in a certain region and another may not.

SAN JOSÉ SCALE.

I have brought here for those of you who may not have seen it, a specimen of that insect which I have already mentioned, the San José scale, and also some speci-

mens in this tube of the adult females of the San José scale, which I have extracted from underneath the scales. You will be able to see the scales on this bark in the form of small, grey, pinhead-like structures.

By the Chairman:

Q. They are very much like the bark louse only smaller?

A. Smaller and circular. Those are partially grown insects. You will find in some cases larger scales during the winter which are the scales of the hibernating females. These females in the spring begin to produce young ones again, and young insects which have passed the winter in that condition continue their growing. Some form females and some males and the latter are the only ones which are winged. I introduce this subject because it is an extremely important insect to the fruit growers of Ontario, and to tell you that measures are being taken to control and destroy this very injurious pest as much as possible. I was down in the Niagara district a short time ago and went through some badly infested localities, and in some places where it formerly occurred, I found it extremely difficult to secure a specimen of the San José scale. I must say that in many instances the San José scale have proved rather a blessing to fruit growers because it has got them into the habit of spraying. They have to spray, and as a result they are getting their trees clean and free from many other insect pests which otherwise would be injurious. Of course a very large number of trees have been destroyed, but if they would only preserve in these methods and pay more attention to the stock in the nurseries, I think we shall be able to keep the San José scale in control. The most useful wash, is the lime sulphur wash, the ingredients of which are fifteen to twenty pounds of lime, fifteen pounds of sulphur and forty-five gallons of water. Of course if any of you would like further particulars in regard to this or any of the other washes for remedies which I have suggested, you have only to write to me to the Experimental Farm and I shall only be too pleased to send you the exact proportions to use and the methods to employ.

Q. You say fifteen pounds of sulphur, twenty pounds of lime, and forty-five gallons of water?

A. Fifteen to twenty pounds of lime, fifteen pounds of sulphur and forty-five gallons of water. It is what we call on account of the proportions the 1-1-3 wash. You slake the lime first, and then while still boiling you add the sulphur and thoroughly stir adding more water as necessary, and boil for about forty-five minutes to an hour until it changes to a rich brown colour. Add sufficient water to make it up to forty-five gallons, and apply it while still warm, because if you allow it to become cool it chrystallizes again, and when it does it is necessary to re-boil it.

By Mr. Smith (Middlesex):

Q. In destroying the insect life on animals you have to have it at a temperature of 110 in order to be effective, why does it not require that temperature on trees?

A. As a matter of fact one of the chief uses of lime and sulphur and the one which is not always recognized as it is usually considered that it directly kills the insects and their eggs, whereas, as a matter of fact the way in which it acts in the case of the eggs of insects, is that it covers the eggs and the scales with a thin film of lime, hence the necessity of thorough spraying. It is always a good thing to have the lime a little in excess of the sulphur because in that case it prevents the eggs from hatching by encrusting them. The sulphur is more of a fungicide and also destroy, such animals as the red spider and other mites which of course, are not insects.

Q. That is not the effect which it has on insects on animals, it is not that it kills them, but that it sufficates them, it covers them over so that they are not able to breathe.

A. On plants?

Q. No, on animals.

A. Not on animals, that is the way it acts with regard to insects which are on plants. I do not think you usually use the same lime and sulphur wash on cattle.

Q. Oh yes, it is one of the standard remedies for scabies or any other insects on animals.

A. Yes, there you use the sulphur and that preparation is made in a different manner.

Q. Sulphur and lime.

A. Yes, but the sulphur in that case is the important ingredient as in all washes that are used for the scabies which is not caused by an insect.

Q. It is a mite?

A. Yes, it is a mite, which is not an insect; it belongs to the spider group, and they can usually be destroyed by sulphur, which is the important ingredient in the case of scabies. I have no doubt if you left lime out altogether and used borax, for example, or even lard with sulphur you would get the same result. I have now dealt with insects which attack man's stock, and I shall now with your permission refer to a few insects which are noxious to man himself.

WIRE WORMS.

By Mr. Donnelly:

Q. There is a great insect pest which is giving the farmers of western Ontario a great deal of trouble at the present time, the wire worm; no doubt you have a scientific name for it.

A. We will call it the 'wire worm.'

Q. There are many farmers in the western country that lost practically one-half of their crop. If a field that has been in pasture for four or five years is ploughed up this pest is almost certain to destroy one-half of their crop. I know of a certain section in which the loss from that source is very great and I should like if you can give any information in reference to the matter.

A. The wire worm is an extremely difficult insect to attack. It is one of those insects which you get when the land has been freshly broken up, and a good method of attacking it, if you can employ it, is to sow a crop of mustard; that has been found to be very effective.

Q. Is not the cure worse than the disease.

Q. The wire worm absolutely refuses to eat mustard, so that if you can do that and if you can find a use for the mustard it is a very good way of ridding land of the wire worm.

By Mr. Thornton:

Q. What kind of mustard do you mean? What we call wild mustard?

A. No, I should certainly not recommend you to use the wild mustard.

By Mr. Wright:

Q. Is there any peculiar condition in connection with the breaking up of sod that allows the wire worm to live? In some sections where you have broken sod you will find them very thick and in others you will find none at all?

A. Of course the chemical and physical condition of the soil itself may be especially favourable for the wire worm, or the soil may have a special supply of food suitable for the insect in a particular locality.

By Mr. Smith (Middlesex):

Q. It very seldom occurs where there is a rotation of crops.

A. No, that is one of the methods employed for combating the wire worm, but the difficulty is that you may find the wire worm will not attack one crop but will attack the succeeding crop.

Q. Sometimes it is worse the succeeding year.

A. That is because the wire worms live more than one year in the soil. It attacks so many different kinds of cultivated crops that sometimes farmers find the method of rotation of crops is not successful as a remedy whereas others again may find it quite suitable. It depends on the crops that are sown.

Q. It seems to apply except in the case of what we call wild grass or probably blue grass. It is very seldom found in Timothy or Clover, where there has been a regular rotation.

A. No, clover is more or less immune to the attacks of wire worm, but, for example, supposing you find it feeding on oats or wheat, and then you put in potatoes it would attack the potatoes the following year to quite a serious extent. Only recently I had some potatoes sent in which were very seriously attacked with wire worm. Then it is generally thought that barley is rather immune, but as a matter of fact I had wire worms from barley in British Columbia from which it appears that under certain conditions it may find barley to be a suitable food.

Q. In the case where mustard has been sown, you say the wire worm would not attack the mustard, but would you expect it to be likely to attack potatoes planted in that soil the following year?

A. You might get a few of them in the potatoes, but you would reduce the attack very considerably by having an intermediate crop of mustard.

By Mr. Donnelly:

Q. What value would a crop of mustard have?

A. I do not know, I leave that to the Agriculturist; I simply know as a fact that mustard is noxious to the wire worm, I am not speaking of wild mustard, but of cultivated mustard.

Q. Will mustard thrive in this country?

Dr. SAUNDERS.—The mustard of commerce is not cultivated much in Canada.

By Mr. Smith (Middlesex):

Q. Flax is a good thing to keep them away.

A. I have not known the wire worm to attack flax.

Mr. SMITH, (Middlesex).—I should like to know something about a grub which is destroying the pasture in our district.

Dr. HEWITT.—Is it a cut worm that you mean?

Mr. SMITH.—No it is a large gray grub, I cannot give you the scientific name for it. In western Ontario we have a very large proportion of land which is devoted to pasture for feeding beef cattle for export, and a good deal of trouble has been experienced from the ravages of this pest during the last few years. These are old pastures that have been sodded down for a great number of years, and the old sod has been cut completely off. You can kick it or roll it around just as you like.

Committee adjourned.

APPENDIX No. 1

COMMITTEE ROOM 34,
WEDNESDAY, December 15, 1909.

The Select Standing Committee on Agriculture and Colonization met here this day at 11 o'clock a.m., Mr. M. S. Schell, chairman, presiding:

The CHAIRMAN.—I have very much pleasure in calling upon Dr. Hewitt, Entomologist of the Dominion Experimental Farms, who was with us last week, and gave us much valuable information, to continue his address. The subjects upon which he will speak this morning are: 'Insects injurious to cereals; insects injurious to stored grain; and insects injurious to certain vegetable crops.'

Dr. HEWITT.—Mr. Chairman and Gentleman,—It was the request of a number of members of this committee that I should speak to you this morning particularly upon certain insects which attack crops—cereal, grass and root crops—and therefore I shall deal with some of the more important insects which we find attacking crops in Canada.

WIREWORMS.

First and foremost of all injurious insects which we find attacking such crops is the wireworm. I am glad to have this opportunity of talking about these wireworms because I find, that not only in this country but in all other countries, there is a great deal of confusion in the popular mind as to what the wireworm really is. I will show you some wireworms, and first will pass around some specimens of the real wireworms so that you will know the appearance of the true wireworm; next I will pass around a case showing the wireworms and its parents; and then I will pass around another case containing an animal, one of the Millipedes, which are frequently mistaken for the wireworms.

Wireworms are the 'worms' or larvae of a particular species of beetle belonging to a family popularly known as the 'click beetles.' They are called click beetles because they have the habit when they are turned on their backs of springing into the air with a click by means of an arrangement underneath their bodies which enables them to regain their normal position, and you frequently will find these beetles which are rather elongate in shape, in rubbish and among vegetation. The worm itself probably has been given the term 'wireworm' on account of its particularly hard nature and also because it looks like a small piece of brown wire. That character is a most serious one in dealing with them, because these worms are so hard, and their skin is so resistant that they are able to withstand the effects of insecticides and other substances which would kill many more softer-bodied insects. We find them attacking not only cereal crops and grass, but they are very injurious to root crops especially potatoes. It is found that they are particularly injurious where grass land has been turned down—I think you use that term in this country where fresh land has been ploughed.

By Mr. Wright:

Q. That is grass turned down?
A. Yes.

Hon. Mr. FISHER.—Sod land.

Dr. HEWITT.—Usually you will find wireworms living in natural grass land feeding on the roots of the grass. When that land is turned down to cultivation and sown with a crop, whether grain or roots, you provide the wireworms with food which is probably far more suitable than that to which they have been accustomed, and the result is that their presence is soon perceived by the injuries which they cause. The difficulty of attacking them is also enhanced by the fact that the different species of wire-worms have different life histories—that is with regard to the length of time they spend in the larval or worm state. Whereas, some may only have a life history—that is the period from the egg to the perfect insect—of two years, others may take as long as four or five years to develop. But the average time is two or three years. You will see therefore that this fact in addition to the character of the larvæ increases the difficulties with which we have to contend in dealing with them.

I will briefly describe the life history:—The eggs are laid by the beetle in the spring or summer and then the larvæ hatch out and begin to feed on the roots. They move about at a depth of a few inches below the soil, and the more loose the soil is, the easier it is for them to do so. They live in the worm condition for two or three or four years, and when fully grown they go a little deeper into the soil and make a little cell in the ground and there change into what we call the pupa, which is a stage in the life history of the insects before becoming the adult beetle which you see in the case which I have just passed around. The pupa changes into the perfect beetles in about two or three or four weeks—usually two to four weeks and generally about August—and in the following year, after hibernating, they again lay eggs and give rise to a fresh brood. You will see, therefore, that you may have in the earth young larvæ, half-grown larvæ, full grown larvæ, and possibly pupæ, all occurring together in the same year, so that in any remedial treatment or measure which you may employ you will have two or three years' broods of insects to deal with. Experiments both in Europe and in the United States have shown that many of the so-called wireworm remedies, in fact the majority of them, are quite useless. They may give, in particular localities, temporary relief from the wireworm; but most careful experiments have been carried on by entomologists and others with insecticides and with such preventive measures which are frequently suggested in the case of the wireworm such as dipping the seed in poisonous substances. But all these are found to be quite ineffectual. The difficulty, as I said, of eradicating the wireworm is due to three reasons. First, its position through life. You will find that it lives just below the surface, that it moves about from root to root, and so it is extremely difficult to touch with any dressing of any kind. Secondly, you have the character of the larvæ itself. It has an extremely hard resistant body which will withstand many chemical compounds in a diluted form, and it has extremely great vitality. Thirdly, there is the difficulty of the length of the wireworm's life. The only methods which have proved to be of any value in dealing with the wireworm are methods of cultivation. You will find that in the case of the majority of these insects which attack farm crops, we can only attempt to control them by methods of cultivation. You will realize that in dealing with many insects attacking large areas, it is quite impossible to apply such methods as spraying, &c., to which you would resort in the case of a small crop growing in a garden or restricted area. But these measures are quite impracticable in large areas. One of the best methods of attacking the wireworm, when you are going to turn turn old grass land into cultivation, is to plough it down in the autumn. Plough deeply, because by so doing you turn up the young wireworms and the pupæ, and expose them to the rigours of winter and the result will be that a large number of them will be killed. In the next year sow clover. It is found that clover is less attacked by the wireworm than most crops. By sowing clover you do not supply the wireworms with food. If you sow roots or corn (cereals), immediately the sod has been turned down it is certain to be attacked by the wireworms, if that insect is previously present in the sod. But if clover is sown the next year and then ploughed

again the following autumn, you expose those insects which were young, and escaped in the previous winter, to the rigours of a second winter. So that by two ploughings down in two autumns, and an intermediate crop of clover, you take such means as will not only prevent the larvæ from obtaining suitable food during the year, but will expose the larvæ and pupæ in both winters to climatic conditions such as frost which are injurious to them.

By Mr. Martin (Wellington):

Q. When you use the word 'corn,' do you mean Indian corn?

A. I must apologize to the Committee for that small slip. I used the word 'corn' as meaning cereals. In England we are often accustomed to use the term 'corn' as synonmous with cereals or grain. I appreciate the fact that in Canada and the United States there is a distinct difference, and in future I will attempt to be as explicit as possible.

By Mr. Sexsmith:

Q. You recommend seeding with clover on the soil? You spoke as if you had a crop. That is not our experience in this country.

A. I do not wish to give you the idea that you should seed for the sake of cutting a crop of clover. I simply recommend clover as being a crop on which the larvæ will not feed. If you are willing to adopt such a plan you may turn some kind of stock on to the clover and feed it off. I do not recommend clover as being a crop for cutting, but simply as a crop which is more or less immune to the attack of the wire worm.

By Mr. Chisholm (Huron):

Q. Would it not be better in this country, where clover makes so little progress to summer fallow?

A. Summer fallowing is a very good method. If you are willing to do it, that would be an even better method of controlling the wireworm, and you should plough deeply in the following autumn.

Mr. Smith (Middlesex):

Q. Why not sow a crop of peas, which is immune to the wireworm? You could get a full crop of this if the land is in good condition.

A. Peas are not entirely immune to the wireworm. The wireworm will attack peas, at least that is my experience in England. You find that barley and rye are more immune than other cereals such as oats and wheat. As I said at the last meeting, it is frequently recommended to sow mustard as an immune crop. The wireworm refuses to attack mustard. You can more or less starve them out in that case, but, as I understand, mustard is not a crop of any importance in this country.

Mr. KIDD.—There is too much of it here.

Dr. HEWITT.—You refer doubtless to the wild mustard.

By Mr. Kidd:

Q. Would two ploughings kill the wireworm?

A. In the case of the common species of wireworm which passes its life history in about two or three years, it would. But if it were a species of wireworm which had a history of four years it would probably be necessary to adopt these cultural methods during the succeeding years.

By Mr. Todd :

Q. Is it true that bacteria will draw nitrogen from the air as in the case of a clover or a pea crop? I have seen it stated that French scientists claim that bacteria will draw nitrogen from the air which enriches the soil, but I do not know whether that has been established or not?

A. Although such a matter does not, strictly speaking, come within the province of the entomologist, the problem of the nitrogen bacteria is one in which I have taken a great interest. They do to a slight extent enrich the soil. The soil is naturally enriched by nitrogen from the air. At Rothamstead in England it was calculated, I believe, that about five pounds of nitrogen per acre is extracted from the air by such natural agencies as snow or rain. But the soil bacteria will not add to the nitrogen content of the soil to the same extent that legumes would.

Q. Would you advise the growing of such legumes as peas and clover?

A. For enriching the soil in nitrogen? Yes, because their roots are provided with special bacteria for that purpose.

By Mr. Sexsmith :

Q. Before you leave the question of the wireworm, have you any knowledge of this insect attacking crops in the province of Ontario?

A. Yes, I had specimens sent to me last week which were attacking potatoes.

Q. In the county of Durham last year there were some patches of potatoes utterly destroyed by a kind of white worm which bored into the potato and ate it right out. I read in the paper of one man who had seven acres totally destroyed. That injury was caused by a white worm, not the wireworm?

A. I shall consider that insect in a few minutes. The insect to which you refer is probably the white grub. It is frequently of service to go over the land with a disc roller, and I understand from Dr. Saunders that in Canada you have a special machine for consolidating the soil which is known as a packer. Where the soil is packed together, or rolled, we find that the larva is less able to move about through the soil, therefore by preventing extensive movement, you prevent a large number of the larva getting from root to root. But such a method of treatment is only applicable in a very few cases. In the case of wireworms which are attacking crops in a garden or small area, you can frequently trap them by putting tempting bait, such as slices of potato, or slices of beetroot, of which they are very fond, and examining these from day to day and destroying the larva that are found. Another method of trapping them is to put bunches of alfalfa, in heaps by the side of the field with a shingle or board on top of them. You find that the adult beetles, the click beetles, will resort to these traps and they may be destroyed from time to time, this method is frequently employed in the case of small rows of roots. It has also been found that dressings of chemicals frequently serve a good purpose. For example a dressing of salt on the land, to the proportion of six or eight hundred weight to the acre, will often clear the land of wireworms.

By Mr. Marshall :

Q. Will that kill the white grub?

A. That will also kill the white grub. Using heavy dressings of such manures as nitrate of soda, super phosphate and kainit have also been found useful.

Another method which is sometimes used in the case of turning down fresh sod is, before you plough down the sod, to pen sheep on it, and feed them on the sod, moving them from place to place as they gradually manure and tread down particular areas. If you feed them in such a manner, moving them from place to place, and feeding them in hurdles, or by similar methods, they manure and tread down the ground heavily. They will not only tend to kill the larvæ but will also make the soil obnoxious to the adult click beetles and prevent them laying their eggs in it.

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Before leaving the question of the wireworm I will say a few words concerning the small creatures which were passed around with the wireworms. They belong to another family of animals but are frequently called wireworms. They are quite different in structure and are not insects but myriapods, so called on account of their enormous number of legs.

By Mr. Kidd:

Q. Did you say the wireworm would not work well where there is mustard?
A. Yes, that is so.
Q. The ground is full of seed here in a great many places.
A. I did not refer to the wild mustard.
Q. You did not refer to the wild mustard?
A. No, it was not the wild mustard to which I referred. It is the cultivated mustard that these insects do not like. Nor do they like the wild mustard either, but I should certainly not recommend any farmer to use wild mustard as a means of eradicating the wireworm.

WHITE GRUBS OR JUNE BUGS.

Another insect whose injuries are of the same nature as those of the wireworm is the white grub, of which there are a number of species. I have handed around specimens of this insect. These insects in the adult state are known in the south as the May bugs. In the north they are called the June bugs, as that is the month of the year when the insects themselves are flying around. The white grubs are found in natural grass land and when such land is put under cultivation the white grub attacks the subsequent crops in a similar manner to the wireworm, and it is on such crops that the greatest injury is effected. Sometimes the white grubs are in such large numbers that they will frequently destroy whole patches of natural grass and you sometimes find whole lawns destroyed by the presence of these white grubs which feed on the roots. Not only do the grubs themselves feed on the roots and grass, but their parents, the adult beetles, are also injurious. In Europe the June beetle frequently occurs in such numbers that clouds of them fly across the country and eat up everything before them, almost like locusts. The adult insect feeds chiefly on the foliage of hardwoods such as the oak, maple, chestnut, willow, ash, &c., and it is extremely fond of feeding on apple trees, especially nursery stock. The adult insect is, therefore, just as much a menace as its larva the white grub. The insects usually appear in this part of the world in June, as their name implies, and they generally fly at night. Frequently in June you will see a very large insect flying about and sometimes it will bang heavily against you, such an insect is generally a large June bug, or as it is called in other parts of the world the cockchafer. They feed upon the foliage of trees and shortly afterwards deposit their eggs in the ground singly at a depth of an inch to three inches. I have a photograph here of the different stages of this insect which I will pass around. The larvæ or white grubs hatch out and first they feed on the young and tender roots of the crop, whether it is oats, wheat or other cereal crops and on the approach of winter they go deeper into the ground and pass the winter in the grub stage. The white grub, like the wireworm, has a life history which extends over several years, generally about three years. I have prepared this table of its life history which will explain to you better than any words of mine could the life history of one of these white grubs:—

DIAGRAM OF LIFE HISTORY OF THE WHITE GRUB. *(Lachnosterna spp.)*

1909.		1910.		1911.		1912.
Summer.	Winter.	Summer.	Winter.	Summer.	Winter.	Summer.
Eggs laid, Grubs hatch and begin to feed.	Grubs hibernate.	Grubs feed.	Grubs hibernate.	Grubs feed and change into Pupæ, from which Beetles emerge in a few weeks.	Beetles hibernate.	Beetles emerge and lay eggs.

Supposing the eggs were laid during the present summer the beetles would emerge in the summer of 1911 or 1912. The greatest damage is done during the second year, and in some cases during the third year, when the larva feeds upon the larger roots, it is then that it begins to make its presence noticeable. It spends, as I have said, two or three years in the soil and then goes deeper down into the soil and makes a hollow cell or chamber in the earth where it changes into a pupa, as we call it. I am sorry that there is no popular term for the pupal stage, but the pupa is the stage in the life history of the white-worm before it becomes the perfect insect. In the pupal stage it is very similar to the perfect insect, except that it is very soft, white and tender. The pupa changes into the adult beetle in the late autumn, and the adult beetle remains beneath the ground and emerges the following year.

Except when white-grubs attack small patches of land, which can be treated very easily and effectively with keresone emulsion, we have no good methods of treatment except those of cultivation. As in the case of the wireworm, ploughing in the fall is the most effective treatment because it exposes many of the white grubs. If you plough deep enough the tender pupa will be brought to the top and thus exposed to the frosts and other climatic conditions which will kill them. If the attack is very severe it is not infrequently a wise plan, in addition to the straight ploughing, to cross plough and thus bring up the majority of these white grubs. As in the case of wireworms, it is never an advisable thing, if the land is infected with the white grub, to plant cereals or roots immediately after the turning down of the sod, because you would invariably get the white grub turning its attention to these crops. We find, as in the case of the wireworm, that clover is immune for some reason or other, or more immune than other crops, to the attacks of the white grub, so that if a crop of clover is sown in the year following the fall in which the field is ploughed deeply, and the land is again ploughed in the following fall, the majority of these white grubs will be exposed and destroyed.

By Hon. Mr. Fisher:

Q. It is usual in this country to sow clover as a cover crop, you are not suggesting that?

A. I am suggesting the sowing of clover as it is a crop that is more or less immune to the attacks of these insects.

By Mr. Chisholm (Huron):

Q. How would flax do for the same purpose?

A. It has been found that flax, both in the case of the wireworm and the white grub, is more immune than other crops, and it probably would be a good crop to employ if possible as the ground might be more suited to flax than clover. At the

same time, one cannot be certain owing to the absence of experimental evidence whether flax, under certain circumstances, would be immune to the white grub. It is a question upon which experiments should be carried out before recommendations are made.

By Hon. Mr. Fisher:

Q. Before you leave that point. You spoke about attacking the white grub by spraying with kerosene emulsion. In what way would you do that, by spraying the plants? The beetle does not attack the plant, does it ?

A. The beetle sometimes attacks the leaves of young cereals, but it usually attacks hardwood trees, and under such circumstances it would be necessary to kill the beetles by spraying them with some arsenical spray. But the kerosene treatment is followed in the case of the white grub occurring on small areas where the grass is an extremely valuable asset. It is found that by giving the soil a very heavy drenching wtih kerosene emulsion, just as you would with water, it will kill the larvæ underneath. Of course you could not apply that treatment in the case of a large area, it would not be profitable.

Q. You would drench the soil just as you would with water?

A. Just as you would with water.

Q. It would be hardly spraying, it would be more like drenching?

A. Yes, drenching. It is frequently found, after ploughing, that if you turn in hogs or poultry, they will exterminate all these white grubs. No doubt under primitive conditions the white grub was regarded as one of the items of food for man, because I have it on the authority of people who have tried these worms that they are extremely succulent and have a very nutty flavour! However, this worm is appreciated by poultry and hogs and if these animals are turned on to land which has been ploughed they will feed on these insects and destroy large numbers of them.

IMPORTANCE OF BIRDS.

Q. The robin is a very effective enemy of the white grub?

A. Yes. Most of the insectivorous birds are, and that is a point I should like to bring out before the gentlemen who represent farming constituencies, that the farmer should pay very great attention to birds which are their allies. During the last few years I conducted an investigation in England into the feeding habits of certain birds in relation to agriculture, and I found that some birds such as rooks and starlings, which have similar representatives in Canada, although not the same species, in some seasons fed principally on wire worms, and on other larvæ injurious to root crops. It should be carefully borne in mind that although at certain seasons of the year these birds may be injurious, for example to fruit, at other seasons of the year they are extremely useful in destroying larvæ which man himself cannot reach, as in the case of the wireworm. Consequently the good as well as the evil that certain birds do should be taken into consideration in deciding whether you should destroy birds or not.

By Mr. Wright:

Q. What effect would the English sparrow have?

A. In England the English sparrow is generally conceded to be a nuisance, and it is the same here in Canada. It is the cause of great loss by feeding on and pulling about the grain which is piled up in the field; it scatters the grain about on the ground and that, to my mind, is the greatest damage that the sparrow does to grain. In the spring, however, it feeds to a slight extent on insects for its young.

Q. We look upon it as the enemy of the farmer.

A. I would also look upon it as the enemy of the farmer and advise its destruction so far as it is possible. But of course we must be very careful to guard against the destruction of insectivorous birds. That is the only mistake which people make when they form themselves into sparrow clubs and destroy every sparrow or every bird which looks like a sparrow. When this is done they frequently destroy a large number of birds which are insectivorous and thus do a great deal of harm.

By Mr. Marshall:

Q. Do I understand that you would recommend fall ploughing?

A. Fall ploughing when turning permanent grass under cultivation.

Q. I understand you would recommend that?

A. Yes, if you are turning down the sod, do so in the fall.

Q. The reason I asked you the question was because we have experienced great difficulty sometimes in securing a crop of tomatoes owing to the depredations of this white grub.

THRIPS.

A. I wish now to consider another insect whose injuries are attaining no little importance in some parts of Canada, although it is one which is generally overlooked. These injuries are caused by an insect which is known as Thrips. The crop which it chiefly attacks is oats. I will pass around photographs of some oats which have been attacked by thrips. You will notice the appearance of the oats which is erroneously attributed to 'blight'. 'Blight', by the way, is a very vague term which is employed by both farmers and fruit growers to indicate the attack of some small thing about which they usually do not know the nature. It may be fungus, it may be an insect, or it may be due to other causes such as climate, soil or minute worms. The attack of thrips has been usually attributed to fungus or to climatic conditions, but whereas fungal diseases may produce an appearance similar to the one you see in the photograph, in many cases it is due to this small insect which we call thrips. It is a minute insect, and the different species vary in length from one-tenth to one-twentieth of an inch. In the case of the thrips which attacks the oats the species is black. I cannot show you a specimen of the insect itself because it is microscopic but I will pass around a figure of one. It is a small black insect, provided, in the adult condition, with two pairs of feather-like wings from which it gets its family name, and has a definite larval stage, which is similar to the adult stage except that it has no wings. Each species attack different plants. Some species attack flowers such as asters, campanulas, &c., others attack grasses and others again cereals.

By Mr. Thornton:

Q. The insect shown in this lantern slide is magnified.

A. It is very much magnified. That particular species is one-twentieth of an inch in size. I passed the lantern slide around so that you would understand the appearance of the insect.

During the present summer before I arrived in this country, some samples of oats were sent down from Saskatchewan to the Experimental Farm. My colleague, Mr. Güssow, examined them. He is well acquainted with the attacks of the many insect pests, and he found that the injury to the majority of the samples was not due to fungus but to the attacks of this small thrips. I will pass around a specimen of oats attacked by thrips which shows you their actual appearance.

By Mr. Sexsmith:

Q. Do these insects not attack potatoes?

A. Yes, they do attack potatoes. Mr. Güssow found on examination that the injuries in 18 out of the 30 samples were caused by thrips, and in one head of grain which contained thirty-six ears he found that twenty-four of them had been destroyed

by thrips. You will see, therefore, that if a crop is attacked, a large percentage of it may be destroyed. Mr. MacKay, the Superintendent of the Indian Head Experimental Farm, who is here to-day, tells me he has noticed the thrips in the oats there for a number of years past, and that last year it was more injurious than it has ever been. He also told me that certain species of oats seemed more immune than others. Such a fact may prove of great service in dealing with the attacks of these insects if we can find immune varieties.

Q. When do they attack the oats?

A. I was about to describe the life history of these insects. The adult insects hibernate usually in crevices in the soil and in rubbish, and they emerge in the beginning of the summer, usually about June. They lay their eggs in the grain which is just forming in the ears, sometimes while the flowers are still there. The larvae which hatch out are little six-legged grubs, generally of an orange or deep yellow colour, and they feed on the developing grain, which is very juicy at that stage, and eat out the grain. By so doing they cause that peculiar blighted appearance of the grain. These insects gradually change into adults and you may get a second or even a third generation in the same year.

Q. Are they visible to the naked eye?

A. They are just visible. You can just see the young larvæ as yellowish specks of colour and if you had a small magnifying glass you could see them distinctly.

Q. In our district there is a kind of a red blight which strikes the oats when they are in the shook. That blight or fungus when it strikes comes in just the same manner. I had supposed it was due to blight on the leaf.

A. You may get a fungus disease and the thrips concomitantly.

Q. You may, but I attributed that to the red blight on the leaf.

A. It may be due to another cause altogether.

By Mr. Smith (Middlesex):

Q. Does the mature thrips feed also?

A. The mature thrips also feed, and it is an extremely interesting fact that the matured thrips has mouth parts which are adopted to both biting and sucking, and in that respect it is a very exceptional type of insect, so exceptional that entomologists hardly know where to place it in the insect kingdom.

By Mr. Kidd:

Q. Do they feed in much the same way as the weevil?

A. They feed in very much the same manner as the weevil, by destroying the contents of the grain. In dealing with this insect we are confronted with the difficulty of treating large areas. In the case of gardens containing flowering plants which are attacked, you can control and even eradicate them by using such methods as kerosene emulsion and other insecticidal solutions, but in the case of large areas you cannot apply these measures. One of the best methods is to plough deeply after the crop has been cut. By ploughing deeply in the fall, those mature insects which are hibernating in the soil are ploughed under and are prevented from coming out in the following year. When the grain is threshed, the screenings and all the loose grain should be burnt. By burning such material, any insects which have not yet completed their life history or any adult insects still in the ears will be destroyed.

By Mr. Wright:

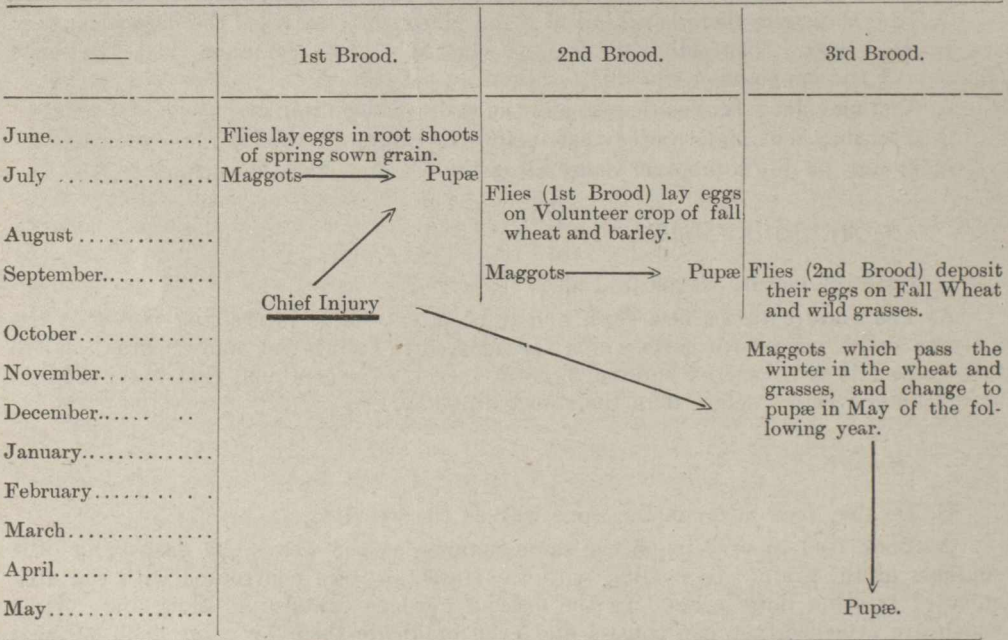
Q. Supposing the chaff were used for feed, would that kill the animals?

A. That would kill them certainly. That method would be useful.

The Greater Wheat Stem Maggot.

There are other important insects which attack cereals and first of these is the greater wheat-stem maggot, *(Meromyza americana* Fitch). When wheat is attacked the resulting condition is frequently called 'silver top,' or 'dead heads.' This is due to a small insect, a small slender green maggot, about one quarter of an inch long which will usually be found inside the mature stalk, just above the top joint. It feeds inside the stem, a point which should be remembered, because in the case of these insects which attack cereals, some of them feed inside and some outside the stalk, for example, the hessian fly feeds inside the leaf sheath and outside the stalk. As to the fly, I have a specimen of it which I will pass around, also specimens of wheat stems which have been attacked. The fly itself is a small greenish white fly, with three small stripes on its back. In Canada there are three broods of this fly in the year, and in order to make it intelligible and graphic for you, I have made a diagram of its annual life history. On the left hand side I have put the months, beginning with June and ending with May. You will see the different broods and the particular crop on which the insects lay their eggs:

ANNUAL HISTORY OF GREATER WHEAT-STEM MAGGOT (*Meromyza americana*, Fitch.)



Note.—Strictly speaking the 'brood' should begin with the egg stage, but the flies of the previous brood have been included to conveniently show the nature of the crop on which the eggs are deposited.

This insect usually passes the winter as a maggot in the fall wheat or wild grasses, and after the winter these change into pupae which emerge in June. The flies then lay their eggs in the root shoots of the spring sown grain and in July the maggots change into pupae. The flies of this summer brood usually emerge in August. The flies of the summer brood lay their eggs chiefly on the volunteer crop. That is an important point to remember in devising control measures. The eggs are laid on the volunteer crop, either of fall wheat or barley. The flies of the second brood emerge in September and they deposit their eggs shortly afterwards. This is also an important fact to remember. The maggots which come from these eggs pass the winter in that

fall sown wheat and also in wild grasses. It is in the root-shoots that the maggots which attack the root shoots of spring sown grain, and the maggots of the third brood which attack the fall sown wheat, do the most injury, and therefore one of the best remedial measures which can be devised with regard to this insect, and which the late Dr. Fletcher suggested, is to postpone the sowing of fall wheat. If you postpone it until after the third week in September you miss the flies of this other brood.

By Mr. Sproule:

Q. Then you would miss your crop next year?

A. Not necessarily; it is a question for you to consider. I think it is found that by sowing at the end of September you do not get quite as good a crop although you may not get so heavy a crop as you might have obtained by sowing earlier. At the same time, if the early sown crop is liable to be attacked by the maggot you would probably get a larger crop by postponing the sowing than you would by sowing earlier and having it reduced by the attacks of the maggots. Another method of control is the destruction of the volunteer wheat, either by ploughing or harrowing with a disc harrow. By destroying the volunteer crop you destroy the maggots from the summer brood and this terminates the annual life history of the insect.

By Mr. Chisholm (Huron):

Q. How would that do in Alberta where they sow the fall wheat very early—some time in July?

A. In Alberta the insect may probably only have two broods in the year. The number of broods depends considerably upon climatic conditions. Where spring wheat is sown it is found that turning over the stubble is a very good measure to adopt because you may get a number of insects which are in that stubble destroyed. But this insect is extremely difficult to attack on account of its habit of living in wild grasses. It is one of those insects of which I was telling you at the last meeting, which are native to the country and whose native foods are the wild grasses. When man interferes with nature and cultivates the land and sows cereals then this insect devotes its attention to these. At the same time it retains its habit of feeding on wild grasses which makes it, therefore, a very difficult insect to control.

There is also the lesser wheat-stem maggot *(Oscinis carbonaria,* Loren.) which sometimes proves troublesome and is treated in much the same manner.

THE HESSIAN FLY.

In the case which is being passed around you also see specimens of that very great pest the Hessian Fly *(Cecidomyia destructor,* Say.) In insects which attack crops one cannot omit this very important enemy of cereal crops, the hessian fly. It was probably introduced towards the end of the 18th century and it may be interesting to you to learn how it received its name. It was supposed to have been introduced by the Hessian mercenaries who were employed during the war of the American revolution, I think about 1778, and who were quartered in Long Island, New York. The Hessian soldiers were supposed to have brought the Hessian fly with them across the ocean in their straw; it is certainly a European pest. It has been found very destructive to spring wheat in Manitoba, and also to spring and fall wheat in Ontario and the Eastern Provinces. There are usually two broods, but in Manitoba there is only one annual brood. In the case of the form having two broods the life history is as follows: The small black flies, with smoky wings such as you see in the case, are about a quarter of an inch long; they emerge in May or June and lay their eggs on the ribbed leaves of the wheat, barley or rye, whichever crop they are attacking. You will find the eggs deposited in small rows on these leaves. The larvæ hatch and work their way down

between the leaf-sheaf which surrounds the stalk and the stalk itself, and there they feed. Later they become full grown and change into pupae which are very distinctive and characteristic of this insect, because they have very much the appearance of a seed and are consequently called 'flax seeds.' The second brood of flies emerge from these pupae in August or September and lay their eggs on the crop which is sown in the fall. This brood is naturally very injurious as the larvæ feed in the young wheat during the winter. Some remain as larvæ during the winter and others change into the pupae or 'flax seeds' before the winter. During the winter, therefore, both flax seeds and maggots may occur. The usual condition in which they pass the winter is in the flax seed state and these are found in threshing. In threshing affected cereals the flax seeds occur in the screenings and it is extremely important therefore to destroy all such screenings in order to get rid of the flax seeds which would produce flies in the following year. By late sowing, as in the case of the larger wheat-stem maggot, the second brood of flies is missed as these are flying about in September. By ploughing the stubble, after cutting a crop a large number of the flax seeds of the summer brood are ploughed under and thus prevented from hatching. These are the chief cultural methods which can be employod against the hessian fly. We can only attack this fly as in the case of most of these insects, by such cultural methods.

THE WHEAT MIDGE.

There is also a small midge which frequently attacks wheat and is known as the wheat midge *(Diplosis tritici,* Kirby*)*. These yellowish midges, which are very minute, lay their eggs in the florets of the wheat in June. The orange coloured larvæ or grubs hatch out and feed upon the forming grain in the same manner as small thrips. In fact they are sometimes found occurring together and it has been considered by some that the thrips were feeding on the *Diplosis* grubs. It is frequently mistakenly called the 'weevil' and sometimes results in very great loss in Canada by eating out the kernel of the grain. When this midge is full grown it drops to the ground and in the ground changes into a pupa in which stage the winter is passed. The best method of destroying this insect is by deep ploughing after cutting the crop; by this means the pupæ are turned deep into the soil, and the flies are prevented from emerging the following year. The screenings should be burnt after threshing, and also the chaff, because in so doing the grubs which have not yet pupated are destroyed.

WESTERN WHEAT STEM SAWFLY.

An insect which was sent to me in September from Manitoba was the Western wheat sawfly *(Cephus occidentalis* Riley & Marlatt*)*. It causes considerable loss in Manitoba and other parts of Western Canada. The stems of the crop fall down and the field then looks as if it had suffered from a very heavy hail storm. That is due to a small maggot about half an inch long which feeds inside the stalks. It bores a passage through the partitions inside the joints so that it can feed through the whole length of the stalk. When it is almost full grown it goes to the base of the stalk and makes a little hole or a partial hole, through the stalk to the outside, out of which the fly may emerge when it comes out, an interesting provision. The larva becomes full grown about August and after spinning a small cocoon remains as a larva in the bottom of the stalk during the winter. About the following May or June the larva changes into a pupa inside this cocoon at the bottom of the stalk and the adult sawfly which is a wasp-like insect, comes out of the stalk through the hole which the grub made, and its progeny continue the attack. There is only one annual brood, so that one of the best methods of attacking this insect is burning over the stubble after the crop has been removed. By burning the stubble a very large number of these larvæ

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which are pupating in the bases of the stalks during the winter are destroyed. Another method is to deep-plough the stubble before the flies emerge in June and this will prevent the emergence of the fly.

You will note that many of these methods which are suggested are simply common-sense methods gained from a knowledge of the life history of the insects. If the insect is in the pupae stage somewhere near the top of the ground, if you plough it deep you prevent it emerging the following year. In the case of wheat if the land has been summer fallowed, or if it is to be put under summer fallow, such land should be ploughed by June so that these larvæ are turned down underneath the soil and their emergence prevented. In some cases some of the larvæ may have pupated rather high up in the stalks; and if you wish to be doubly certain that all the larvæ have been destroyed it is not a very improvident thing to burn all the straw after cutting. By so doing, the larvæ which have pupated higher up in the straw than the reaper goes, are destroyed.

LOCUSTS.

The locusts or short-horned grasshoppers are a class of insects which are extremely injurious not only to crops but frequently to grass. Locusts can be divided into two groups, the migratory locusts which, after they become full grown, migrate to another district, and the non-migratory locusts which do not migrate in that manner. The greatest injury to the crops in Manitoba, for example, is caused by the two migratory locusts, the Rocky Mountain locust *(Melanoplus spretur* Uhler*)* and the Lesser Migratory locust *(M. atlanis* Riley*),* both of which belong to the same family. These deposit their eggs in little packets, containing about thirty eggs, in the ground usually about August. They do not usually deposit their eggs on the prairie, but in soil which has been cultivated. They remain in the egg stage during the winter and the young locusts hatch out in the following year. There is no 'grub stage' in the case of the locusts. What corresponds to the grub stage is a little hopping insect, exactly like the adult insect except that it has no wings. This stage compares to the grub stage of those insects that have grubs. In Manitoba it emerges in April or May. It begins to feed and these young forms are the forms which usually cause the most damage, especially in South Africa where they suffer so terribly from the attacks of locusts. The young form comes out and feeds voraciously and gradually changes into the adult form by the development of its wings, so that it can fly about June or July when it begins to migrate. In British Columbia there is another form the Pellucid Locust *(Camnula pellucida* Scudder*)* which is non-migratory, but frequently causes great injury. The Red legged *(M. femur-rubrum* De G.*)* and the Two-striped *(M. livittatus* Say.*)* locusts are to be found over the whole of Canada.

There is a very simple remedy for locusts which has been devised by a farmer in Manitoba, Mr. Norman Criddle, who is now doing some work of an artistic character for the Department of Agriculture. His remedy has been called 'Criddle's Mixture.' He found that locusts were very fond of horse-droppings and, knowing the habits of locusts, naturally conceived the idea of poisoning the horse droppings and farmers are now finding it a very cheap remedy. The method of making the Criddle mixture is as follows: Take 60 pounds of horse droppings to a pound of Paris green, which is the arsenical poison, and two pounds of salt. Mix them well in a barrel and then cart this barrel to the edge of the infested field, and by means of a spade, trowel, or wooden paddle, scatter it around the edge of the field which is infested, or likely to be infested, and the locusts by feeding on these horse-droppings are poisoned. Another method is ploughing late in the autumn where there has been an attack of locusts. By so doing the egg capsules are ploughed under and the young locusts prevented from emerging in the following year. Another method which is frequently employed against locusts is that of using 'hopper-dozers,' which are long narrow tin trays on wooden frames shaped something like this (illustrating) with two ends. The

trays contain water covered with coal oil, and as they are dragged along the field, the locusts hop into the trays and are thus caught. Such a measure is frequently used, especially in the United States for catching locusts. Locusts are subject to the attack of many parasitic enemies, especially parasitic flies, and these frequently keep them in control.

CUTWORMS.

We have another class of insects which are responsible for a great deal of damage; These are the cutworms. The injuries due to cutworms may vary according to the species of cutworm. For example, some cutworms feed above the ground and others below it, and it is extremely important in dealing with a particular attack to know what kind of cutworm is inflicting it. We frequently have inquiries from people who say that a certain cutworm is attacking a crop, but when you do not know what species of cutworm it is, it is often extremely difficult to advise what remedial measures they should apply. The cutworms are the worms or caterpillars of moths of nocturnal habits. They are frequently called the 'owlet moths.' These deposit their eggs on the plants attacked or on weeds and other vegetation and from these eggs the young cutworms emerge. They were the original inhabitants of the wild and unbroken land, and they turn their habits to other crops. They are insects which have very wide feeding habits. Some of these cutworms do not confine their attention to particular species of plants like certain insects are accustomed to do, but they are extremely wide feeders. They attack crops such as vegetables or cereals, grasses, roots, and almost any kind of vegetation. The life histories of these worms vary, of course, according to climatic conditions. Some spend the winter in the egg state, some in the worm stage, some in the pupa stage and some as moths; and there are some species that spend the winter both as pupæ and moths. But most of them spend the winter in the cutworm stage, usually about two-thirds grown and underneath the soil or under rubbish. The species which is most injurious in this country, in fact over the whole of America, is what is known as the variegated cutworm *(Peridroma saucia* Hub.*)*. This species when it is very abundant, may adopt the habit of a certain species of cutworm known as the army worm which travels *en masse* like an army, and destroys everything before it. In Canada it usually spends the winter in the larval stage although it has been found in the pupa stage.

Another species you have is the red-backed cutworm *(Paragrotis ochrogaster* Gn.*)* Teh remedy for surface or feeding cutworms is a simple one. It is made by poisoning such a substance as bran of which these cutworms are very fond. Mix half a pound of Paris green with 50 pounds of slightly moistened bran adding half a pound of sugar to each gallon of water used. The mixture must be made so that it will crumble between the fingers. This mixture is sprinkled in front of the cutworms if they are travelling, or about the crop; the cutworms will turn their attention to it rather than to the crop and will thus be poisoned.

Another method which is frequently employed in the case of cutworms attacking crops is to spray a small patch of clover with an arsenical poison such as can be made by adding a pound of paris green to about one hundred and fifty gallons of water. By spraying the clover with such an arsenical poison and then cutting it and placing heaps of the poisoned vegetation in different places where there are cutworms, they feed on it and by so doing are destroyed. These remedies are extremely useful and serviceable in attacking cutworms.

In the case of cutworms attacking small crops you can destroy them by means of an arsenical spray such as lead arsenate. If this is used in combination with the Bordeaux mixture, in the case of potatoes for example, the Bordeaux mixture acts as a fungicide which prevents fungal diseases, so that by combining an arsenical poison with a fungicide a solution is obtained which is destructive to animal pests and will control vegetable diseases. I shall append to my evidence the most serviceable formula for making this Bordeaux mixture and also for making the arsenical mixture.

APPENDIX No. 1

In the case of crops such as cabbages, which have almost formed their heads, it is not advisable to my mind to spray these near the time of cutting with arsenical poisons, although that is frequently recommended. It is much more safe to use any such insect poison as hellebore or pyrethrum in conjunction with flour. You would use about one pound of hellebore or pyrethrum to about five pounds of flour. By tying such a dry powder in sacking or cheese-cloth at the end of a stick, or by means of bellows a crop can be quickly covered. It is a far more preferable method to employ such an insecticide than to use an arsenical poison which may be injurious to other animals than caterpillars.

By Mr. Sproule:

Q. What explanation have you of the fact that corn sown on sod turned up is much more liable to these attacks than corn planted in ground which has been worked for years previously?

A. The reason for that is, that as in the case of the wireworm and white grub, these cutworms are natives of the sod land and you frequently find them in considerable numbers living in the natural sod. Therefore when you put in a crop, these insects turn their attention to the crop, although corn is usually attacked by a particular species of cutworm.

Q. It works below the ground?

A. The corn worm to which I refer *(Heliothis armiger* Hbn.*)* injures the cobs of sweet corn.

Q. Does the cutworm attack the heads of the cabbages?

A. Yes, cutworms often attack the heads of cabbages, especially the cabbage worms. You find them working inside the heads and that is where they cause great injury. It is frequently recommended to spray the fully formed leaves with arsenical poisons, but I think people should be advised against such a procedure if the heads are well advanced. Hellebore should be used.

By Mr. Miller:

Q. Are you referring to the soft fleshy worm, the green worm?

A. Yes. To the common cabbage caterpillar.

By Mr. Kidd:

Q. Does that white grub, which reference has been made to, attack corn?

A. Yes, the white grub and also the wire worm attacks corn.

ROOT MAGGOTS.

Another class of insects which are very injurious to crops are the root maggots. These are white maggots very like the maggots of the blow-fly or the house-fly and they feed on the roots of the various plants. The flies are most abundant in the summer, and lay their eggs at the bases of the plants, and they hatch out as white maggots in the summer. These feed for two or three weeks on the roots and form a small brown pupa and afterwards change into flies. You may get a number of broods of the root maggot fly during a single season. The most damage is caused during the months of June and July. There are several species of root maggots. In some experiments which I carried on in studying root-maggots I found that one species, the root maggot *(Anthomy radicum* Meigen*)* was able to breed in horse manure which attract the female flies. This is an important fact as I believe that in many cases the flies are attracted to crops by the manure in which they deposit their eggs. The cabbage root maggots *(Phorbia brassicae* Bouché*)* which chiefly attack cabbages and plants belonging to the cabbage family are somewhat similar in appearance to the

common house-fly though smaller. The other species are common, the seed corn maggot *(P. fusciceps* Zett.*)* so called because the maggot was found feeding on seed corn; but as a matter of fact in Canada it is very injurious to beans—garden beans and peas; and the onion maggot *(Phorbia cepparum* Meigen*)* which also attacks other crops. It is interesting to note by the way that when the late Dr. Riley was making his investigation into the attacks of the Rocky Mountain locust in 1877, he found that *P. fusciceps* was parasitic to the extent of fifteen per cent on the Rocky Mountain Locust in Kansas, Nebraska and Missouri. So you have in that case an example of the same fly proving itself of very great service on the one hand and on the other hand causing great injury. The remedies which are employed against these maggots are several. A very simple one is to use pyrethrum and flour. A dry mixture is made of one pound of pyrethrum to four pounds of flour, and this is applied around the roots of the plants. If manure is used, no manure should be left exposed when the plants are planted out, so that the risk of attacking the flies will be obviated. Another very good remedy is known as the carbolic acid emulsion. The young plants are dipped into this and it is sprayed over the soil. It is made by boiling a pound of soap and a gallon of water. Half a gallon of crude carbolic acid is added and the mixture is diluted with thirty-five to fifty parts of water. If this is applied to the stalks of the affected plants, or the plants likely to be affected, so that it runs down into the soil you will make them obnoxious to the flies and also destroy the larvæ that are there. The application should be made soon after the plants come up and be repeated about every week or ten days afterwards.

By Hon. Mr. Fisher:

Q. You practically water the plants?

A. Yes, with carbolic acid emulsion.

Another method which has been employed with very great satisfaction is one which is known as the tar paper disc method. By means of a metal punch hexagonal discs of tar paper of this shape (shown) with a slit to the centre, and these small tarred paper discs are placed around the base of the cabbage stalk as they are planted. By pushing the disc down to the soil you have the base of the cabbage protected and it has been found that this prevents the flies from depositing their eggs around the base of the plants. You may say at first sight that it would prove rather expensive. As a matter of fact it has been proved—and I could give you the exact statistics—that this method is not expensive, and the results are extremely successful where crops are liable to the cabbage root maggot.

Another method which I found successful in England, and has proved successful on this side of the Atlantic, is that of injecting carbon bisulphide. As I told you last week the carbon bisulphide is a volatile liquid; it volatalizes and forms a poisonous vapour. It is injected by means of an injector which is an instrument specially made for the purpose. By means of a single injection into the base of each plant you destroy the maggots which are attacking that plant. But the simplest methods that can be employed are the tarred paper and the carbolic acid solution.

FLEA BEETLES.

The flea beetles are an injurious class of beetles, as both adults and larvæ feed on the crops that are attacked. The turnip flea beetle (*Phyllotreta vittata,* Fabr.) is periodically troublesome. They are a serious pest for some time, and then for some reason or other they disappear almost as suddenly as they came. They are small black shiny beetles about one-eighth of an inch long with a wavy yellow stripe down each wing cover, as you will see by the photograph which is being passed around. They are particularly numerous during the hot dry summer. There are usually two broods during the year, one of which hibernates. This hibernating brood takes shelter under the loose soil and among the rubbish and weeds around the borders of

the field. That is one of the points to which I called attention last week, the importance of clean cultivation and keeping the weeds around the edges of fields, and also of not allowing rubbish, which serves as sheltering places for so many of these insect pests, especially during the winter, to accumulate. The most serious attack is that of the insects which have hibernated and which lay their eggs on the young plants. Before laying their eggs these beetles, as in the case of the June bug, feed on the plants, and they cause great injury by feeding on the young seed-leaves of the young turnip, which comes up first, and in that way, by destroying the seed leaves which are the source of food material for the growing seedling, they kill the plant. If possible, where these insects have been prevalent, it is advisable to sow the turnips as late as possible to avoid the over-wintered brood of beetles. Dr. Fletcher used to recommend, in the case of Ontario, sowing after the third week in June. One of the best methods to be employed is to obtain a very vigorous growth. By helping on the plants and raising them quickly and in a vigorous condition, you enable them to withstand and overcome the attacks of this insect. If the plants are weak and feeble they would easily succumb and be killed. The obtaining of vigorous growth is a recommendation which can be employed in the case of many of these injurious insects. By having a vigorous growth, as in the case of the plant lice, for example, you enable the plant to withstand the attack of the insects, as, in the same way, a man whose vitality is at its best, is able to withstand the attacks of such diseases as pneumonia.

Another remedy which is very useful in the case of these flea beetles, especially the potato beetle, is to spray the plants with the poisoned Bordeaux mixture—that is, arsenate of lead combined with the Bordeaux mixture. In the case of the potato flea beetle, the mixture not only kills the beetles, but is an excellent fungicide.

PEA WEEVIL.

In considering insects attacking such crops, mention must be made of pea weevil, which is sometimes a cause of very serious loss in different part of Canada. Its life history is as follows: the worms or grubs pass the winter in the stored seed peas, and early in the year they change into pupæ, which in turn develop into beetles. The beetles emerge and lay their eggs inside the developing pea, the grub emerging from the egg feeds on the pea. When the peas are harvested, the almost full-grown grubs are harvested also. The grubs or larvæ, therefore, are contained in the harvested peas, that is, they are in the stored crop. This fact gives us an extremely simple remedy for dealing with this insect, and it is that of fumigation. By fumigation with carbon bi-sulphide you can eradicate the pea weevil entirely. There is no reason why any district should suffer from the attacks of the pea weevil if there is concerted action on the part of the growers in that district in the eradication of this weevil.

By Mr. Marshall:

Q. How would you treat green peas? We have something which bothers us very much, the pea louse?

A. That is one of the plant lice, or aphides.

Q. How do you treat that?

A. You can treat that by spraying.

Q. You could not spray a thousand acres?

A. In the case of such a large area you could send boys through the crop with pine switches and follow them with a cultivator; the plant lice drop to the ground, and the cultivator following covers them over and prevents their getting on to the plant again. That is one of the best remedies that can be suggested against the pea louse.

Returning to the pea weevil, as I said, there is absolutely no reason why this insect should not be completely eradicated, because the method is very simple. All that is necessary is to take a barrel which will hold about three hundred pounds of peas, fill it with that quantity of peas infected with the weevil and on the top of the peas put a small saucer containing about three fluid ounces—that is about six tablespoonsful—of carbon bi-sulphide, and put on the cover of the barrel so that no air can enter and no vapour can escape. The vapour of the carbon bi-sulphide is very heavy. The liquid volatilizes and the heavy vapour percolates and sinks down through the peas, and if left in that condition for about forty-eight hours, when the barrel is opened not a single live pea weevil will be found. In that way you can easily treat your peas if you know or have any reason to believe that they are attacked by the pea weevil. Care should be taken, however, not to bring a light of any kind near the carbon bi-sulphide or its vapour, as it is extremely inflammable, and therefore dangerous under such conditions.

By Mr. Robb:

Q. It is the seed peas you would treat?

A. Yes. To treat the seed peas is the best method of preventing the succeeding crop from being attacked.

INSECTS AFFECTING CLOVER.

A number of insects attack clover; the different species attack the seeds, the roots, the leaves and the flowers. The clover-seed midge *(Cecidomyia leguminicola* Lintner.*)* frequently causes considerable injury to clover seed in Ontario. It is a very small insect and there are two broods which correspond to the two crops of clover. The small midges deposit their eggs in the flowers of the clover and the maggots feed in the forming seed, and by so doing destroy the entire contents of the seed. The first brood become mature in June and the adults—the mature midges—attack the forming flower heads of the second crop. The remedy which is suggested to us, therefore, is that of feeding off the first crop of clover before the middle of June, that is before the maggots become full grown. If the first crop of clover is fed off the maggots contained in that crop are destroyed and the second annual crop of clover will be comparatively free from the clover seed midge.

Another insect attacking clover is the clover-leaf weevil (*Phytonomus punctatus* Fabr.) which belongs to a very large family of vegetable feeding beetles. The larvæ or grubs of these beetles, like the larvæ previously referred to, become full grown in June. The beetles come out in July and August and attack the second crop of clover. The method which might be employed in the case of this insect is that of ploughing the crop under or it can be fed off; but it is better to plough down the first crop of clover about May, that is before the insects become mature.

Sometimes in Canada another insect occurs which feeds on the roots of the clover. This is the clover root-borer. *(Hylesinus trifoli* Mull*)*, which is a beetle about half an inch long. These insects hibernate during the winter as beetles which emerge in the spring and lay their eggs near the base of the stalk of the plant. From these eggs grubs emerge which bore into the roots and feed on the central portion of the root, thus destroying the plant. In the case of this insect the simple remedy of ploughing down deeply the infested crop and thus getting these insects down underneath the soil and unable to emerge is the best.

Before I pass on to other insects I should like to say in passing that if there are any questions which the members of the Committee would like to ask at the present stage I should be very pleased to answer them because frequently one can explain things which might otherwise be overlooked.

APPENDIX No. 1

By Mr. Sproule :

Q. You did not give us a remedy for the cutworm in corn.

A. This cutworm usually hibernates in a pupal condition and if, during the winter by ploughing in the fall you can expose these pupal which are just beneath the surface of the soil a large proportion of the insects will be killed. The only direct method of destroying this species is to pinch the tops of the young ears of corn at intervals of several days and thus destroy the larvae which are inside.

Q. Suppose you turned that sod under in the fall? Do you regard that as a sufficient remedy for it?

A. Not entirely sufficient because natural sod is more compact than soil which has been cultivated two or three years. But if the sod is ploughed and then cross-ploughed a large number of these insects would be destroyed. It would not be advisable if it is found that the sod contains adult cutworms, which can be easily discovered upon examination, to sow corn or some other crops the follwing year, but such a crop as clover which is less likely to be attacked.

CORN ROOT APHIS OR LOUSE.

This is another insect which sometimes attacks corn in this country, the corn root aphis *(Aphis maidi-radicis* Forbes*)*. One frequently finds corn dying off owing to the attacks of these aphides or 'plant-lice' which occur on the roots. I mentioned this species not only because of its economic importance, but because it shows you an interesting relation which is sometimes found in the insect kingdom. On the roots of the green corn small plant lice are found feeding in small chambers.

By Hon. Mr. Fisher:

Q. Do you mean cereals?

A. No. I mean maize. These small plant-lice are placed there by ants. The plant-lice do not take up their positions on the roots of their own free will, but the ants, as some of you know, are very fond of the secretions of the aphides and they cultivate them just in the same way as the farmer raises and keeps cows. These small ants keep their cows in the shape of aphides. They take care of the eggs during the winter and when the young ones hatch out they are also tenderly cared for. The ants bring them to the surface occasionally to give them a little airing or exercise. When the corn is growing they carry off the young aphides and put them out on the roots of the corn just in the same way as the farmer takes out his cows and places them out in certain pastures. In view of very peculiar inter-relationship between the ants and the aphides, which one would hardly credit if he did not actually find it occurring, the remedy is to make the plants unpleasant for the ants. Professor Forbes, who made a very careful study of these insects, discovered a very good and simple remedy for prevnting this corn root aphis, which is by using a solution of oil of lemon and wood alcohol. To one gallon of wood alcohol add a pint of oil of lemon. Six teaspoonsful of this mixture, that is, three fluid ounces are used to each barrel of corn, it is sprinkled over the corn and stirred in carefully. The solution creates an odour which is very objectionable to the ants and consequently they will not take the plant-lice, their small cows, onto the roots of this corn.

Q. You are speaking of the seed corn?

A. Yes, the seed corn. Worked out it costs less than ten cents per acre to use that remedy. Professor Forbes found that in some cases this reduced the number of aphides on the roots by eighty-nine per cent and reduced the number of ants by seventy-nine per cent.

Another insect of this family of bugs or plant-lice which is very injurious to crops is the 'green bug' or green aphis. It is especially injurious to oats. It is found, however, that it is very irregular in its prevalence, and this is due to the

fact that it becomes very highly parasitised. It is attacked by small insect parasites which destroy it completely. Whereas in one year a locality has a very bad attack of the green bug, in the following year or the year after that it may disappear entirely. Such a sudden disappearance is due to the fact that the parasites have increased to such an enormous extent that they had completely wiped out the 'green bug.' One of the best remedial methods is that of destroying the volunteer grain in the fall. The volunteer grain frequently serves as food for this bug. Another remedy is the careful rotation of crops.

By Mr. Smith (Middlesex):

Q. To go back a little in your address. The white grubs are very destructive in parts of Ontario to pastures and you have not suggested any remedy that could be applied other than simply changing the system of farming altogether.

A. In the case of pastures it would be well, if you could, to feed sheep upon them. If you penned sheep in a small area as sheep are often penned when they are being fed up, and gradually work them all over the pasture which is very badly attacked, they will manure the land strongly and tread the moisture into the soil which will be closely trodden down, this will result in a very great destruction of the white grub. Such a method has frequently been found of service in dealing with pasture lands.

Q. Well, even that would scarcely be practicable in the case I am suggesting. In the western part of Ontario, as perhaps you are aware, there are very large fields which are entirely devoted to pasture. These fields are one, two, three, and even four hundred acres in extent, and even the sheep proposition would not be practicable there.

A. Is it found that the white grub attacks the whole area?

Q. Yes. Very large patches all over the field are entirely destroyed.

A. I should suggest in the case of the attack occurring in patches like that, it might be worth while drenching them with kerosene, if they are not of a very large extent.

Q. They have an area of fifty or one hundred acres and kerosene drenching would not be practicable.

A. Would it be practicable to plough up those infested portions in the fall?

Q. Yes, but that would mean changing the entire system of farming.

A. At the same time it would rid the ground of the white grub. When you got the insect destroyed you could afterwards let the ground go back to pasture.

Q. In these cases the farms are entirely devoted to pasture. The fences are simply round the outside, and the buildings have been removed and in order to adopt grain rotation a very large expense would be involved.

A. I would not recommend a rotation. I should simply recommend ploughing and cross ploughing as a means of turning up the grubs and exposing them so that they could be eaten by birds and other enemies, and also in order that they could be destroyed by the frost in the winter.

Q. Of course that would render necessary the cultivating of that land and reseeding again, and it would mean the cultivation of the whole field because these are mostly hundred acre fields or more?

A. Otherwise I do not see any other remedy: either that or the penning out, which you say is not practicable. You might give the land a very heavy dressing of kainit or super-phosphate. That might be found serviceable and of course would not change your system of cultivation.

APPENDIX No. 1

INSECTICIDES.

I have mentioned a number of insecticides during my remarks which you would no doubt like to have embodied in my evidence, and which I am very pleased to include.

Kerosene emulsion.—

Kerosene, 2 gallons.
Whale-oil soap, ½ pound.
Water, 1 gallon.

The soap is dissolved by boiling in the water. While still boiling hot it is taken away from the fire and poured immediately into the kerosene. It is now vigourously churned and agitated for about fifteen minutes to form the emulsion. This is the stock solution and will keep for a long time if well made. It is diluted for summer use in the proportion of one part of the stock solution to 10 or 12 parts of water. For winter use a stronger solution should be made by diluting this stock solution with only 11 gallons of water.

The addition of one ounce of flowers of sulphur to each gallon will make the solution of use against red spider and certain other plant mites.

Tobacco.—

One pound of home-grown tobacco soaked for several hours in 4 gallons of hot water; apply warm.

Whale-oil soap.—

For green aphis such as pea louse, 1 pound of whale-oil soap to six gallons water.

Woolly Aphis. Treatment for root-form.

Remove the soil from the crown of the tree outwards to a distance of 18 inches or 2 feet and to a depth of about 4 to 6 inches. Then distribute 2 to 5 pounds of tobacco dust around the base of each tree.

Instead of tobacco dust a strong solution of kerosene emulsion has been found effective when used in the same manner (4 parts of water to one of the above stock solution).

Lime-sulphur wash.—

For San Jose Scale and other scales and fungi. The best formula is known as the 1-1-3 formula, made as follows:—

Lime, 15 pounds (up to 20 pounds of lime may be used to advantage).
Sulphur, 15 pounds.
Water, 45 pounds.

The unslaked lump lime is slaked with sufficient warm water. While it is boiling hot the sulphur is added and thorougly stirred. The whole is now steadily boiled over a fire, or with steam, adding more water when necessary until the mixture is of a deep reddish-brown colour. It will be necessary to boil it from 45 minutes to an hour. Add sufficient water to make up to 45 gallons and apply at once while it is warm. It should be strained before being put into the spraying machine. If the solution crystalizes it will be necessary to reboil. For badly infested trees it is applied when the trees are dormant; the first application is made in the late fall, and the second application in late spring, three weeks before buds open.

Pyrethrum.—

For insects on vegetables and for root maggots. Mix one pound of pyrethrum powder thoroughly with 4 pounds of common flour and store in a closed vessel for at

least a day before using. This dry powder is used in the form of a dust applied either by means of bellows or shaken from a bag tied to the end of a stick.

Hellebore.—

One pound of 5 pounds of flour. Applied dry in a similar manner to the pyrethrum.

Bordeaux mixture.—

Copper sulphate, 5 pounds.
Fresh unslaked lime, 5 pounds.
Water, 50 gallons.

Dissolve the copper sulphate by suspending in a bag just below the surface of 5 gallons of water. Carefully slake the lime by adding just sufficient water to wet it; it should crumble up in about a quarter of an hour, if the lime is fresh and suitable. When slaked, five gallons of water may be added to make the milk of lime, and this should be strained to get rid of any lumps. When it is clear add it to the solution of copper sulphate and make the whole up to 50 gallons.

It should be tested by adding a drop of a solution of potassium ferrocyanide to a little of the mixture placed in a white vessel. If a brown colouration is formed insufficient lime water has been added and more lime water should be added until no change takes place when the ferrocyanide is added.

For *poisoned Bordeaux mixture,* add 2 to 3 pounds of lead arsenate to every 50 gallons of Bordeaux.

By Mr. Robb:

Q. You have told us about the ants handling the aphides on the corn roots, can you tell us about ants cultivating lice on the peony?

A. The ants cultivate them to a certain extent. They take them about and take care of their eggs in the winter. The ants look after them in this manner because the plant lice secrets a sweet fluid in the digestive canal of which the ants are very fond.

Q. Do you use the same remedy on the peony as on the corn?

A. You might use the same remedy. If you spray with that solution you will make the peony objectionable to the ants and they will not come near it.

The CHAIRMAN.—We have had a very instructive address from Dr. Hewitt. Some might regard it as somewhat technical for the average listener, but it is nevertheless so full of information that when it appears in pamphlet form it will be a most valuable contribution to our agricultural literature and will doubtless be widely read. I should regard this address as being very valuable to the farmers of Canada. We have been very pleased to hear Dr. Hewitt, who is so thoroughly versed in entomology, and we hope that the work in which he is engaged will result in great good to the country as a whole.

Committee adjourned.

Certified correct.

C. GORDON HEWITT,
Dominion Entomologist.

THE PROBLEMS OF PLANT DISEASES.

HOUSE OF COMMONS,
COMMITTEE ROOM No. 34,
Wednesday, January 19, 1910.

The Select Standing Committee on Agriculture and Colonization met here this day at 11 o'clock a.m., Mr. M. S. Schell, Chairman, presiding.

The CHAIRMAN.—I have much pleasure in introducing to you Mr. H. T. Güssow, Dominion Botanist, Central Experimental Farm, who, as you will see from the agenda paper, will address you on 'The Problems of Plant Diseases,' under the following heads: (*a*) General aspect of diseases. (*b*) Economic importance. (*c*) Specific diseases. (*d*) Prevention.

INTRODUCTORY REMARKS.

Mr. GÜSSOW:—Mr. Chairman and Gentlemen,—It gives me great pleasure to appear for the first time before the Committee on Agriculture and Colonization to give evidence of the work which I have been carrying on and which I intend carrying on in the near future in my capacity as Dominion Botanist. I am also glad of this opportunity to answer any inquiry and to receive your valuable suggestions, so that I can render my work generally useful to the farming and fruit-growing community of the Dominion of Canada.

The separation of the branch of Economic Botany from the Division of Entomology and Botany hitherto so ably carried on by my predecessor, the late Dr. James Fletcher, must be referred to here and is to be welcomed as a very important advance in the right direction.

I believe it is now universally recognized that the establishment of the two separate divisions, viz.: that of Botany and that of Entomology will enable the two new officers appointed to pay undivided attention to any special problems that may come up for their consideration. I hope to prove, as far as the new Division of Botany is concerned, that there are far more important problems to be solved, than would appear on casual examination. Indeed, during my short activity in this country, I have come across some really important problems, which require immediate and prompt attention. The great difference in the work of an Entomologist and a Botanist, the necessity of specializing only in certain groups of insects or plants, requiring special scientific training to conduct researches into the life history of insects and microscopic fungi—to which severe losses of plant life are due—render it practically impossible for one individual to be a thorough expert in both these branches of biological science. It has been said that little knowledge is dangerous, but it is useless from the farmer's point of view to try and apply any suggestion to practice, which does not prove itself in every way of real assistance to him in his daily toil. To render our work of real value to the practical farmer and fruit-grower of the Dominion of Canada it is noted with great satisfaction, that two separate divisions have been formed.

To accept this statement, however, without further qualification would seem to omit the consideration of all facts. In that respect we may learn from our neighbours in more than one sense. The English Board of Agriculture and Fisheries has a special branch, known as the 'Intelligence Division,' which is at the service of farmers, gardeners, fruit-growers and all that cultivate the land. This branch has

as its advisor in botanical problems, the head of the well known Royal Botanic Gardens at Kew, with his staff of specialists in the different branches of botany as applied to science and agriculture. The Royal Agricultural Society of England founded forty years ago separate laboratories of Botany and Entomology. This society has had for nearly forty years the services of my esteemed late chief, Dr. Wm. Carruthers, F.R.S., the late keeper of Botany, British Museum, whose name is well known not only in botanical, but also in agricultural circles. The United States Department of Agriculture, as usual, heads the list of public institutions, devoted to the development and conservation of the natural resources, of which agriculture is by no means the least important. As many as one thousand men are engaged in carrying out the work of the division of plant industry, about two-thirds of whom are employed in scientific research work and in the investigation of the numerous problems in applied or economic Botany. The sum of $1,348,576 was granted for the fiscal year of 1909 solely for the purpose of investigation and realization of scientific problems. These few inadequate examples may suffice to impress you with the necessity for the division of the work of the Entomologist and Botanist.

The late Dr. Fletcher, to whose excellent qualities great tribute has been paid by men who have known him personally, was far more of an Entomologist than a Botanist. This statement will be verified when examining some of his former reports. Thus the reports for the years 1909, 1908, 1907 refer to no particular work done on botanical lines. The report for 1906 has devoted 28 pages to Entomology and three pages to Botany in which reference is made to correspondence dealing with a peculiar fungus, of little or no economic importance. The 1905 report devotes thirty-eight pages to Entomology and four to Botany; dealing again with only one subject, namely clover and alfalfa dodder, which, as you undoubtedly know, is a parasitic plant growing on and capable of destroying our clovers and other leguminous plants. I wish to point out, that these remarks are in no way intended as a criticism of the work of my predecessor. The late Dr. Fletcher's work was so unique and he had the rare capacity of rendering all his work so very interesting, that all, with whom he ever came in contact, are full of praise; and I do not to any less degree recognize his excellent qualities. But in consequence of his devotion to the entomological side I wish to say that I am now practically compelled to organize an entirely new division of Botany. The field of Botany is extremely wide and may be referred to as analogous to Zoology. Zoology deals with animals of all kinds; Entomology is its most important branch which most closely concerns the investigation of insect pests of agricultural and other crops. Botany deals with plants of all kinds. Although it may be somewhat of an assumption, but it is nevertheless true—without a vegetable kingdom—where would the animal kingdom be?

As I have stated before, since my arrival in Canada in July, 1909, I have found many important problems awaiting immediate attention, and it is with great pleasure that I am here to give you an idea in which way I shall aim to render the new division of Botany of general usefulness to the farmers and fruit-growers of the Dominion of Canada.

Much of my time is occupied and many lines of work are suggested by the daily routine work. This consists mainly in the reply to numerous inquiries on almost every subject relating to agriculture and fruit-growing, received from the farming and fruit-growing community all over the Dominion. New land is constantly cleared, new farms spring up in every locality, old farms change hands and the advice asked for concerns a large number of subjects. On new land new plants make their appearance and farmers wish to become acquainted with their value or their uselessness and many hundreds of specimens are sent for identification and report. This often necessitates a careful research into the nature, habit, and yield of new plants, to ascertain if they are worthy of cultivation. The investigation often results in a warning, if useless or injurious plants are met with. It becomes necessary to suggest the sowing of the most suitable and economic forage plants, to improve pastures

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and meadows. And this line of inquiry has suggested the necessity of tabulating the most useful fodder plants, which would be suitable under the very varying conditions of soil and climate in the different localities. For this purpose I contemplate careful and conclusive experiments with fodder plants and grasses that may be generally useful under the applying physical or mechanical conditions. There have been already carried on for a number of years very interesting experiments on small plots situated on the Central Experimental Farm, but no record has yet been taken, and with the results obtained from this source, augmented by the experiments contemplated, a really useful publication may be anticipated which is certainly greatly needed by the agriculturist. In these experiments it is specially desirable to carefully study the like and dislike of animals, the power of discrimination of which is often very remarkable. It has frequently been recorded that animals carefully select the food most palatable to them, when grazing, and that they reject any plant which the animals do not care for—till they are driven by hunger to eat them. At the present time farmers generally allow their pastures to grow naturally. While this may in some cases answer their purpose, yet in many cases such pastures may be rendered far more useful and nutritious, by the sowing of seeds of valuable and luxurious grasses and fodder plants and by means of proper care and cultivation.

Numerous other inquiries refer to the extermination of weeds and useless plants. Much valuable work has already been done in this direction by the Department of Agriculture and it is gratifying to observe how the farmers have eagerly possessed themselves of the useful information contained in the new book 'Farm Weeds,' issued some few months ago by the Seed Branch of the Department. On the whole it is remarkable how much any useful kind of information is appreciated by the farmers of Canada and it is very encouraging to receive the friendly messages of such appreciation. The farmers of Canada with whom I have become acquainted during my short time in this country, are a people ready to learn and ready to try our suggestions; and to cultivate and develop this interest should be, and indeed is, the pleasant duty of all officers of the Farm, for we must recognize that this interest will eventually lead to a universal development of so important an industry as agriculture.

The co-operation of the Botanist and Chemist is much desired in clearing up some mysterious poisonings of stock, supposed to be due to poisonous herbs. Most of the poisonous principles of plants are well known and although the nature of the injury permits of no uniform methods of cure, yet the eradication of plants of this kind should be universally practised. An instance illustrating this special line of investigation exists in the so called 'Loco Disease,' for the cause of which a number of plants have been blamed; but it is very doubtful, whether these particular plants are really responsible. More recent investigations into the nature of this obscure trouble, conducted elsewhere, indicate that the presence of Barium salts in the plants examined is the cause, but no conclusive evidence from feeding experiments is given and the nature of this trouble is by no means satisfactorily ascertained. In this particular line there is a large opening for further researches.

I have here pointed out but a few general lines, in which the new division of Botany may be rendered useful. The careful investigation of these problems alone would well occupy the time of several trained specialists and I endeavour to hope that in the development of the new division, any request for additional assistance will receive your kind support. For after all the initial expense of one or two more capable assistants would be greatly minimized by the good and useful work that would result from carrying out such important investigations.

I now ask your attention to my main subject on which I wish to address you, namely: 'Problems of Plant Diseases.'

PROBLEMS IN DISEASES OF PLANTS.

My colleague, Dr. Hewitt, Dominion Entomologist, who addressed you some little time ago, dealt with the problems of injuries to vegetation due to insect attacks.

The term 'Diseases of Plants' is generally applied to injuries in plants not due to insects. A plant may be diseased in many ways. We may group the diseases to which I wish to refer into two main divisions:

I. Diseases due to physical causes such as climatic conditions, frost, heat, drought, hail, lightning, superabundance of moisture, mechanical or chemical conditions of soil, etc., and,

II. Diseases due to parasites:

a. Parasites belonging to the group of flowering plants.

b. Parasites belonging to the group of non-flowering plants.

DISEASES DUE TO PHYSICAL CAUSES.

There is no special necessity to refer to more than a few examples under the first division, viz. Diseases due to physical causes. Injuries due to frost are very common in this country. Practically every year some fruit plantation or other suffers injuries from this cause. While we are, of course, not able to prevent the injuries due to frost, heat, hail, &c., and other injuries due to the act of god, yet we can do much to encourage the healing of wounds due to these factors. Losses due to superabundance of water, or to drought, may be considerably modified by judicious systems of drainage, while injuries resulting from the mechanical or chemical conditions of the soil may be minimized by providing more suitable conditions, often by mere cultivation or by the use of chemical fertilizers supplying the deficient ingredient to the soil or by counteracting those injurious ingredients that may be harmfully exerting their influence.

These conditions besides causing original injury of a more or less serious character, play also an important part in rendering plants more liable to contract specific diseases due to various minute parasitic organisms such as microscopic fungi and bacteria. The neglect of wounds due to frost, hail, etc., throw the trees or plants open to an attack of these organisms, which now can gain easily entrance through such wounds and which may cause the death of the plants. In consequence every orchard or forest plantation should be inspected from time to time and any wound, split or crack be immediately attended to. This is done by painting all wounds of trees accidentally injured; I may here point out that this care of wounds should always be made a practice wherever any branch or limb has been cut off any tree. A coat of 'white lead paint' will protect the wounds from any infection with parasitic organisms.

Unsuitable mechanical conditions of the soil often result in producing signs of feeble growth in plants, thus rendering them more susceptible to disease. The following example may serve to explain this statement. Take two plants of any kind, selecting two as much alike in vigour, size and development as possible, the one growing under the most favourable conditions and surroundings, the soil uniformly warmed and ventilated, containing the right quantities of food which is readily taken up by the roots, which experience no difficulty in spreading; the parts of the plant above ground expanding into bright air and light.—The other plant, however, growing under conditions exactly opposite. We naturally would expect a healthy plant that grew under the former conditions, and we are prepared to look for signs of failing health in the second plant, due to the unsuitable conditions under which it grew. The feeble plant according to our experience cannot possibly be possessed of any such degree of resistance to disease, as the strong and vigorous one. The researches into the origin and nature of disease make us acquainted with many conditions under which plants, like any other living organisms, may be weakened and thus be rendered more liable to take disease, but on the other hand the knowledge so obtained points out direct lines of prevention. Maintain the natural conditions under which health is manifest, restore them if they are absent, and by means of cultivation improve the

unsuitable conditions—and healthy plants will be the result. If the proper attention would be paid to these suggestions, if the trouble would be taken to eliminate all predisposing factors and to aim at providing suitable conditions for the growing plants, our crops would suffer far less from disease., Many examples may be quoted where the attacks of fungi, the spores of which are present everywhere, just like the disease germs surround human beings, have been evaded by means of timely sowing, manuring, &c. The disease known as 'Finger and Toe' or 'Club-root' of turnips and all other plants of the same tribe, caused by the parasitic fungus *Plasmodiophora brassicae* has been known to appear with surprising regularity amongst turnips, cabbages, &c. I do not know whether this disease is known to you under that name. It produces extraordinary swellings in the roots of the turnips or cabbages, which have the shape of fingers and toes, hence its name. Happily little damage is caused by this disease in Canada though it is not unknown. Sometime ago my attention was called to an extraordinary behaviour of the parasite. Turnips were sown in the ordinary way at the usual time but through some accident the sowing had to be delayed for about two weeks, when it was continued. The turnips that had been sown first, were practically all killed from an attack by this fungus. But the second sowing escaped injury altogether. Subsequent inquiry showed that this was by no means a singular case and many instances have been investigated, where the same observation was made. Some farmers now practise in England the sowing of turnips at various intervals, with every success. The investigation into the conditions under which parasitism is favoured, therefore must receive the foremost attention, for the practising of such means of prevention as cited are within the easy reach of every farmer.

By Mr. Smith, (Middlesex):

Q. The investigation you spoke of is not a Canadian one?

A. No.

Q. I do not think the disease has ever been referred to in Canada; it is not a common disease.

A. I have seen cases of it.

Q. But it is not common?

A. I have no evidence to the contrary.

There is another disease due to a miscrocopic fungus that attacks young cereal plants during the early stages of their growth. I refer to a disease caused by a *Fusarium* species. It has been found that the disease attacks slow growing plants and where the growth of the plants was encouraged by a top dressing of Nitrate of Soda two weeks after sowing, the parasite had no effect on them. When the spores had reached their stage of activity the plants had already passed the dangerous stage and no disease resulted.

DISEASES OR PLANT INJURIES DUE TO FLOWERING PLANT PARASITES.

I return now to the first subdivision of the second group of disease—causing organisms, viz., the diseases due to parasites belonging to the group of flowering plants. I must explain the meaning of the term parasite. A parasite, strictly speaking, a plant parasite, is an organism more or less highly developed, that obtains its food directly from living upon any host plant. A parasite cannot prepare its own food but utilizes for its development the food of other plants, which has been manufactured by this particular plant for its own use. As a result of this mode of life, parasites, of course, cause more or less injury to the plants upon which they live and often cause the death of the attacked individual. One of the most common parasites of this group is dodder, growing on clovers and other leguminous plants, Dodder, I might say, does not cause very much trouble in Canada. I have selected this plant to demonstrate the parasitic mode of life. This parasite is generally introduced into

clover and alfalfa fields when the seeds of these forage plants contain dodder seeds. When this seed is sown, the clover germinates a few days earlier than the dodder, and young plants have appeared when the dodder seeds start into active life. The young dodder plant is very peculiar in appearance and habit. It appears like a fine piece of yellowish thread and bears no leaves whatever. This thread is pushed to the surface of the soil and immediately starts revolving about very slowly until the tip of the thread comes into contact with a neighbouring plant, when it immediately coils around the young plant and firmly attaches itself. I have brought photographs of a clover plant showing dodder growing on it. I have also prepared a micro-photograph of a section of a clover stem which had the parasite growing on it. This illustration represents the clover stem and this is a part of the branch of the dodder; also shown in this photograph are three suckers. The dodder absorbs the food contained in the stem of the clover by means of these suckerlike organs (demonstrated by photographs).

A clover field which is infested with dodder looks as if somebody had thrown corn cob 'silk' all over it. It is, therefore, easily recognized. It is very peculiar that every tip of this parasitic plant is endowed with the capacity of revolving, which is freely made use of and neighbouring clover plants soon offer new places for attachment. Thus, a clover field in which dodder is present appears very patchy; the clover remains living so long till the dodder plant has produced its flowers and ripened its seeds. Clover plants that are first attacked are killed; the dodder plants continue spreading in every direction from this centre. When it is neglected to watch clover or alfalfa fields, very serious damage may result from an attack of dodder, but any observant farmer will immediately proceed with the destruction of all affected plants and thus prevent the dodder from developing in an alarming degree. Here in this country injury from dodder appears only the first year after the clover or alfalfa has been sown. Great care should be taken to have all clover and alfalfa seeds examined at the seed branch of the Department of Agriculture before sowing, and information will be gladly given, whether the seed is fit for use or not. There are a number of other parasitic plants belonging to this group, but as they are of little economic importance they need not be referred to here.

DISEASES DUE TO NON-FLOWERING PARASITIC PLANTS.

I now turn to the second subdivision, namely diseases caused by non-flowering plants. The commonest non-flowering plants are ferns, mosses, algae, &c., but none of these plants are parasitic. The group of non-flowering plants containing some of our most serious parasites are known as fungi. Few of the larger group of fungi, known as mushrooms or toadstools are parasitic. Some of them are found growing on and destroying deciduous and coniferous trees. The fungus parasites, which concern us are generally very minute and often miscroscopic small organisms. Fungi belonging to this class may live as saprophites, that is, as moulds on decaying vegetable or animal matter, on damp wall paper, books, clothes, &c., or as parasites when they live upon living tissues of plants and in some cases, like, for instance, the Ringworm fungus *Trychophyton tonsurans,* on animals. Saprophitic fungi, though generally beneficial as nature's scavengers may, however, cause serious injury to animals when present in large quantities in their food, for instance in hay, silage, feeding cakes, &c. Food that is so spoiled has frequently caused serious disturbances in the digestive organs of animals; and care should be taken to ascertain whether the food given to animals is sweet and in good condition. It is by no means uncommon in this country where a great deal of silage is used for feeding, that the silage is spoiled by fungi. Frequently the corn when it is cut is damp and the ventilation of the silo when packed is not satisfactory. Hence we get the development of fungi and bacteria which decompose vegetable matter and if fed in this condition to the stock, very frequently serious results have occurred. I had not long ago a sample of hay sent to me where fungi had appeared, on account of the hay being exposed to the wet. The animals

fed with it were seized with attacks of diarrhœa which stopped immediately when the feeding of this mouldy hay was discontinued. It is interesting, however, to know that there is some good use to which fungi are turned and that is in the manufacture of the well known blue cheeses like Stilton and Gorgonzola. The bluish green masses present in these cheeses giving to them the particular flavour are entirely composed of miscroscopic fungi.

ECONOMIC IMPORTANCE OF PLANT DISEASES.

Some of our common plant diseases are caused by members of the group of fungi known as true parasites, and I wish to point out briefly the economic importance of plant diseases.

It will be necessary to refer to a few figures showing the economic importance of plant diseases. The attacks of plants due to fungi generally result, if no means of checking them are employed, in severe losses of yield and oftentimes in complete destruction of the crops. When some thirty years or more, the potato disease, or as it is referred to in this country the 'Late Blight' of potatoes or 'Irish potato disease,' made its appearance in Ireland, it soon developed in such alarming degree that a severe shortage in potatoes was the result, and for some years the cultivation of potatoes in Ireland was dangerously injured. This at one time so serious malady is now happily under control by means of spraying with Bordeaux mixture. And although Canada is not free from this disease it only assumes epidemic virulence, when the growers neglect to spray.

The losses due to the California Vine disease have been estimated by Pierce in 1892. About 25,000 acres were infected with an original value of $300 to $500 per acre, but which was so depreciated by the disease in a few years, that the land became worth not more than about $75 to $200 per acre. The estimates furnished by Pierce as to the total loss through this disease reached the sum of over ten million dollars.

Diseases like Pear Blight, Apple scab, Potato scab and many others afford excellent examples of the economic importance of plant diseases. Those diseases greatly affect the marketable value of the fruits or tubers; badly spotted fruits or badly scabbed potatoes will find no buyer, and the grower experiences a severe loss.

Still more striking evidence of the economic importance of crop diseases is furnished by the following example. The fungus causing rust in cereals is universally recognized as one of the most prevalent and widely distributed parasites. It is surprising to note the large amount of money lost, due to the attacks of cereals by this fungus during one single year. In the absence of statistics in this country giving an estimate of the damage of our crops I quote some estimates published by the Prussian Imperial Bureau of Agriculture in statistics reviewing the losses in Prussia from grain rust. During the year 1891 we find that the shortage in yield of the wheat, rye and oat crops, due to attacks from rust amounted to a sum of $103,140,735. When taking into consideration that the year 1891 was a very unfavourable one regarding rust, and when on that account, taking the estimate as only half the mentioned sum, the Prussian farmers have a yearly loss from rust of more than $50,000,000. It is a very unfortunate fact that though the rust disease in cereals has been known for many centuries the investigators all over the earth have not succeeded to any satisfactory extent in the control of it. Nor have the so called disease resisting varieties of grain bred during the last few years proved themselves absolutely resistant under changed conditions of climate and cultivation. So-called disease resisting varieties of wheat whenever tried in this country were found to be more rusted than the varieties which were originally grown here. There are fortunately very few other diseases which have so completely resisted all means of control. In concluding this paragraph I wish to point out, that in this country nobody has ever tried to calculate the losses due to diseases of plants. It is very desirable that such estimates be collected from time

to time. The information would not only serve as a warning to farmers, fruit growers and others, but would prove an immense help in government legislation, and in deciding which sum of money may be wisely expended for the scientific investigation into the nature of diseases.

At the present time we all know that a great many diseases are present in Canada and I tried to find some estimates as to the loss resulting from disease, but I have failed to discover one single item which I could quote here. It is important to know that, for if a farmer is told that a particular disease has made its appearance and is capable of causing a loss of so many thousand dollars, that man realizes the loss expressed in dollars and cents far more quickly, and in consequence will pay much greater attention to the prevention and combatting of disease. On the other hand, if it were known, that the Canadian farmers and fruit growers lose annually 15 per cent of the total value of the harvest—which 15 per cent are estimated generally as expressing the total loss—we might realize the necessity of expending considerably more public money for the investigation into the nature of the diseases with the idea of preventing these alarming taxes which are now paid to the disease without hesitation.

SPECIFIC DISEASES.

I now wish to direct your attention to some specific diseases which have come under my observation since taking up my duties here.

POTATO CANKER.

A very serious disease made its appearance in close proximity to the Dominion and great caution must be exercised to prevent its introduction and establishment on the virgin soil of Canada. In October of last year I received specimens of diseased potato tubers from Red Island, Placentia Bay, Newfoundland. For some years past the disease was well known to me, it having worked great havoc in European countries among the potato crops. The disease is known as Potato Canker and exhibits extraordinary changes due to a microscopic fungus. I have brought some specimens and a photograph of diseased tubers to show you. At the beginning the disease seems very inconspicuous but, when diseased tubers are planted, the disease is liable to develop into an epidemic of the worst kind known. (Showing photographs). I have two micro-photographs here which are taken from this original microscopical preparation. A very fine section was cut of the diseased tissue of the potato which I have mounted as a miscroscopical specimen. This will show how many spores or germs which distribute the disease are present in so small a particle of diseased tissue. The second photograph shows here a number of black dots. These black dots represent the disease germs. The disease organisms are enlarged in this photograph where you can see their number still better. But it will interest you more to see specimens of the potatoes (showing specimens). These are some of the tubers as they appeared when attacked by Potato Canker. The potato disease is extremely dangerous as I will show you in my remarks.

This specimen here is a tuber showing the disease in its first stages. We see small tumors here and here (pointing). Now, if the potatoes are not perfectly free from such knobs or warts when they are planted the disease is liable to appear.

Where badly present, practically no sound tuber will be harvested. The disease is due to a fungus known by the technical name *Chrysophlyctis endobiotaca.* The fungus lives in the outer cells of the tuber and causes extraordinary canker-like tumors such as I have shown in the specimens. Every particle of these excrescences contains a large quantity of resting spores, bodies by which the fungus reproduces itself. A small portion of diseased tissue of the size of the head of a pin and in thickness less than the breadth of a human hair, has been examined under

the microscope and I counted as many as forty-one of these resting spores. The resting spores contain each from seventy to eighty very minute swarm spores, each of which is capable to infect a potato plant with which it comes into contact. The disease was discovered in 1896 in Upper Hungary and made its appearance in 1901 in England, having been, no doubt, introduced by means of diseased tubers. The disease assumed alarming dimensions in England, so that, unfortunately very late, in 1908 this disease was scheduled under the Destructive Insect and Pest Act as a notifiable disease rendering persons concealing it liable to prosecution and heavy penalty. This legislation, as I have said, came only into force after the disease was allowed to firmly establish itself in Great Britain, Ireland and Scotland. And still it spread into Scandinavia, Germany, France and other European countries. Not until it was my good fortune to discover the disease in Newfoundland was it known on this side of the Atlantic. From the lessons learned of its alarming spread in Europe you will realize how necessary it is for this country to be on the lookout and to adopt the most vigorous measures in preventing the entry of the disease. It is with great satisfaction, that farmers and fruit-growers will welcome the introduction of the new Bill directed against the introduction or spreading of insects, pests and diseases destructive to vegetation, and I am sure that this important measure will receive the support it deserves in protecting so important an industry as agriculture. In connection with the outbreak of this disease I was sent by the Department of Agriculture to Newfoundland to investigate the origin of the disease and assist and advise the Newfoundland government in dealing with it. I visited the locality near where the disease first appeared and have ascertained that the disease is far more prevalent in Newfoundland than was supposed. This is due to the helplessness, not to say ignorance, in these matters, of the growers, who practiced an interchange of diseased seed potatoes amongst themselves and thus actually propagated the disease. On the other hand where new seed tubers were imported they were planted again on infected soil with the result that the disease reappeared with great vigour.

I inquired where the new potatoes had been obtained, and the people in Newfoundland told me that potatoes which were imported from Canada were no better. I was alarmed, of course, to hear that the imported potatoes should have been diseased in the same way, but upon going into the history of these importations, I found that the Newfoundlanders had planted the new potatoes again on the infected land and in consequence the next season there was a renewal in spite of the imported sound potatoes from Nova Scotia and Prince Edward Island.

POTATO ROT—LATE BLIGHT.

By Mr. Henderson:

Q. What is the great source of potato rot? Has the condition of the soil not got a great deal to do with it, for instance if it were wet soil?

A. I would like to know to which rot you refer?

Q. The Irish potato rot.

A. The condition of the soil if free from the germs of the disease is not likely to produce the disease. It is due to a fungus which may be present in the seed tuber, or in the soil on which a diseased crop was raised previously.

By Mr. Todd:

Q. How would you renovate that soil?

A. We must bear in mind that a great many disease spores may be present in the soil from previous infested crops. To get rid of these spores, crushed stone lime should be applied in a fairly heavy dressing to the top soil, and then the land should be ploughed. It is also very important that the growing of potatoes on this land should be discontinued for about three years so that the soil may recover its former fertility.

By the Chairman:

Q. Is spraying with Bordeaux mixture effective?

A. Yes. Spraying with Bordeaux mixture is practically the only means of checking 'Late blight.' The spraying should be continued every three weeks until the frost appears and the tubers are harvested. By that means the disease can be checked and sound tubers be harvested.

Q. It is almost an absolute cure is it not?

A. Yes, however, more of a prevention than a cure. The fungus cannot easily grow on plants sprayed regularly, but if the disease is allowed to establish itself largely in the fields before spraying has begun, the crop will be invariably injured.

During my visit to Newfoundland I have been greatly aided in my investigation by the Newfoundland Department of Agriculture and I have been able in return to assist this department with advice and suggestions how to deal with the outbreak. Since my return from Newfoundland I had specimens of diseased potatoes sent to me from St. John's, Newfoundland, showing that the disease is also known in this locality. A few days ago I received a communication from a resident of Port au Port, Newfoundland, and I have evidence to believe that the disease is also present in this district, which is a considerable distance from the original place of infection. I recognized the disease in specimens sent in October and by the direction of the Minister of Agriculture a bulletin was prepared on the subject as a warning to Canadian farmers, which bulletin appeared in print immediately and is by now in the hands of all farmers, who it is hoped will exercise the greatest precautions to prevent the disease from establishing itself. Soon after the publication of this bulletin the Newfoundland Department of Agriculture requested me to prepare a leaflet for them to be widely distributed in that colony. This request was complied with and it is hoped that its distribution throughout Newfoundland will result in the extermination of the disease in that island and thus remove the danger which threatens Canada from this source. It may not be generally known that potatoes are imported into Canada from Newfoundland, but I have made careful inquiries and have been informed of the names of some dozen people in Canada who received from one to two barrels of potatoes from Newfoundland. On learning this I immediately addressed a circular letter to each recipient of potatoes to ascertain what has become of the potatoes, with the view of finding out whether the disease has actually been imported. As yet I am glad to say no case has come to my notice, but I am on the lookout and have no doubt, that if any Potato Canker should exist here, that I shall soon hear of it. I also have been informed that twenty-two barrels of potatoes have been imported into the United States. I delivered an address on the subject before the American Phytopathological Society at the meeting of the American Association for the Advancement of Science held during the vacation week of last year at Boston. The subject was greatly welcomed and I was appointed a member of a committee which was formed to consider the best measures to be taken against the introduction of this disease. I have also received letters of thanks from many United States authorities for pointing out the imminent danger from this disease.

I have omitted referring to the origin of the outbreak of potato canker in Newfoundland. The disease was known to some growers for several years, and, though purely circumstantial, yet sufficiently conclusive, evidence was obtained that the risease was introduced by means of diseased tubers imported from Scotland. What the timely discovery of this disease means to Canadian potato growers is clearly indicated when considering that for the whole of Canada the yield of potatoes for 1909 was 99,087,200 bushels which is 25,297,200 buhels more than in 1908 or in value, $36,399.000.

WHITE PINE RUST.

I wish now to refer to a disease of white pines that, as I have reason to believe, has actually been introduced into Canada some little time ago.

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The United States Department of Agriculture called my attention recently to a shipment of 200,000 white pine seedlings which were imported from Europe into Canada. These pine seedlings were said to be attacked by a fungus which caused great devastation amongst pines in many countries in Europe. It is known as the White Pine Rust. I at once communicated with the parties to whom the seedlings were consigned. In their reply it was stated that the shipment was delayed and arrived rather late in the season and in consequence the young forest trees were hastily planted and very little inspection was given to the plants during the season in which the rust would have most likely shown. This very unfortunate neglect of examining the trees at the port of entry and ordering their destruction, together with the material in which they were packed has resulted in the actual planting of the suspected trees. I have brought a diagram which illustrates the presence of the disease on young pine seedlings and which also gives details of the life history of the fungus. The rust appears, in the form of orange-yellow cushions caused by the colour of the fungus spores, on the stem of seedling pines or on branches of older trees and an attack may result in their death. These spores are very minute, hence they are easily carried about by the wind into distant areas. Another serious factor is that the spores do not at once germinate on pines; they pass through an intermediary stage on another plant. This fungus (like most other rust fungi) passes through a further stage in its life history on leaves of wild and cultivated forms of Ribes (Currants and Gooseberry bushes, &c.) on which plants it is liable to spread rapidly causing great damage to the cultivated varieties. The spores produced on the Ribes can only germinate again when coming into contact with Pines growing in the neighbourhood. The fungi, however, may hibernate in the bark of attacked pines and produce early in spring a new series of spores which thereafter again infect the wild and cultivated species and varieties of Ribes. As means of eradication the following suggestions may be made: 1. The growing in close proximity to each other of Ribes species, &c., and Pines must be avoided. 2. Pines attacked by the rust should be destroyed, and, 3. Pine seedlings should not be obtained from infected areas.

In suggesting these means to the consignee I was informed that they had carefully eradicated all species of Ribes within a considerable distance of the field on which the pine seedlngs were planted in June, 1909, and in fact all currants and gooseberries had been destroyed throughout that locality. This measure although quite in harmony with the eradication of the fungus seems very severe, the white pine seedlings ought to have been destroyed and not in order to safeguard the imported seedlings should the eradication of the Ribes, have taken place; especially as it is hardly possible to carry out the complete destruction of these bushes. I contemplate the examination of this consignment at a season when the pine rust will most likely show and hope that the responsible parties will proceed with the destruction of the infected trees that may be found in order to prevent the establishment and spread of this disease. I must here again point out the great usefulness of the new Act directed against the enemies of vegetation in providing power to inspect any farm, garden, orchard, &c., in which the presence of a dangerous disease is suspected . By these means only can the spread of serious plant and insect pests be averted.

'SILVER LEAF' IN FRUIT TREES OF VERY SERIOUS IMPORTANCE.

When on my way to Newfoundland I had occasion to visit the Provincial Experimental Farm at Truro. My attention there was called to the presence of an obscure disease affecting apple trees which was thought to be possibly the 'European Silver Leaf Disease. I carefully examined the leaves and found certain similarities, but it was so late in the season, (November) that I could only advise the authorities to watch for the fruiting stage of the fungus causing this disease. This fruiting stage can be observed on the dead twigs, branches or main

stem of the trees, in form of smaller or larger scales of purplish white colour. Some few weeks ago I received specimens of small twigs, some of which I have brought to show you. These twigs show plainly the characteristic fructification of the fungus which causes Silver Leaf. To realize what the presence of this fungus disease may mean to a countr, so largely concerned in fruit culture we must consider its economic importance in countries where it prevails. These are the branches which I received from Truro showing the fungus which causes Silver Leaf. (Showing specimens.)

The disease is well known in Europe. In England I have observed it very frequently. It attacks peaches, plums, apples, cherries, apricots and pears. Trees that have made a luxuriant growth, suddenly produce smaller leaves which are of characteristic appearance. The popular name of the disease 'Silver Leaf' gives a good indication of its appearance. The leaves of the affected trees become silvery, which symptom is especially noticeable on the upper surface. This condition will continue for several years, during which the trees bear very little and much inferior fruits than before. Later on some branch or other does not produce any leaves and in a short while the fruiting bodies of the fungus make their appearance. The present state of our knowledge of this disease is that the fungus lives in the branches of the attacked trees, the spores of which may have gained an entrance through some unattended wound. The spores then germinate and produce fine ramifying tubes which act upon the cell contents of the trees and by this action a certain toxin, or enzyme more properly speaking, is produced which spreads all through the plants and which it is reasonable to believe produces the silvery appearance of the leaves. Never at any time of my investigation have I discovered the fungus actually living in the leaaves but there is evidence that the disease is spread by means of the toxine. I have as yet never observed a tree that is once attacked recover and I am sure you will realize the great danger to our orchards if this disease is allowed to establish itself. To protect this most important industry of Canada it would be well to engage the services of some competent inspectors whose duty it would be to tour the country and report on the appearance of this or any other like serious disease, and immediately take action to safeguard the interests of the fruit-growers by giving them the best advice how to deal with an outbreak of disease. It is an unfortunate practice that many fruit-growers, maybe due to pressure of work, neglect to immediately remove dead or dying branches of trees as soon as they are noticed. If all dead and dying branches of trees are removed at once the fungus would be prevented from producing spores and the danger resulting from this source of infection would be largely reduced, and the disease restricted to individual trees. Towards the end of my address I intend to refer to the prevention of diseases on general lines and I therefore reserve what I have to say on the necessity of clean cultivation for later.

By Mr. Henderson:

Q. Would you consider it a good plan to cut out every decayed limb?

A. Yes.

Q. And not allow them to remain?

A. No. It is best to cut dead limbs off, as soon as they are noticed.

Q. You spoke some time ago of painting a portion of a tree where the limb was cut off with white lead paint. Why do you speak of white lead? I think the general practice is to use red paint, is it not?

A. It really does not matter what kind of paint is used as long as you know it is an antiseptic or impervious paint. You may use red lead. The latter has the same ingredients as white lead except that some colouring matter has been added which would make it more expensive for farmers.

PEAR BLIGHT.

By the Chairman:

Q. You spoke about pear blight a few minutes ago; do you know of any remedy which is effective?

A. No, there is no remedy known to cure a tree infected with pear blight.

By Mr. Henderson:

Q. Would it not be well to cut the tree down?

A. I would not recommend cutting the tree down at once. It has been found that a tree many be good for many years and able to bear good fruit, by cutting away only the infected shoots or branches and then painting over the surface with white lead. The branches that are killed must be cut down to the healthy wood and then be painted.

Q. I have always failed to stop the disease by cutting off the infected limb. My conclusion has been that it was best to cut down the tree right to the root.

A. That is certainly the best plan, but the root should also be taken up and all parts of the diseased tree burnt.

Q. What is the cause of pear blight?

A. It is due to a specific bacterium, *Bacillus amylovorus* by name, which enters and kills the twigs. It then grows along the vessels which conduct the sap of the tree up and down the limb and eventually bigger branches will die. The first symptom noticed is in the leaves, which become brown, as if scorched by fire, hence its popular name 'fire blight.'

Q. Is that the thing which causes the pear scab?

A. No.

Q. What do you do for a tree which produces scabby pears?

A. The tree must be sprayed with Bordeaux mixture which is a very good remedy indeed.

BLACK KNOT IN PLUMS.

By Mr. Smith (Middlesex):

Q. Is the fruit from a plum tree which is very badly affected with black knot suitable for human consumption?

A. Yes, because the branches are the parts on which the black knot is present and not the fruit. Branches showing black knot are in course of time killed and produce no fruit.

Q. That is not always the case. I noticed during the past summer and picked from a tree a fruit that was right alongside a large specimen of black knot on the limb and it was a perfectly healthy looking fruit.

A. The branches may live for some time, though a black knot grows on them.

Q. Still it would not affect the fruit that would grow beside the black knot, we will say on the same limb?

A. No, that is not possible.

By Mr. Henderson:

Q. Going back to the pear, is it not a fact that if you graft a pear on a quince root it is susceptible to pear blight?

A. I am not aware that grafting has anything to do with this bacterial disease, unless diseased stock or scions are used.

Q. You would not recommend any man grafting a pear on a quince root.

A. There are advantages in grafting on quince roots and one may use that stock for grafting if it is otherwise sound and well rooted.

Q. Are there no means of preventing black knot, or keeping it under control, other than cutting down.

A. No.

By Mr. Smith (Middlesex):

Q. I have heard it stated that there has never been a known case of pear blight when the pear has been grafted on the thorn.

A. So it has been said but that is not correct. Experiments have been made to ascertain which stock is the best to use for the elimination of the disease, and all stock that has been tried was found liable to take the disease although in varying degrees. On the whole if the disease should appear it does not matter at all on which stock the tree has been grafted upon.

By the Chairman:

Q. It was a very common thing last year to see some of our apple trees with just the tips of the limbs all over the tree turning quite brown, that is after the leaves had come out on the trees fairly well and possibly for three or four or five inches just on the tips of the limbs you would see a blight.

A. You could observe a blight?

Q. Yes, the trees were almost turning black in some cases, and some varieties—the Greenings, for instance—were probably worse than others. The trees of course were producing fruit to a considerable extent?

A. But it would have killed the buds for next year?

Q. Do you know what the disease is?

A. I am sorry I cannot say, because these symptoms do not enable me to form an opinion.

Q. I think it is worse in Nova Scotia.

A. I would be glad to have specimens of this or any other disease. And I trust that farmers who will read this evidence will send any specimens of diseased plants as soon as the disease is noticed. It is very bad practice to allow a disease to establish itself before asking advice, and in most cases it is too late to suggest any methods which would have the desired effect. Therefore I would much like to have specimens sent at once. In sending in specimens the following instructions should be followed:

SPECIMENS SHOULD BE SENT WHENEVER POSSIBLE.

In reporting on the prevalence of weeds, poisonous plants or plant diseases, or in any correspondence relative to their treatment and eradication, doubt in regard to the nature of the trouble will be avoided if specimens are sent for examination.

PAY NO POSTAGE.

All letters and parcels (not exceeding five lbs.) may be sent free of charge by mail if addressed to 'The Dominion Botanist, Central Experimental Farm, Ottawa.

SELECT MATERIAL WITH CARE.

If the plants are small, send these entire, including roots and preferably in flower. When sending diseased plants loose dirt should be carefully shaken or washed off. Samples of the soil are not needed, the dirt often injures samples in transit. Choose specimens representing various stages of the trouble. In the case of many leaf diseases the latter stages of the disease are most needed for identification, while with bacterial diseases, stem blights, wilt, and diseases of fruits, the earlier stages are usually most satisfactory. All stages should be sent. Fleshy or moist, watery material likely to become decayed or offensive while in transit should be packed as dry as possible. If the material is very perishable, dry completely or preserve in alcohol before sending.

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CARE IN PACKING

Is very important to make the identification easier. If small plants or parts of larger ones are sent, straighten them out between layers of newspaper. If specimens of diseased stems or solid parts are sent, wrap each in dry newspaper. Fruits likely to be crushed (grapes, cherries) forward in strong boxes. Do not use moist packing when *sending any diseased specimen.* When sending several fruits, wrap each separately in newspaper.

Each package should bear the name and address of the sender.

I have already called your attention to the danger from diseases of plants that I have observed since my arrival in Canada, and it shall be my duty to bring these instances to the knowledge of all whom it may concern, and indeed, as I understand, this evidence will be distributed and thus serve as a preliminary caution to all farmers and fruit-growers. I wish, however, to emphasize that I do not desire to unnecssarily alarm the growers. But it must be realized that the careful study of diseases of plants is extremely important to enable us to suggest practical means for their eradication. It is of no use fighting an enemy in the dark, and of no use whatever to try and treat diseases, the cause of which is not satisfactorily ascertained.

'CROWN GALL.'

How true this particular statement is, can be learned from a disease which bears the stigma of the 'greatest scourge of fruit trees' known in this country for many years. Fruit growers and nursery men have been instructed for a number of years that "crown gall" is one of the most destructive diseases of fruit trees. Although often experienced fruit-growers have pointed out again and again that crown gall—or as it is also referred to root gall—does not injure the trees on which it may be present, yet these objections are silenced rapidly by the so-called discoveries that have been made on the cause of the disease and its supposed contagious nature.

This is a crown gall (exhibiting specimen) which I have taken off the root of a plum tree, and this is a seedling which has been transplanted. It shows three crown galls. Crown galls may at times reach this size. This is a specimen of a peculiar growth on alder. I brought this entirely to show you to what size crown galls may grow.

By Mr. Wilson (Lennox and Addington):

Q. What kind of tree do you say that is?

A. Alder. It is interesting to observe the way in which wounds heal. At some time or other this tree was broken by wind, or some other cause, but was supported by neighbouring trees. In consequence the edges of the wound were kept fairly well together and this large growth of tissue has formed around it, similarly as callus is formed round a broken bone of an animal, and the tree continued to grow, without any noticeable change of condition.

Crown galls are knotlike swellings on the roots or collar of apple trees, plum trees, peaches, cherries, pears, raspberries, gooseberries, and a number of other plants. Crown gall is known in every country where fruit trees are grown. In Canada and the United States, however, it is said to be most alarmingly prevalent. This to my mind is not exactly true, it is proportionally not to any greater extent present in Canada than it is in Russia for instance. Simply it is more prominent on account of the large areas of Canadian soil under fruit cultivation. Crown gall is blacklisted under Provincial Government's legislation as a notifiable disease, and also in the United States the destruction of trees showing crown galls is largely advocated. I do not know whether it is not directly detrimental to the fruit growing industry, or at least very aggravating to the nursery man to have one's trees destroyed on which a something is present of which no man has yet supplied satisfactory evidence as to what

the 'something' really is. Everything has been blamed to cause crown gall, mechanical injury, frost, insects, fungi, slime fluxes, bacteria, &c., and its serious infectious nature has been pointed out scores of times. Yet in direct opposition to the statements of investigators, namely, that crown gall causes the death of trees, is infectious and spreads from tree to tree, we must place the experience of the experienced practical fruit-growers which we should not ignore in the investigation of a disease which is pronounced to be of so serious a nature. The evidence of some of the most important fruit-growers of Canada can be summarized in the following sentences: We were aware of crown gall since we first saw trees, but having never seen or heard or known of any damage done by it paid little attention to it, until some five years ago we learned through the press that crown gall is a disease that should be thoroughly stamped out. We have never known apple trees being sick or dying from the crown gall and consequently we are forced to believe that this cannot be a very dangerous disease, at any rate, if it is a disease at all. And yet one of the most prominent growers informed me that he had over fifteen hundred trees broken down by an inspector on account of their showing crown gall.

I examined some of these trees afterwards and it was a pity to see fifteen hundred trees of about that size in thickness (illustrating) broken down on account of crown gall, and what is more important still—what the inspector has taken for the incipient stages of crown gall in some cases were harmless swellings caused by adventitious buds.

I have become suspicious about this crown gall and have collected a good deal of material but I have not yet been able to confirm the views of any one of my colleagues holding the disease theory, but on the other hand all material that I have collected seems to indicate that the crown gall does not really cause damage. I have investigated several cases where it was said that crown gall had caused injury to the trees and have found the damage has been due to other things than crown gall. This problem shall receive my immediate attention and I am anxious to solicit the co-operation of all fruit growers in Canada, who can collect for me extremely valuable data. I would like to hear from every fruit-grower in Canada what he can tell me of his experience with crown gall. I intend to investigate every case where damage due to crown gall has been known. At the present time nursery men are the only people on whom legislation on crown gall may prove of serious compromise. They cannot sell their stock, when crown gall is present, and in spite of every precaution they cannot raise or import stock free from it. I have no doubt that you will agree with me that it would be injudicious to treat this mysterious trouble and to render the sale of trees difficult on account of the presence of crown gall. I have made experiments at the Farm where I have produced crown gall artificially not by using parasitic organism at all.

I have prepared a schedule of questions that have been sent to all important fruit-growers all over the earth and it remains to be seen what the result of this necessary inquiry will be, in addition to experiments to be seen what the result of this necessary nature of the cause of crown gall.

VIOLET ROOT ROT OF POTATOES.

Before concluding my remarks on specific diseases of importance to the agriculturist or the fruit-grower, I wish to refer to one more potato disease which prevailed this year in the provinces of Quebec and Ontario and which is attributed to a fungus known as *Rhizoctonia solani*. The fungus causes a characteristic scab on the tubers, but it has also been known to cause complete destruction of plants in low-lying badly drained portions of a field, attacking them at the base of the stems. Some few years ago the disease appeared in England and I investigated a severe outbreak of it in Essex County. On subsequent experiments I discovered the fructification of the fungus and ascertained how the disease propagated. I wish to show you here a tuber which appears to be sound, though on careful examination you will observe small dirt-like specks or particles adhering to the surface.

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I expected to appear before the Committee in December and I had preserved some specimens of this disease to show you. We had a very severe frost in our rooms at the farm and those specimens were destroyed so that I could not bring them. I then examined some of the farm's potatoes to see whether I could find this disease present and I found it practically everywhere. In the potatoes which are sold in the market everywhere the disease was present. At first sight the potatoe appears to be perfectly sound—these scratches are accidental—but they are covered with small specks which almost look as if particles of soil still adhered to the tubers, in fact they could be easily scraped off.

By Mr. Wilson (Lennox and Addington):

Q. Are these potatoes fit for use?

A. They art fit for table use if peeled. I will explain to you how the disease is propagated. These small specks are really dormant roots of the fungus which will develop as soon as the tubers are planted. Two days ago I cut off one of these diseased potatoes a portion of the surface showing the specks and for the purpose of encouraging the growth of fungi I placed this portion into a small moist tube, and you can see that since then a prolific growth of fungi has resulted from these particular specks. That shows of course they are dormant and as soon as favourable conditions of soil and moisture are given to the fungus it will develop and produce the disease.

By Mr. McLean (Huron):

Q. You would not advise the planting of these and the using of them for seed?

A. No. I have planted tubers showing the small particles, in sterilized soil and watered them with sterile water and the typical disease appeared.

When cultivated under ordinary conditions the disease would of course be communicated to the soil, and new tubers, though sound when planted, will be infected. I can assure you that this disease is extremely prevalent in Canada and needs very careful attention. Here again we have a disease which is annually propagated by using unsound tubers. The tubers are perfectly good for table use, but of course the presence of a large number of these spots reduce their marketable value. This disease, though present every year to a more or less extent, is greatly influenced by physical conditions, thus its prevalence in the province of Quebec this year may be accounted for. In some seasons the disease is more prevalent than in others. It may thus happen that when potato tubers are planted which are covered with these round specks of fungus mycelium, the disease may not affect the crop, but it is better not to run any risk and therefore it must be suggested not to plant any affected tubers at all but to procure sound tubers on which no specks of any kind are noticeable.

It is possible to immerse these tubers which show specks in a solution consisting of an ounce of sulphuric acid to one gallon of water. The mycelium will then be killed and no infection will take place.

TURNIP DISEASE 'INTERNAL ROT.'

Two days ago I received turnips from a farmer in Nova Scotia. He says that his turnips are externally perfectly sound but internally very bad. I wish to show you two of them here. You will see that both are apparently perfectly sound externally, and no sign of disease was noticeable until the roots were cut. In this specimen you may observe large cavities denoting disease. Not only are there these cavities, but a discoloration is manifest everywhere. This injury is generally known as 'water core.' The water core is not due to any parasitic organism. I have made several cultures from tissues which show the translucency plainly, but they remained unaltered and gave no rise to the development of any germs, fungal or bacterial. In consequence water core is proved not to be a disease, strictly speaking, as it is not contagious. There are some turnip diseases due to bacteria which will show at early stages water

core, but this injury here is really due to chemical changes. Normally the tissues of the roots are filled with starch grains, and they appear of a clear yellowish colour, while the area of water core is distinctly deeper in colour, and if thin slices of a turnip with water core are held up to the light they will appear sharply translucent wherever the 'core' is present. On microscopial examination one cannot discover any starch grains in the deeper coloured tissues. On testing the water-coloured tissues for sugar it is found that they will give a deeper reaction than those that are normal. Sugar is produced from starch and would result in producing the water core. This change within the root may be due to physical conditions asserting their influence, by the production of a starch reducing enzyme. Or it may be due to either too late or too early digging. Too late digging, no doubt would result in some chemical changes going on in the roots, especially when the tops are cut off and the leaves cannot any longer supply food that is stored in the form of starch in the cells. It remains yet to be proved in this case to what cause the water core was due and careful inquiries are being made. The tissues which are not filled with starch will collapse and in consequence more or less large cavities will result, such as shown in the specimen. In many cases turnips will decay when exposed to microscopic organisms which have gained entrance through injuries of some kind or other.

By Mr. Smith (Middlesex):

Q. Has that any connection at all with what is called the turnip louse?

A. No.

Q. That condition follows the appearance of the turnip louse?

A. You refer to the decay? That is frequently the case. The wounds made by the turnip louse are contaminated by bacteria, and will cause the decay of the turnip. Unfortunately turnips are often fed in this condition to stock.

By Mr. Wilson (Lennox and Addington):

Q. And you say these turnips are not fit to feed to stock?

A. I would not advise their use for that purpose because the bacteria reduce the feeding value greatly and may cause digestive troubles in the animals.

PREVENTION OF DISEASES.

I have in speaking about specific diseases already referred to some means of preventing diseases of plants. The effectual prevention of diseases cannot be carried out with success if the disease causing organism is not or only partly known. It is quite evident that no doctor can cure a disease of which he knows nothing but the symptoms. Symptoms are extremely misleading as to the real cause of the disease. A good many diseases show themselves in producing the same symptoms. We must carefully study every disease and learn of the different stages of the parasite in order to attack it during its weakest stage with the utmost vigour. However, the battle with microscopic organism is by no means easy, and as yet very few really curative remedies are known to save plants that have once been attacked. We must direct our main efforts to prevent disease. While it is practically impossible to protect plants from coming into contact with disease germs, we must concentrate our efforts to destroy all material likely to harbour disease. Many fungi live on leaves of plants during the summer and pass through their winter stage when the leaves have fallen to the ground. If these leaves are allowed to remain on the ground the disease germs hibernate and the disease is liable to re-appear during the next season. All those leaves should be destroyed by fire, or if this is not practicable they may be deeply buried. Again we find that through carelessness a good many diseases are spread.

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MALPRACTICE OF FEEDING DECAYED ROOTS, &C., TO STOCK.

For instance it is a very common occurrence that diseased potatoes are simply left on the ground either to be eaten by stock or to rot in the ground. Both practices are equally wrong. In the case of Potato Canker for instance the spores which are present in the potatoes remain alive, though they may pass through the bodies of animals and new land is liable to be infected from the droppings of the animals. I have here some potato tubers which show potato canker at its worst stage. When the tubers have been harvested by the farmers they are stored till further use, and among them there are often decaying, pulpy tubers, which will communicate the decay very easily to accidentally injured tubers with which they come into contact.

I have here a tuber which shows the potato rot. A potato like this when present amongst stored potatoes is sure to contaminate others. Great care should be taken not to bruise potatoes when digging them, as they are liable to decay in the places of storage. It also is a bad practice to leave diseased potatoes on the ground. It is frequently the case when using potato digging machines that not all potatoes are removed from the ground. Early frosts will kill half of the tuber. Subsequent warmer weather, thaws the frozen half and bacteria and fungi make their appearance furthering the decay. Animals may then be turned into the field, and will feed upon these potatoes and in consequence the disease is liable to spread to neighbouring fields which had no disease before. Let me point out that this is a very dangerous practice.

It must be carefully avoided to give to animals decaying roots or tubers, spoiled silage, hay, &c. I have pointed out that fungi utilize the food stored in plants for their own growth. In consequence the value as feeding material of diseased roots, &c., is already reduced, besides there is the danger of spreading disease germs, and finally in many cases the health of the animals has been known to suffer from eating diseased or decaying food. Some little time ago I examined a sample of hay that was sent by a farmer. He stated that his animals became sick after eating it. The hay was found to contain ergot and in addition some poisonous plants. Ergot, which is a fungus product, is found on cereals and grasses. Its action upon the gravid uterus is well known and there is reason to believe that a good many cases of abortion are produced when cows or mares feed on ergotted grasses. On the other hand when ergot grains are ground with wheat for flour, the bread made therof has often resulted in the production of dangerous gangrenous diseases in people who have eaten it. Instances of this kind should serve as a warning to carefully examine the food before it is used, and reject any that is suspicious, or serious calamities may result. In recent years greater attention has been paid to the investigation of the serious disease known as pellagra which has appeared in the Southern States of the American Union, and it has been ascribed to be due to bacteria which were present in corn which had been cooked for human food and which produced certain changes in this cooked food, injurious to health. Nevertheless some people had eaten of the spoiled food with the result that pellagra appeared, which is one of the most dangerous diseases supposed to be caused by spoiled food.

To return again to the question of preventing diseases. What has been said about diseased leaves or roots being allowed on one's ground, equally applies to many diseases of fruit trees like black-knot, pear and apple scab, silver leaf, fire blight, plum pockets, &c. Either the diseased branches twigs, fruits, &c., are simply left on the trees, or they are, if cut off, thrown on to the rubbish heap where they are afforded undisturbed opportunities for developing their fructifications. Many more instances may be quoted showing the regrettable indifference observed by some farmers in neglecting to remove and destroy at once any material that is obviously diseased. Hence it should be the practice of every farmer to immediately after the harvest of any crop, plough the land, which practice, besides smothering a good many weeds, would bury the stubbles of cereals, corn, &c. that may carry diseased germs or insects. Under no circumstances should broken roots or potatoes be left on the ground, the fields should be carefully

cleared of all rubbish which should be burnt. In orchards after harvest, no fruit should be left on the trees or on the ground, or they will decay, drop from the trees and infect the soil. If practicable the orchard should be ploughed and left fallow during winter. During the winter months when work on the farm is naturally slack much good work can still be done in orchard and store room. During open weather the trunks of the trees could be scraped and if possible be treated with a solution consisting of 2 lbs. of caustic soda (98% purity) to 10 galls. of water. This practice serves to remove any loose particles of bark, and to destroy mosses and lichens growing on it, which frequently serve as a hiding or hibernating place for many insects, besides, eggs of insects and spores of fungi may be prevented from starting into active life. Potatoes set aside for the use of seeds should be hand picked, any bad and diseased ones removed and only healthy tubers selected for planting. If the preliminary suggestions in combating diseases of plants are everywhere carefully observed on farms, garden and orchard, we can look forward to an increase in yield and to an improvement of quality. With these objects in view the new Division of Botany is sure to meet the desire of all who are engaged in the cultivation of Canada's soil.

These are the remarks which I wanted to make this morning.

By Mr. Henderson:

Q. Before you resume your seat will you tell me why it is that in a hill of potatoes some will be large and some small. Why are they not all big?

A. If you will permit me to refer to a very analagous case, why is it that children in one family are large and others small?

Q. Why is it?

A. I do not think this can be satisfactorily explained, it is nature. When small seed tubers are planted it has been observed that a large percentage of small tubers are produced. It would be better to cut larger tubers in halves when a much larger proportion of fair sized tubers are known to result. But there will always be a more or less large percentage of smaller tubers in every potato hill.

By Mr. Sealey:

Q. In connection with the potatoes, which I understand you spoke of as having been imported from Newfoundland, I gathered that you said the disease does not exist in Canada except in the instance of having been brought in by these importations.

A. I did not say that diseased tubers had actually been introduced, I only pointed out the possibility. I have traced every importation and found that no case of diseased tuber has been imported. The disease is not at present in Canada, to my knowledge.

Q. Did I understand you to say that some ten or twelve barrels of potatoes had been imported into Newfoundland from the United States, which contained the disease?

A. No. Vice versa, potatoes were sent to the United States.

Q. Where did you get your information that the disease existed in the United States in the vicinity from where these importations were made?

A. You must have misunderstood me. The disease is not in the United States. I think I made it clear that the disease is present in Newfoundland. A Montreal farming paper received from Red Island, in Placentia Bay on the North West coast of Newfoundland specimens of diseased tubers from a farmer there. The Editor of the paper sent them to me for investigation, when I recognized the disease and immediately called the attention of the farmers through my bulletin to the imminent danger from this disease should it be imported.

Q. What was the nature of your reference, or why did you refer to the importation of potatoes from the United States to Canada?

A. I think I did not say that, No diseased tubers were imported from the United States but as potatoes have been exported to that country it is not unlikely that the disease may establish itself there and that subsequently we may get diseased tubers from the country to the south of us. That is the point I desired to make.

Q. I am very glad to have had that explanation, but would it not be in the interest of Canada to prohibit the importation of potatoes from the United States, as well as from Newfoundland?

A. I have no doubt you have seen the Bill which was introduced by the Hon. Mr. Fisher directed against the introduction and dissemination of plant pests and diseases. The matter has received, as you see, immediate attention from Mr. Fisher, and no doubt, he will take every precaution to protect the Canadian farmer.

If Mr. Fisher considers it advisable he will, no doubt, prohibit the importation of diseased potatoes from Europe or rather from the United Kingdom, France, Germany and other countries where the disease is known to exist.

Q. If the same disease has been carried from Newfoundland to the United States it would be equally as important to prevent it from coming from there would it not?

A. I had occasion to discuss this very question with the authorities of the Bureau of Plant Industry at Washington and they expressed their anxiety to trace every barrel of potatoes which had been imported from Newfoundland. In my opinion we need not prohibit the importation of potatoes from the United States, but of course, they will have to be inspected at the port of entry into Canada. I do not know whether it is necessary to import potatoes from the United States at all.

Mr. CHISHOLM (Huron).—We have early potatoes from the United States, that come in before our old potatoes are on the market. A great many early potatoes are imported in that way.

Q. If there was any danger from that source, as I gathered there was from hearing your remarks, it would be better in order to guard against infection to any extent to take an ounce of prevention otherwise it may reach a point where it would be beyond control.

A. I am sure this question will receive careful consideration. We must unite against the introduction of that disease into Canada and any other disease destructive to vegetation.

Q. Do you think it of sufficient importance to deal with it at the present time?

A. I think so certainly because already the exchange of potatoes is beginning. However the bulletin which I prepared is in the hands of almost every farmer in this country at the present time so that he is aware of the danger. The disease is easily recognizable.

Q. The potato crop is an enormous one and of great importance to Canada.

A. That is the reason why I wish to take every precaution in the interest of the potato growers of this country. We can only deal with that question, however, by legislative measures.

Q. Would you recommend immediate legislative measures to prevent the possibility of its introduction into Canada, especially in view of the fact that it is really an important matter for the good and welfare of Canada?

A. I am entirely in favour of immediate legislative measures, to prohibit the importation of potatoes from Newfoundland. I would also include potatoes coming from Europe, but I am doubtful whether the United States should be included. However, that is a point that will be dealt with by Mr. Fisher.

The CHAIRMAN.—Our thanks are due to Mr. Güssow for his interesting and very able address. It is not necessary for a formal resolution to be adopted, but on behalf of the committee, Mr. Güssow, I wish to tender you the thanks of this committee. I

hope the information which you have given us this morning will be widely disseminated so that the country may receive the benefit from your extremely valuable suggestions. I hope we shall have the pleasure of a visit from you on some future occasion.

Committee adjourned.

Certified correct,

H. T. GUSSOW,
Dominion Botanist, Central Experimental Farm.

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GROWING AND TESTING OF WHEATS

HOUSE OF COMMONS,
COMMITTEE ROOM No. 34.
WEDNESDAY, January 26, 1910.

The Select Standing Committee on Agriculture and Colonization met this day at 11 o'clock a.m., Mr. M. S. Schell, Chairman, presiding.

The CHAIRMAN.—We are pleased to have with us, Dr. C. E. Saunders, Cerealist of the Dominion Experimental Farms, who will address us on (*a*) 'early ripening wheats' and (*b*) 'milling and baking tests.'

Dr. SAUNDERS.—Mr. Chairman and gentlemen.—I have arranged my subject under two chief topics—early ripening wheats, and milling and baking tests. Under the first heading I shall give an outline of some of the work that has been done at the Experimental Farms, with a view to meeting the needs of those comparatively newly settled sections of Canada (particularly Western Canada) where the summer season is short. Under the second heading I shall mention some of the researches which we have been carrying on, and are still carrying on, in regard to the effect of storage on flour, the effect of artificial bleaching, and as to the value (for bread making purposes) of wheat which has been subjected to the action of water for longer or shorter periods before reaching the flour mill. I shall not make any formal address, and shall be glad if the members will interrupt me with questions at any time during the course of my remarks. In any event, there will be time at the close for questions on any matters which you may think it desirable to bring up.

EARLY RIPENING WHEATS.

Various aspects of the subject of early ripening wheats have been taken up at the Experimental Farms, and they have occupied very much of my time for a number of years past. Certain sections of our newly settled country demand early ripening wheats and other sections (one might almost say all other sections) ask for them. It is not a question of trying to induce farmers to sow early ripening wheats. It is a question of providing for them the best early ripening varieties we can. If we do not provide satisfactory varieties, they will obtain early ripening sorts elsewhere, which, in some cases at least, will be distinctly inferior to the best which we can provide. In the early history of the farms, efforts were made to import suitable varieties from abroad, but these efforts did not meet with very much success. The early imported varieties were in no case found to be satisfactory. It was therefore decided many years ago that we must depend upon ourselves for the solution of this problem, and, therefore, having collected the best available material, methods were tried for improving it, by selection and cross-breeding, the cross-breeding being followed, of course, by selection. In this way we have produced thousands of new kinds of wheats, most of which were rejected while they were still single plants. Others have been grown in small plots, and others again in larger plots, sometimes for several years. A few of the best have been tested at other farms, and subjected to milling and baking tests also. Altogether about ten or twelve varieties so far have been in-

troduced to the public—some of these only for special and peculiar conditions. Of these varieties I wish to refer to four which are now being generally distributed to farmers who cannot ripen the old standard variety Red Fife. These four varieties are all Fife crosses. Three of them fall into one group, viz.: Preston, Stanley, and Huron. These are all of similar parentage.

By an hon. member:

Q. Are these all fall wheats?

A. No, they are spring wheats. We have not experimented very much with fall wheat. Ottawa is not a favourable locality for such experiments.

These three varieties differ in certain respects, but are all of a vigorous and productive habit and early in ripening. Preston and Huron are both bearded, Preston having pale chaff, and Huron reddish. Stanley is a beardless wheat. Preston and Huron are fully equal to Red Fife in hardness and depth of colour, but Stanley is perhaps not quite so hard, as a rule. Of none of these three can we say that the flour is equal from a commercial point of view to that made from Red Fife. That is to say, the flour will not usually produce as light bread as that made from Red Fife wheat. These three varieties therefore suffer from that distinct disadvantage commercially. They make very good bread indeed, but are not so highly prized as Red Fife in that respect.

The fourth variety—the only other which I shall mention by name—is Marquis. Marquis is newer than those others, and of different parentage. It is a cross between Red Fife and a small hard red wheat from India, which we obtained under the name of Hard Red Calcutta. This is from one of the crosses made on the Experimental Farms many years ago. It came into my hands in 1903 as an unfixed mixture of related types. Out of this several selections were made and the name Marquis was given to the best of these selections. It has been propagated from a single plant of the year 1903. Except for its earliness, this variety is almost indistinguishable from Red Fife in the field, and in its action in the mill, and in the bakery; so that it combines in itself to a considerable degree all the advantages we are looking for. It retains essentially the Red Fife quality in regard to baking, and at the same time shows a distinct advance in earliness. It has about the same degree of earliness as Preston, that is to say, ripening from five to ten days or more before Red Fife.

In regard to yield, it has not been grown for many years but it gives very good promise. The average yield for four years at Ottawa in plots has been 26½ bushels, while Red Fife during the same period gave 25½. At the branch experimental farms it has done very well, and reports from most farmers who have received samples are very encouraging. The best record is that made last season at Brandon, where a four acre field gave something over 200 bushels of crop. In baking tests the Marquis has proved very satisfactory. I may explain in this connection the meaning of the term 'baking strength,' which one is obliged to use, although it is not always employed by everyone in the same sense. In a general way we may say 'baking strength' refers to the ability of the flour to take up water and retain it, and produce a very large yield of bread of fine texture. A large volume does not necessarily mean a very open texture. One may have large volume with coarse texture, or large volume with fine texture. The latter is the ideal form. I use a scale of points for baking strength, in which 100 stands for excellent, 85 for medium, and 70 for very poor. On that scale Red Fife usually obtains a mark between 89 and 100 or occasionally more, as the scale for strength does not terminate at 100. I shall give you some of the figures obtained in the baking tests of Marquis wheat as compared with Red Fife. The 1906 crop of Red Fife at Ottawa gave flour which earned 102 marks for strength. Marquis grown at Ottawa earned 98, and Red Fife grown at Indian Head, 95. That is to say, our Marquis wheat grown here, while a little inferior to Red Fife of the same season, was superior in baking strength to Red Fife grown that year at Indian Head. In the 1907

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crop there were four strains of Red Fife grown at Ottawa, and they gave baking strengths of 89, 91, 92 and 97, while Marquis gave 91. No. 1 Northern Manitoba gave 91 points for strength, and No. 1 Hard, 95, so you see that the Marquis grown at Ottawa was that year equal in baking strength to the same season's No. 1 Northern from Manitoba, a high grade consisting chiefly of hard Red Fife wheat.

In 1908 I made three tests in this connection and found the Marquis and Red Fife at Brandon both earned 97 points for strength. Red Fife at Indian Head earned 93. It is evident, therefore that Marquis compares very favourably with Red Fife for baking strength. It is impossible to answer the question in a definite manner as to whether it is absolutely equal to Red Fife or not, because that would require an extended series of tests for a number of years, as individual varieties fluctuate very much in their baking strength, according to the soils and the seasons where they are grown. This Marquis wheat has taken very well in the west. In fact we have been somewhat surprised at the demand for it. Applications began to come in last autumn in unusual numbers, and they are still arriving every day. As this is a new variety of which we have no large stock, it is quite impossible for us to meet the demand. Many farmers expressed themselves as willing to pay any price for a few bushels of the wheat. The highest specific offer made was $50 for ten bushels. Much to my regret, it was impossible to send so large a quantity to any one applicant.

SELECTION.

Leaving this subject, the production of new varieties by cross-breeding followed by selection, I wish to speak of selection alone, as a means of improving wheats. This is the age of selection, as you know, and the question often arises: Why not select Red Fife for earliness, instead of trying to produce by cross-breeding, a new wheat which shall be earlier than the Red Fife and equal to it in other respects? If we pick out the earliest heads of Red Fife every year, and gain only one day in earliness every year for say twenty-one years, we shall then have gained three weeks. I think it is Darwin's influence which makes almost everyone believe that this method of work is very promising, and we are asked sometimes why we do not try it. To that question there are two answers. The first is that we have tried it, and are still trying it, and the second is that no such results as one might expect can possibly be reached. You cannot select out of Red Fife early heads every year, and secure by this continuous selection any such continuous improvement as that which I have referred to. It is possible, if one could carry the process on for about twenty-one thousand years, that one might succeed in gaining twenty-one days in earliness, but it cannot be done in twenty-one years or any such period. In fact the process is so slow that progress is, I should almost say, not to be seen at all; provided one begins with an absolutely fixed variety of wheat. Of course when selection is commenced with mixed seed the progress is very rapid at first. But this is really purification which is going on rather than improvement in the strict sense of the term. Strictly speaking there is no such thing as an absolutely fixed variety of grain, because nothing in nature is absolutely fixed; but we use that term to designate the varieties which vary so little that they appear perfectly uniform when studied in the usual way. We are trying repeated selections not in the hope of reaching important results, but rather to demonstrate just what can be done. The method of breeding selected strains from single plants, however, promises better results and we have already attained some success by that process. In the case of Red Fife wheat, for example, we selected a number of early plants and from each of these, without any further selction, we grew a separate strain. In this way I have obtained two important strains of Red Fife, one of which goes by the name of Red Fife H, and the other is now called Early Red Fife. Red Fife H. is very slightly earlier than the ordinary Red Fife, perhaps from one to four days on an average, and baking tests have shown it to be absolutely of the highest standard. Early Red Fife shows greater earliness (about five to ten days) and

is altogether a very promising selection. It has been baked several times and has proved to be the same as ordinary Red Fife in baking strength as well as in most other respects. It is slightly different in the appearance of the head and distinctly different in its earliness in ripening, but otherwise it is indistinguishable from Red Fife. In many respects it is very much like Marquis, although there is a slight difference in the shape of the kernel, and it is a question whether Early Red Fife or Marquis will prove more satisfactory. At present the evidence is slightly in favour of Marquis. Early Red Fife is not yet ready for distribution. We are saving our seed to sow on some of the western farms this coming spring, and expect to have it for distribution next year.

In these two ways (by cross-breeding and by selection) we have been endeavouring to meet the needs of the Northwest, for earlier maturing varieties. Though we have had a good measure of success thus far in producing selected Red Fife with increased earliness and early cross-bred varieties, some of which are of very great value; nevertheless we have by no means finished with the great problem of early maturing wheats, because none of the varieties to which I have referred is early enough for some of the districts where wheat is now grown, or for other localities where wheat will be grown in the future. The work is therefore being continued. I have this year about fifty new cross-bred varieties of considerable promise, which are being baked and I expect to have approximately fifty a year for the next few years. Out of these two or three hundred new varieties I hope to be able to select two or three which will be in advance of the best yet produced, from the point of view of those districts where the summer is short.

THE QUALITY OF WESTERN WHEAT.

There arise sometimes the inquiries, 'Is the standard of western wheat going down?' 'May not the introduction of new varieties and the extension of wheat areas lower the standard of the country as a whole?' We have no actual tests carried on for a series of years in regard to the baking strength of wheat from different sections of the country, so that one cannot fully answer these quetions, but it seems to me obvious that if the most favourable sections of country were first settled, the settlement of less favourable sections must lead to a certain amount of deterioration in the average value of the wheat grown. There is a theory, I know, that the further north any crop is produced the better it is, and I believe in that theory, but with one limitation. After a certain degree of latitude is reached, I think that any further progress northward brings one to conditions where the crop, whatever it may be, is not so good. We have found in our baking tests good evidence not only that frost is a very serious injury to the baking strength of wheat, but that cold weather at the ripening period, without actual frost, injures the baking strength also. It seems necessary for the production of the finest quality of wheat to have warm ripening weather, and our work goes to show that wheat ripened under unfavourable conditions, even when the appearance of the sample is not injured, is inferior in the baking strength of the flour to that ripened under the best conditions. There is a popular idea among wheat buyers that the finest Red Fife comes from certain sections in Manitoba. Personally I believe the idea has some foundation in fact.

By Mr. Sharpe (Lisgar):

Q. Are the English millers objecting to our samples and our grades of wheat?

A. I think not. I have said that the extension of the wheat area has probably lowered the average quality of the wheat, but I must explain carefully that I do not mean that the average quality of any particular grade of wheat has necessarily been lowered. This may also have occurred, but certainly not to any appreciable extent. I am pleased to be able to say that the baking tests which I have conducted with the western wheat of this past season have indicated that the crop is above the average strength of previous years. This statement of course refers only to the higher grades,

such as are generally used for the production of flour. Our grades are intended to be kept fixed as far as possible, and to a very large extent I think they are fixed; and I think any lowering of the average quality which may have occurred has shown itself in the larger proportion of wheat of the lower grades.

By Mr. Wright:

Q. Would you be prepared to state some degree of latitude beyond which wheat would not be so good?

A. No, I could not do that, because the questions of altitude, rainfall and air currents are so important that in isolated spots and in specially favourable seasons it might be possible to grow first-class wheat several hundred miles north of any line which I might venture to draw as a limiting line. Our knowledge of the far north country is not so extensive yet as we should like it to be; but I have no doubt that in some seasons it will produce crops of wheat superior to those reaped in some localities further south.

By Mr. Sharpe (Lisgar):

Q. What reason do you give for the quality of wheat in Manitoba being better than the quality in other districts?

A. A more favourable ripening season; warmer weather.

Q. Superior to Saskatchewan?

A. Yes, I think, from my baking tests—which were not very extensive however, on that point—that the average baking strength of any particular grade taken from central or southern Manitoba, would be superior to the average of the same grade from Saskatchewan, unless the season had been particularly favourable over the whole country.

Q. Do you think it would be advisable to keep them separate in the shipping?

A. I do not think the difference would usually be sufficient to make it worth while, and, besides, such an arrangement would bring no advantage to the country as a whole; though it would be advantageous to the districts producing the best wheat. Under the present system the wheat in each grade as sent out from the terminal elevators is a mixture containing shipments from widely separated localities.

Q. If you were a miller would you pay more for Manitoba wheat than Saskatchewan wheat?

A. I think probably I should be willing to pay a little more especially in an unfavourable season, provided the Manitoba wheat was of the same grade and equally good in appearance.

By Mr. Henderson:

Q. Do you think the superior quality of the Manitoba wheat is due to the fact that the land has been cultivated for a much longer period than these other districts and perhaps a little more manure introduced in the cultivation of the land?

A. No, I do not think so. My opinion is that it is primarily a question of season. Medium or poor-looking Red Fife grown at Ottawa sometimes gives flour superior in baking strength to that produced by much finer looking wheat grown in the northwest. I do not say the Ottawa wheat is of more value, because, on account of not being usually so plump and hard, it will not give as large a proportion of patent flour, nor perhaps as large a total yield of flour; but in regard to the quality of the bread produced, our Ottawa wheat is very often superior to western wheat, which looks far better. Brandon wheat has also sometimes given better bread than wheat from Indian Head. I think these differences are primarily dependent on the warmth of the ripening season. In making these comparisons I have almost always used pure samples of the same variety from both localities.

By Mr. Robb:

Q. Before you get away from this question between Manitoba and Saskatchewan wheat, is it not a fact that the lowering of Saskatchewan wheat in comparison with Manitoba wheat is due to the introduction of the Preston and Stanley wheats?

A. No, I do not think so. I do not think Saskatchewan has come down in reference to Manitoba. I think probably it always has been just a shade inferior from the point of view of baking strength. I am only speaking of that one point.

Q. Is it not a fact that there is more Red Fife grown in Manitoba than in Saskatchewan?

A. A larger proportion—yes, perhaps there is. I do not think the proportion of Preston wheat grown is very large, and according to the law Preston cannot be graded higher than No. 3 Northern. So that in so far as the law can be carried out—and I am sure it is not fully carried out—Preston is kept out of the first three grades almost entirely. These are the grades chiefly used for milling purposes.

Q. It is supposed to be kept out, but there is not one buyer in a hundred that knows the difference between Preston and Red Fife when it comes on the market in a wagon.

A. That is most likely.

By Mr. Sealey:

Q. In the ordinary commercial way of handling wheat do the buyers and millers make the baking test to ascertain if there is this difference?

A. Not as a rule.

Q. The publicity of the difference is mainly from the experiments such as you make, which go abroad?

A. Yes.

Q. And the buyers take advantage, or otherwise, of using that in argument, but in the ordinary course of trade they would never notice the difference.

A. The buyer and the miller would probably not notice the difference. The baker would notice it if he made comparative tests between samples, the source of which was known; but usually the wheat in commerce becomes so mixed that millers and bakers are familiar only with average samples.

Q. But if you or some other person making a special test did not publish that, the difference is so unnoticeable that the general public would not take any notice of it.

A. I do not think the general public ever will take any notice.

Q. Or the buyers?

A. I am not prepared to say the buyers will not. It is currently supposed that the buyers for our large milling companies pay special attention to the districts which those companies believe to be capable of producing the best wheat, and that if they do not really pay more for the wheat there, at least they are more careful to buy from those districts in preference. Most consumers of our wheat are familiar only with the average mixtures which make up each grade.

Mr. WRIGHT.—Having had business reasons for discussing with the representatives of one of the largest milling concerns in Canada, this question, I was told by him that their firm found it necessary to go further back to get the new wheat to mix with the older, to keep up the standard and his theory was that if you grew wheat for a long time in the older sections the quality of the wheat became inferior, and some chemical change was necessary to make that wheat better for milling purposes.

A. That idea seems opposed to the one I have just put forward; and it is certainly a popular view that the quality of wheat is lower on old farms. I am not prepared to say there is nothing in it, but I do not think it is true from the point of view of baking strength. Millers are much concerned with the hardness of the wheat, and it may be that older soils produce wheat that is less hard, although I am not of that

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opinion myself. It is a common opinion that wheat deteriorates as the soil deteriorates. I am just about to commence some tests, (which unfortunately I was not able to carry out in time to present to this committee) as to the baking strength of wheat grown on exhausted soil, and on highly fertilized soil. These experiments will perhaps give some light on that problem.

BAKING STRENGTH OF EARLY RIPENING WHEATS.

The Experimental Farm officers were criticized by one of the western newspapers not long ago for not having made public the baking qualities of our new cross-bred wheats, which are being sent out. This criticism showed considerable ignorance in regard to our publications. We have frequently referred to the subject and have always given as full particulars as were available. On the 20th March, 1908, I sent out a special circular dealing with this subject quite exhaustively. This circular made no reference to Marquis wheat as it was not available for distribution at that time. The circular dealt chiefly with Preston, Stanley and Huron wheats; and gave a clear statement as to their characteristics from the point of view of farmers, millers and bakers.

At the close of the circular I wrote:

'Wherever in the western provinces Red Fife can be depended upon it should be the main wheat sown, these earlier sorts, if used at all, being sown in relatively small quantities merely to make possible a somewhat earlier commencement of the harvest.'

Marquis wheat has proved superior to these other sorts and can fairly be referred to in a much more enthusiastic way. Early wheats are demanded and are sown, and will be sown, and our business at the Experimental Farms is not to recommend them, but to have available the best early varieties that we can produce, so that those farmers who insist on growing early sorts will receive from us something better than they would otherwise be able to find. Club wheat for instance, an early sort which was grown in parts of Manitoba, is inferior to anything that we send out, and we have discouraged the growing of that variety and always endeavoured to substitute for it something superior.

By Mr. Currie (Simcoe):

Q. Have you taken any steps to improve the quality of Red Fife?

A. Yes, I have produced Early Red Fife by selection. I discussed that question a few minutes ago.

By Mr. Henderson:

Q. You discussed it, but could you give us the conditions from year to year where the system of selection has been continued from time to time—not simply one year but for half a dozen years in succession?

A. You mean selection for earliness.

Q. No, for productiveness. I think that is the great essential with the farmers.

A. I have not carried on any experiments to study the gain in productiveness by continuous selection; chiefly because I consider it an inferior system of selection to that which I have already referred to. One must recognize that any form of continuous selection provides a chance for undesirable variations in some other direction, while one is looking for and perhaps obtaining a desirable variation in one direction. It is a very complicated matter.

By Mr. Currie (Simcoe):

Q. You understand what they have done in some of the American States with reference to corn, improving its quality and increasing its productiveness. The United States has on the same area increased the production some 40,000,000 bushels

of corn through the selection of the proper ear, and instructing the farmers how to work. Have you ever taken the problem in hand of working out the same result in regard to Manitoba wheat? I think that would be a good move.

A. The problem in wheat and other cereals is quite different from corn. The fundamental difference between wheat and corn in this regard is that corn is usually cross-fertilized in the field every year while wheat is almost invariably self-fertilized. The two problems cannot possibly be approached in the same way; the same method of working is not feasible.

Q. Why?

A. Because with corn the system involves the planting of alternate rows so that the pollen from one row can fertilize the cobs of the other. Alternate rows of wheat will not work in the same way. You cannot get the same results. It is not practicable to perform on wheat on a large scale, the operation which corresponds to the detasseling of corn.

Q. Did they not accomplish good results in regard to corn by giving advice to the farmers how to select the ears to plant?

A. Partly.

Q. The ear with the more grains on it would always bring a larger crop. Has anything of the same kind been tried with reference to wheat?

A. Not in exactly the same way. It is a comparatively easy matter to carefully select enough ears of corn for a large field; but to select with care enough heads of wheat for a field of even moderate size is not practicable. The work has therefore to be done somewhat differently and the results are not so quickly reached.

By Mr. Henderson:

Q. Supposing a farmer goes to work and selects enough to produce two bushels of superior wheat from superior heads; he sows that next year, and selects again from his field, and continues that mode of selection from year to year for eight or ten years. Has that system in the past not produced very excellent results?

A. It has produced good results for a couple of years when the original seed was a mixture of varieties; but this method of continuous selection for the gradual improvement of any variety is not satisfactory when the experiment is commenced with really pure seed the pedigree of which can be traced back to a single selected plant.

By Mr. Sexsmith:

Q. Is it not generally the rule that a farmer removes all the smaller kernels and uses for seed nothing but the very best?

A. Good farmers usually follow that plan. It is safer, on the whole, than the method of selecting heads, except in the hands of trained experts. I have seen cases where the repeated selection of fine heads has led to disastrous results. An important and well managed agricultural station (the name of which need not be mentioned) sent out a superior selected strain of Red Fife wheat in which I was unable to find any Red Fife at all. The superior looking heads had been selected, and these were White Russian. This shows how difficult that system is. When such a thing can occur with very careful workers in a good institution, it would certainly often occur with ordinary farmers. The wheat thus produced was not any longer Red Fife and would not give satisfaction to bakers. If yield were the only point to consider the matter would be different. But in the case of wheat the baking strength of the flour is of very great importance also, and any method of repeated selection while increasing productiveness might ruin the baking strength.

By Mr. Currie (Simcoe):

Q. It would not necessarily follow. You are taking an alarming view of the matter. From your remarks we would all come to the conclusion that if a man

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exercised care and took all those precautions in regard to the production of his wheat that necessarily the grade of flour produced from it would be very much reduced?

A. I do not mean to say that it would necessarily follow; but that it has occurred and would sometimes occur again.

Q. It is only by a remote contingency that it would happen. Everything points directly in the opposite way.

A. In the case of Red Fife wheat there is a particular danger, because the variety known as White Russian has somewhat longer and more striking heads, and is usually mixed with it.

Q. But it is not of the same colour. Do you not think it would be better for the Department to encourage the production of Red Fife, instead of scattering broadcast alleged imitations of Red Fife that will grow a little better? In the province of Ontario samples of potatoes have been scattererd abroad of various kinds until at the present time you cannot get a bag of potatoes of one kind in the province, and the result is the crops have been ruined.

A. We always encourage the growing of Red Fife when there is any chance of success with it. We do not send out any alleged imitations of Red Fife. Each of our varieties stands on its own merits, and we are careful to publish full details in regard to these. We do not in any sense scatter our seed grain broadcast. Every sample is asked for before being sent; and early ripening wheats are not sent unless they are specifically asked for. Red Fife is the principal variety distributed.

Q. Do you issue any samples of inferior quality of Red Fife?

A. Inferior in baking strength but superior in some other respect. Farmers who cannot grow Red Fife and who are determined to grow wheat receive some variety better adapted to their conditions. We do not like to take the ground that we must oppose their growing wheat altogether. We do not think that is reasonable. We do not advise them to grow the earlier varieties, unless they say they cannot depend upon the later sorts.

By Mr. Wright:

Q. As a matter of education for the new people going into the Northwest, people who do not know the difference between Red Fife and Preston or Stanley, would it not be better for the Experimental Farm to advise these people to grow Red Fife?

A. Not in all cases. In many of the districts now being settled Red Fife is not a success. We always advise the growing of Red Fife where the season is long enough.

By Mr. Sealey:

Q. In the olden days when we had fairs in our districts the prizes were generally awarded to one person in the County of Halton. He usually hand picked his wheat and would sell selected portions to his neighbours at good prices, and would take the culled stuff and sow it on his own farm and produce a better quality of wheat than the men who bought the wheat from him, but that was largely on account of his land, which was more favourable for producing the largest and best kernel?

A. Yes, that might be.

By Mr. Robb:

Q. But Red Fife has not a large kernel. As a matter of fact Red Fife has a small plump kernel?

A. The Red Fife kernel is rather small. If one were to select the largest kernels (or the longest heads) from ordinary commercial Red Fife one would ultimately obtain pure White Russian. Both the heads and the kernels are of essentially the same colour. Any method of repeated selection is attended, as I have said, with an element of danger; and is certainly inferior in its results to the method of propagating from

single selected plants. I usually advise farmers to be particularly careful about the original seed, and then to carefully clean the seed from their crop, and to sow a special plot every year on good land, for their seed for the following year. This special plot should be 'rogued' before cutting, so as to remove any heads which differ from the desired type. In this way the purity of the seed can be maintained. I may quote here from the last Annual Report of the 'Cerealist,' the advice given to farmers who desire to grow pure seed grain and who do not wish to follow the plan of selecting heads every year.

'For the maintenance of the purity of his grain some such method as the following—which will be found both easy and effective—may be followed. The farmer should choose a particularly clean and fertile piece of land for his special seed plot. In sowing the grain it is advisable to stop up about every eighth spout in the seed drill, so as to facilitate walking through the standing grain later in the season. If only a few pounds of pure seed are available the first season a small plot must be sown, but when a larger quantity of seed is on hand, one or two acres (or more) may be sown as a special seed plot—enough to provide all the seed required for the following year. The seed plot should be gone through once or twice during the growing season and everything that looks false to the desired type of grain should be removed. This should be done again just before the grain is cut. The task may appear formidable to any one who has not tried it; but it is really by no means difficult. If the special seed plot covers only a small fraction of an acre, it is imperative that the crop should be threshed by hand, as otherwise it will almost certainly be seriously mixed with other seed when passing through the threshing machine. For the threshing of larger quantities the machine should be cleaned out as thoroughly as possible before the operation is begun and the first few bushels of seed that pass through should be rejected. It is highly desirable to thresh the special plot after some totally distinct grain, so that if any seeds remain in the machine and are carried over into the special grain they may be easily seen and separated. Wheat, barley or oats could, for instance, advantageously follow peas. The seed grain should be well cleaned in a fanning mill, and as much of it as is to be used the next year for the special seed plot should be hand picked during the following winter: an easy matter considering the small quantity required.'

'The main portion of the seed may be used for the general farm crop of the next year without any further preparation than that given by the fanning mill.'

'In this way any farmer can keep his seed grain in excellent condition, and can maintain its purity with the minimum of labour and with no danger of altering the characteristics of the variety by errors in selection. This method will be found far more satisfactory in the great majority of cases than the time-honoured custom of a change of seed every few years, with its attendant dangers of new weeds and unsuitable types of grain.'

Q. The wheat buyers in the west tell me that if things keep on in the west as they are going at present there will not be any Red Fife out there after a while. There is a mixture of lighter coloured wheat coming into the Red Fife which destroys its grading?

A. I scarcely think this is correct. We send out almost exclusively those varieties which have a red skin; and I do not know any pale variety which is increasing in the west. Even White Fife, which is as good as Red Fife, is being grown to a smaller extent as there is a prejudice against wheats with a pale skin. It may be that the lighter coloured wheat, which is objected to, is true Red Fife but somewhat soft. The soft kernels are somewhat paler than the hard ones, though not so pale as White Fife for example. We have to be very careful not to send pale wheats into the west as they are not acceptable. Our wheat grades in the Manitoba Inspection Division are based on red wheats and the buyers of that wheat are accustomed to regard redness as an index of quality. This is not quite accurate, but it would perhaps be unwise to combat the idea in commerce. Australia has had the opposite diffi-

culty. It has been the rule, if it is not still the case, to grow pale coloured wheats in Australia with the idea that they are superior to the red wheats. Here in Canada we have made our reputation on red wheat, and it would be almost impossible to change the prevailing prejudices, even if we were to produce distinctly superior varities with a naturally pale, yellowish skin.

EARLY WHEATS IN NORTHERN SASKATCHEWAN.

Q. With regard to sending to new settlers only Red Fife wheat, my experience in northern Saskatchewan, where the country has to be cleared is this, that it would be dangerous to do so because in that country, where there is more or less timber, if you undertook to confine the farmers to raising only Red Fife wheat the results would not be satisfactory. By allowing them to sow some earlier variety they can successfully raise wheat, and afterwards as the country becomes settled, conditions become suitable for raising Red Fife, because the seasons change. We all know that when the black soil of the country is turned up the country becomes warmer. Farmers can then go on raising Red Fife wheat and have it ripen successfully. I do not think the proportion of early ripening wheat grown would increase except temporarily. It is only for the new districts and it is necessary in those districts to raise the early varieties of wheat for the time being.

A. I should like to pass around a remarkably fine sample of wheat grown at Beatty, in northern Saskatchewan, which I received yesterday. It weighs 66¼ lbs. to the bushel and is one of the best samples of spring wheat I have ever seen.

By Mr. Sexsmith:

Q. How do you find the baking strength of Ontario wheat?

A. Ontario wheat when not too soft bakes well. Usually it is very soft and in that case it contains a larger proportion of starch than hard wheat and does not make as big a loaf. That applies to spring wheat as well as to fall wheat. When it looks soft it is usually deficient in baking strength. Hard samples of Ontario wheat are often superior in baking strength to the wheat grown on the western plains.

Q. Would it be possible to produce wheat grading No. 1 Hard in Ontario?

A. Yes, I think I have occasionally seen wheat grown in Ontario that would grade No. 1 Hard, but it is very rare.

By Mr. Currie (Simcoe):

Q. I saw a sample grown in Ontario about three years ago. I took a sample of it to Toronto and it was graded No. 1 Hard?

An HONOURABLE MEMBER.—It is grown right here on the Bonnechere.

Mr. SEXSMITH.—Red Fife wheat originated on a farm near where I live, the first Red Fife wheat raised in Ontario. It is the variety of wheat that was grown entirely in the district years ago, but now they can make scarcely any success of it?

By Mr. Cash:

Q. Is it not a fact that wherever you have timber or scrub you cannot raise No. 1 Hard Red Fife?

A. That is the rule, on the newly cleared land at any rate.

Q. Why does the presence of timber prevent the production of No. 1 Hard Red Fife?

A. I do not know why, but as you have said, the wheat becomes softer on such land. It is, however, true Red Fife still, although not hard. The bran is still red. There is a difference between a soft, starchy red wheat and a true white wheat. Red Fife remains Red Fife even when it becomes soft.

By Mr. Rutan:

Q. Wheat grown while the settler is clearing the land is generally spotted, but after the land is cleared and cultivated for a number of years that disappears and the grain goes back to the ordinary hard Red Fife.

A. The spotted or 'piebald' wheat is somewhat starchy, and is always placed in a lower grade on that account.

By Mr. Sealey:

Q. By continuing to use the same seed from year to year on other soil it will revert back to its original character, will it not?

A. Yes, I think one would obtain hard wheat again the first season from soft seed, provided the soil and climate were favourable.

MILLING AND BAKING TESTS.

I shall now speak of milling and baking tests. These terms are loosely used, 'milling test' commonly means 'baking test.' The small mill that I use is not very accurate for quantitative milling tests. These can be best made in large mills. But good straight grade flour can be made for comparative baking tests. I shall therefore not speak of milling tests (in the strict sense) but shall discuss the results of some of my baking tests under three headings: First the effects of storage on wheat and flour, second the effect of artificial bleaching on flour, and third, the baking value of flour from damp or wet wheat.

BAKING STRENGTH AS AFFECTED BY STORAGE.

We have been carrying on for some time a study of the effects of storage, and we find that when wheat or flour is stored under good dry conditions, the effects are very beneficial on the baking strength of the flour. The improvement occurs more rapidly in the case of flour than in the case of wheat. Our flour has always been stored in a warm room, and the wheat in an unheated one. I have commenced this season a new series of tests with flour stored in an ordinary unheated storeroom to determine how far the temperature of storage in winter affects the results.

Under any of the conditions of storage tried there is a rapid bleaching of the flour. Stored wheat also gives paler flour than new wheat, but the change is very much slower when the material is kept as wheat than when kept as flour.

Q. That is in warm storage?

A. No, I am speaking of wheat kept in an unheated storeroom and of flour kept either in a heated or an unheated place. The colour change in the flour is quite rapid under both conditions. It is often stated that wheat and flour after a while begin to lose their baking strength. This of course may be true in the case of bad storage—storage in excessive dampness where mould can be formed, but I have made singularly fine bread from wheat seven years old, and also from flour that was two years old and which was made from wheat five years old at the time of the grinding—that is to say the wheat was stored five years before it was ground, and the flour was stored two years after that. There was not only no deterioration, but there was a very decided improvement over the original strength in both cases. The flavour of the bread also was excellent. In other tests I have thought that the flavour of bread made from wheat or flour two years old was even better than that from new wheat.

By Mr. Thornton:

Q. At what age after grinding would flour reach its best stage?

A. I have never tested it more than two years after the grinding.

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Q. Would it be at its best in a less time than that?

A. I think not. We have not done enough experimenting to be sure.

Q. But it is improved in one year?

A. In most cases flour is improved by storage for a year, and in some cases so much as not to be recognizable at all. That is to say, flour which within a month or two after the grinding was so poor that good bread could scarcely be made from it has been found after a year's storage to be distinctly superior to the very finest new flour that could be obtained.

By an hon member:

Q. Is it necessary to keep it very dry?

A. The samples were kept very dry, but I have no reason to suppose that any unusual precautions would be necessary. Flour should always be kept in a dry storeroom as it absorbs moisture very readily. Moisture determinations made a few days ago showed about fifteen per cent of moisture in samples of flour kept in a dry, unheated storeroom and about 9½ per cent in samples kept in a warmed room.

Though the age of the sample has so great an influence on its baking strength much depeneds also on the variety of wheat.

Q. Are you speaking of soft wheat?

A. The experiments include both kinds; but some hard wheats make very poor bread. The hardness of the wheat is no guide as to the baking strength of the flour unless you know the variety. A hard sample will usually make better bread than a soft sample of the same variety; but a hard sample of one variety may not make as good bread as a soft sample of another sort. Comparisons must be made within the variety if they are to be of any value.

Q. Can you state the characteristics of those wheats which produce poor bread?

A. No. They have no characteristics in common at all. They are not wheats of any one class or type. Some of the poorest wheats I ever tested for bread making were hard red varieties of excellent appearance.

Q. Is it not that quality of hardness which gives western wheat its value?

A. The quality of hardness combined with the fact that the variety is chiefly Red Fife. Soft Red Fife would be considered inferior, but some wheats quite as hard as Red Fife make poor bread. Wheat of the Durum class, such as Goose wheat, are even harder than Red Fife, but some of them are very poor for bread making.

By Mr. Schaffner:

Q. Red Fife sown on different soils produces different kinds of wheat. They grow hard Red Fife on the prairie, but go a certain distance—to the Turtle Mountains for instance—and sow Red Fife, and you get a large soft wheat. That would not produce good flour?

A. It will not usually make as light bread as the harder sample, but the soft Red Fife is pure Red Fife in spite of its appearance and generally yields very good flour.

Q. But it would not grade No. 1 Hard?

A. No, it would lose its grade, but that seed if sown under favourable conditions would in one season produce No. 1 Hard again. Sometimes the soft samples of Red Fife show quite a high baking strength, though they are somewhat low in gluten. The poorest sample of Red Fife (properly ripened) that I ever baked gave a baking strength of about 84; that is to say just below medium. Excellent looking, hard samples of some other varieties have shown as low a baking strength as 75. I have also had soft wheats that have shown a baking strength above 84. You will see therefor that there is no fixed relationship between hardness of wheat and baking strength of flour. Many of our results reached in the study of the effects of storage have already been published. It is therefore unnecessary to dwell on this subject at the present time. I wish, however, to emphasize this one point that storage has

nearly always a beneficial effect on wheat and on flour, and in some cases an effect that is astonishing. The fact that the improvement is more rapid in the flour than in the wheat furnishes additional argument for the grinding of our wheat at home. In this way any unavoidable delay in the export of our products would cause an increase in their value. Such delay often occurs now and would be especially important if the Hudson Bay route were to be used. Wheat, or more particularly flour, which had been in good storage for several months should bring a higher price than the fresh product.

By an hon. member:

Q. You would advise storage in an unheated place for flour rather than warm storage?

A. I cannot yet say what difference it might make? In most of our work the flour has been kept in a heated storeroom in winter. It is not likely that this would be worth while in any climate where the winter is severe.

If our wheat were ground during the winter and if the flour were exported the following summer, we should not only keep the bran and shorts for use at home, but gain a still greater reputation and a higher price for our flour.

By Mr. Martin (Wellington):

Q. How would the weight be affected?

A. The amount of moisture in flour affects its weight very much; but old flour does not act differently from new in this respect. I do not think there could be any appreciable loss in the weight of either flour or wheat by storage.

By Mr. Schaffner:

Q. Almost invariably grain shrinks when kept in the elevator.

A. No doubt it sometimes shrinks soon after it is thrashed; but I was referring to wheat at least a few weeks old at the time it was put into storage.

By Mr. Henderson:

Q. To make your information practical to the ordinary consumer how long should flour be kept before it is used?

A. For the very best rsults it should not be used until it is about a year old; but of course some lots of flour are very good even when quite fresh.

Q. And how long do you say wheat should be kept before it is ground?

A. I should advise grinding it almost immediately and keeping it over as flour, because in that way more rapid improvement would be obtained.

Q. The improvement is more rapid in flour than in wheat?

A. Yes.

By Mr. Currie (Simcoe):

Q. Is it not a fact that the reputation of our Northwest wheat is largely due to the fact that it is used in the old country to mix with softer grain?

A. Yes.

Q. If you ground it here, would you not lose that increased value?

A. Not at all. In that case the baker in Great Britain would mix the flour instead of the miller mixing the wheat. It is sometimes claimed that even better results are obtained in that way.

Q. When you speak of grinding the wheat immediately do you mean that you would grind it before letting it pass through the sweating process?

A. No, I mean a reasonable time after the harvesting. I have been surprised however to find how high is the baking strength of flour made in September from new wheat. It is not nearly so poor as I had been led to suppose. I have tried several

samples in two different seasons and have found very little difference between bread made in September from new flour and bread made in January from the same wheat, ground in the month of December.

ARTIFICIAL BLEACHING OF FLOUR.

For the artificial bleaching or so-called ageing of flour, various processes have been tried, and various bleaching agents but there is only one agent which is commonly used at present and that is nitrogen peroxide. This gas is generated either by decomposition of nitric acid, or electrically, from air by what is called a flaming discharge of electricity, which causes the combination of some of the nitrogen of the air with some of the oxygen. The air which has been thus treated and which contains a little nitrogen peroxide is passed through a rotating cylinder where the flour is kept in constant motion. The flour is subjected to the action of this air for about fifteen seconds. Bleaching is practically instantaneous. It is claimed that bleaching produces the effects of a certain period of storage, how long a time is not stated, and that the flour is improved in baking strength as well as in colour. The amount of change in colour depends on the proportion of nitrogen peroxide in the air as used and perhaps somewhat also on the length of time it is allowed to act on the flour. A considerable part of the yellowish or creamy tint which is natural to most flours—especially when new—is thereby removed. The claims of the company owning the patents (the Alsop Process Company) are supported by various investigators, the best known of whom perhaps is Prof. H. Snyder, formerly chemist of the Minnesota Agricultural Experiment Station. He has gone into the question very fully, and has shown conclusively that the bleaching action does not render the flour in any sense undesirable as food. He does not, however, demonstrate clearly whether the bleached flour is improved in any other way than in appearance.

Q. What chemical change takes place?

A. The colouring matter in the fat is bleached.

Q. It is oxydized?

A. That is what is believed to occur.

As a result of the action of the nitrogen peroxide there is left in the flour a very small amount of some nitrite-reacting material, probably ammonium nitrite. Some chemists maintain that minute quantities of nitrite are naturally present in flour; but whether this be so or not, the quantity found after bleaching is quite negligible. Furthermore this nitrite is destroyed in bread-making. There can, therefore, be no fair objection to the artificial bleaching on the ground that it introduces any deleterious substance into the flour. It seemed important to determine whether or not bleaching causes any change in the baking qualities of the flour or its moisture content. Prof. Snyder's bulletin gives very little information on these points. He does not seem to have determined the moisture in his samples, and certainly did not take it into account in the figures derived from the baking tests. The baking results are therefore of very little value.

Toward the close of his paper Prof. Snyder draws the following conclusions:—

'Flours bleached with small amounts of nitrogen peroxide generated by electrical action are in all respects similar to flours bleached and cured by storage, except that the electrically bleached flours contain a trace of nitrite-reacting material which is removed during the process of bread-making.'

The latter part of the sentence I have no doubt is quite correct, but the first part is entirely an expression of opinion, because the author does not appear to have made any baking tests with naturally aged or naturally bleached samples of flour. As the relationship between naturally aged and artificially bleached flour is a matter of importance, it seemed advisable to obtain some experimental basis for an expression of opinion.

By Mr. Low:

Q. Is it not a fact that the bleaching of flour is prohibited in the United States?

A. No, not prohibited. The United States Government prohibits the transhipment of bleached flour in interstate commerce. Bleaching is allowed in most or all of the states. In other words, the federal authorities have reached for it as far as they can reach. They cannot interfere with any flour bleached in a state and not sent into another state.

Q. Is bleaching done in Canada to any extent?

A. I believe it is, but cannot say to what extent.

Q. Do any of the large milling companies such as the Ogilvie or the Lake of the Woods Company bleach any of their flour?

A. I do not know whether they use the bleaching process at all. They do not advertise their flour as bleached. One of the companies advertised a certain brand of flour as bleached for some time but afterwards dropped the advertisement, and I presume discontinued the bleaching.

By Mr. Martin (Wellington):

Q. Is not the bleaching of flour condemned by medical men?

A. No.

Q. In Canada, bleached flour is not considered fit for human food?

A. I am not aware that there have been any tests in Canada on that point. There is absolutely no objection to bread made of bleached flour.

By Mr. Currie (Simcoe):

Q. There must be some objection when the Federal Government on the other side interferes with the bleaching. Can you give us the opinion of Secretary Wilson of the United States on the subject?

A. He is certainly opposed to the artificial bleaching of flour. It is claimed by some of the federal authorities that bleaching makes the flour less desirable for human food than it was before, but I am not aware that this opinion is based on any observations that are thorough and satisfactory.

Q. You understand chemistry?

A. Yes.

Q. What is the effect of nitric acid on cellulose?

A. That depends on the concentration of the acid and on other conditions.

Q. Is not the tendency to make something akin to gun cotton?

A. Under some conditions gun cotton is produced; but there is certainly no gun cotton in bleached flour. As I have pointed out the only chemical substance added to the flour is a very minute quantity of material which behaves like ammonium nitrite. I make this statement on the authority of Prof. Snyder who has most carefully investigated this phase of the subject. He says that in any case the amount of nitrite left in the flour after the bleaching is so small (whether any was present before the bleaching or not) that it would be quite negligible even if it remained in the finished bread. He proves, however, that the finished bread contains no nitrite unless it has been baked in a gas oven, where the products of combustion have access to the bread. In that case a little nitrite is always present in the bread whether made from bleached or unbleached flour.

By Mr. Henderson:

Q. The object of bleaching is to cover up some defect in the flour, is it not?

A. I do not think it can quite fairly be expressed in that way, unless one would say that the object of colouring butter is to cover up a defect. Bleaching increases the saleableness of some flours. I think it would perhaps be worthy of consideration

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whether there should not be legislation against the alteration of the natural colour of foods. If that were done, then in winter we should have white butter and cheese, and yellowish bread, as nature intended them to be. But the public wants yellow butter, and pale flour, not quite white, but very pale.

Q. My own opinion is that the colouring of butter is a very good thing in many instances, and it is harmless. The butter looks nicer.

A. That is the claim made for bleached flour, that it looks nicer. In one case it is less yellow, and in the other more yellow than the public demand. I see no difference in principle between the artificial bleaching of flour and the artificial colouring of butter.

Q. Have you any evidence to show that flour made from the bleaching process sells for more than flour not bleached?

A. I think it does, though I have no figures available to show. Of course the question of colour is purely a matter of taste. Sometimes when the flour is the very finest cream colour that can be obtained, to bleach it makes it a rather dead white which makes it less attractive to some people. On the other hand, when flour has a heavy yellow colour the bleaching reduces this to a creamy tint which would certainly be preferred by most people. But it is a matter of taste after all, and can be best settled by those who handle the flour commercially.

NATURAL AND ARTIFICIAL BLEACHING.

Flour when stored undergoes a natural bleaching. The effect of artificial bleaching is not identical with that of natural bleaching. Very old samples of flour can be still further bleached by the artificial method. Two samples of flour two years old were bleached in my presence by the Canadian representative of the Alsop Company. These old samples were given the same treatment as new flours are subjected to. The result was that they were still further bleached, the bleaching removing from them almost the last traces of cream colour and making them different and less desirable I think in appearance. New flours were also bleached on the same occasion, and some of these were certainly improved in appearance from a commercial point of view.

I found that flour made from wheat which had been stored for two years produced bread of almost exactly the same depth of colour as artificially bleached flour from new wheat. But it was not the same kind of colour in the two cases. There was a distinct difference. The naturally bleached flour was more creamy, and the artificially bleached flour was a little more reddish. The difference was very slight but still distinct. It is clear therefore that bleaching does not produce exactly the same colour change as the natural ageing.

MOISTURE CONTENT OF BLEACHED FLOUR.

In regard to the moisture content of bleached flour, further investigation is needed. Prof. Snyder claims that the bleaching is beneficial to the consumer as the flour is weighed at the mill after it has been bleached and a certain amount of moisture removed by the bleaching. He neglects, however, to give any account of the determinations on which these statements were based. The question is therefore still open. The problem has been taken up by Mr. Frank T. Shutt, the Chemist of the Experimental Farms, who is working on the chemical aspects of bleached flour. Mr. Shutt found that all the samples of bleached flour contained less water than the corresponding unbleached samples after they had all been stored under similar conditions for a month after being bleached. It is difficult to say exactly when this moisture was lost. It does not follow that it was lost during the bleaching process; but at all events the bleaching so altered the flour that after being stored for a month it contained less water than the unbleached. This was true in every instance (six pairs of samples). If therefore two similar flours, one bleached and the other not, have been

stored together it will be to the advantage of the purchaser to buy the bleached flour, provided it is weighed for him at the time of sale. If, however, the weighing, was done immediately after the bleaching it is quite another question. In that case it is quite possible that, after storage, a bag of bleached flour would be found, if re-weighed, to be lighter than a bag of unbleached flour, though both might contain the same quantity of dry matter.

BAKING STRENGTH OF BLEACHED AND UNBLEACHED FLOUR.

The relative baking strength of bleached and unbleached flour is a question of considerable importance to which not much attention has usually been paid. The question to be answered is, does the bleached flour make bread materially different from the unbleached in any other respect than in colour? I have taken up this problem very carefully with twelve samples of flour, six bleached and six unbleached; and I am obliged to say that the difference in baking strength in almost every case is clearly within the unavoidable limits of experimental error. In one case there is a difference of about two points in favour of the bleached flour (in the scale for baking strength which I use.) But even this difference is so slight that I cannot say it is beyond the possible errors of experiment. It is the average result of four separate determinations which agreed fairly well. In another case I found a similar difference but in favour of the unbleached flour; but in this case neither sample of flour gave good bread. In the other pairs of samples examined the differences were less than these and really amount to nothing. I am not prepared to say that there is any consistent difference in bread making strength between unbleached and bleached flours. It is quite clear, however, that good bread-making flours are not lowered in their strength for that purpose when bleached.

These comparative bakings were done all together under absolutely the same conditions, the flours being tested in pairs, the bleached beside the unbleached.

Q. The flours were the same?

A. Yes, exactly the same. Half of each original sample was bleached and the other half left in its natural state.

By Mr. Currie (Simcoe):

Q. If an inferior flour, which by its very appearance would show the purchaser that good bread could not be made from it, were to be bleached, would the bleaching not have a tendency to deceive the purchaser and lead him to think the flour was first class?

A. It is possible that might occur, a false impression might sometimes be produced; but I am not sure that I understand just what you mean by a flour which by its appearance would show clearly that it was unfit for bread making. Some rather dark flours make very good bread. It is difficult to judge by appearances.

Q. No one would go to the expense of bleaching flour unless there was money in it? The commercial side of it is what the business community will look at.

Are not the manufacturers able, by bleaching, to get a higher price for a lower grade flour—is that not an imposition on the public? That is the question.

A. I am not in a position to fully answer that; but as a matter of fact bleaching is by no means confined to the lower grades of flour. The finest flours are sometimes bleached, and I do not think that it is primarily a question of trying to raise a low grade flour. It has been claimed that if flour had specks of bran, &c. in it these would be more conspicuous after the bleaching. But even if we accept that statement in regard to really low grade flours, it does not dispose of the case of flours of intermediate grade, well milled, but rather dark. It is easy to conceive that such

samples might be improved in appearance by bleaching so as to rank almost in the first class. I am not prepared to say how far this could be done. While I consider that artificial bleaching, like artificial colouring, has an element of deception about it; I do not think we should treat the one question any differently from the other.

Q. You know one reason why butter is coloured?

A. So as to make it look like June butter, I presume.

Q. And to produce what result? To bring more money is it not?

A. Yes.

Q. Because no one will spend five minutes colouring butter or bleaching flour if there is not more money in it. Do you not agree that this bleaching of flour is primarily for the purpose of improving the appearance without any question of quality at all?

A. Yes.

By Mr. Robb:

Q. The real test of flour is in the baking. You have just proved that there is really no difference in the baking tests between bleached and unbleached flour; so that if a low grade flour by being bleached deceived the purchaser it would only occur once.

A. Yes, the miller would lose his reputation. It is not likely that any large milling company would undertake anything of the kind because in the long run it would do them more harm than good. If the flour did not answer expectations it would become unsaleable except at a lower price.

By Mr. Schaffner:

Q. To what grade of flour is bleaching mostly done? Not so much high grade as low grade flour?

A. I believe the high grades are as often bleached as the low grades.

By Mr. Currie (Simcoe):

Q. I believe from a business standpoint no one would pay for an expensive process and pay a royalty for the mere purpose of looking at it, unless he were to get a few cents more.

By Mr. Low:

Q. Will the bleached flour sell at a higher price because of the bleaching?

A. I think it either sells at a higher price or finds a more ready sale at the same price. That would be an advantage to the miller.

Q. The bleaching enables one to place the flour on the market sooner than if it were unbleached?

A. I do not believe it is customary to hold flour for a long enough period to bleach it, naturally, to any great extent. Artificial bleaching gives the flour, at once, an appearance similar to that which would have been produced by natural bleaching if the flour had been stored for some time.

Q. Do you not think there must have been some good reason why the Federal government of the United States objected to the sale of bleached flour?

A. I think it was due to a desire to insist on absolute openness in regard to all food products. I should not be surpised to hear of a ruling by the same authorities against artificially coloured butter. The present ruling does not finally dispose of the matter. It will be settled by the courts of law.

By Mr. Currie (Simcoe):

Q. You having been interested in this matter would have the advantage of studying the question from the bulletins that have been issued by the Department of Agriculture of the United States. Is it not Mr. Wiley who is the chief there?

A. Mr. Wiley is the chief chemist.

Q. Did he not give some reason for the ruling? He never does anything of that kind without giving ample reason for doing so.

A. The ruling was made I understand by the Secretary of Agriculture. I do not think that full and convincing reasons for it, based on careful investigation, have ever been given to the public.

BAKING STRENGTH OF DAMP WHEAT.

The last subject I wish to speak of is the investigation into the baking strength of wheat which has been damp or wet, and which appears to have been injured in that way.

In the last Annual Report of the Experimental Farms I published the results of the first series of tests, which lead to the following rather remarkable conclusions:—

'The conclusion which must be drawn from this series of experiments is that dampness in wheat although very injurious to its appearance does not necessarily injure, but under some conditions actually improves the intrinsic value (to the baker) of the straight grade flour produced from it. No doubt injurious action of the moisture would commence earlier at higher temperatures than it did in this series of trials, but on the other hand it should be remembered that the amount of moisture present in the wheat in these tests was greater than that usually found in 'damp' or 'tough' wheat.'

I may say the wheat was stored under cold conditions (above frost, however), and kept extremely damp, and that the baking strength of the straight grade flour produced from it—(that is to say all the flour which could be considered good for bread making)—was greater in some of the samples which had been kept extremely damp than it was in the original wheat. A sample kept for twenty days so damp that it could almost be described as wet made distinctly superior flour to that obtained from the original sample. After twenty-seven days the wheat was quite musty and spoiled and made very poor flour. Some of the conclusions drawn from this series of tests were so unexpected that it was thought advisable to make further experiments. What we wish to find out is whether wheat injured in appearance by being wet in the stook will make good bread. Further tests are being made this winter and I am able to make a preliminary report this morning on one series of experiments.

I have a bright, hard sample of Red Fife from Indian Head which was soaked in water three hours every day, and then spread out and dried in an ordinary, heated room for 21 hours. This was repeated every day for eight days. After one day, two days, four days, and eight days portions were dried off, and ground and baked. I have brought for your inspection a sample taken after the fourth day. You will see that it is dull and soft looking—entirely different from its original condition. It weighs 4 lbs. less to the measured bushel than the original wheat. The baking tests of these samples are only half done, but the indications are that they will fall in line with last year's tests. That is to say that the baking strength of this wheat has not been injured, but rather improved by a certain amount of wetting and drying. I must interject, however, this statement that in all my baking tests what may be termed 'plain bread' is made. Bakers often add to the flour malt extract or malt flour as well as lard and other materials. In using such additional ingredients the results of the experiments might be altered. If this improvement in the flour from wheat which has been wet is due to the production of those products which accompany malting, then while we may have an advantage in the bread made from such flour when

no malt extract is used, there may not be any advantage discernible when malt is employed. The flour from the samples of wheat which have been wet behaves somewhat as if a small quantity of malt extract had been added.

By Mr. Schaffner:

Q. Do you mean that if wheat that has been cut in good condition when put in stook is rained on, dries, is wet again, and dried, that the baking quality of that wheat is not injured?

A. These tests show that in some cases it would actually be improved in baking strength—although greatly injured in appearance. This sample which was soaked and dried four times has been reduced in weight from 61¾ to 57¾ lbs. per bushel and has apparently been converted into a soft wheat, although it does not show any appreciable increase in the break flour. I cannot say it will give the same proportions of high grade, patent flour, but the baking strength of the 'straight' flour has not been injured.

Wheat may be wet or damp under such a variety of conditions and for such varying periods of time that the whole problem is difficult to work out; but the evidence thus far shows that in many cases the bread-making strength of the flour made from such wheat will not have been injured.

Q. The price the grain buyer gives the farmer is injured?

A. Yes.

By Mr. Currie (Simcoe):

Q. Does wheat, like barley, produce malt?

A. It is customary to use the term 'malt' in reference to barley only, but the chemical changes which occur during the sprouting of wheat are similar. Diastase or some substance of a like character is produced.

Q. Have you made tests with frozen wheat?

A. Yes. Frost does wheat very great injury. Even cold weather near the freezing point appears to injure the baking strength of the flour, although the appearance of the grain may not have been altered.

By Mr. Schaffner:

Q. How does the frost affect it for seed?

A. Not so seriously as in the case of oats. I should have no hesitation in saying that plump wheat of fair germinating power could safely be used even though the skin showed considerable injury from frost.

Q. What percentage of germination?

A. I should not hesitate to use seed which showed 70 per cent. of strong germination; but of course it would be necessary to sow more than the usual quantity.

Q. You mean seventy live grains to the hundred?

A. Yes, at least 70 grains. Most of these should show strong vitality. If many were weak the seed would not be safe.

Q. What is the standard of the ordinary grain? How many to the hundred?

A. An ordinary good sample would give 94 to 98.

Q. So you would have to make up that difference between 70 and 95 in the quantity sown?

A. Yes. Some samples of wheat that have been entirely spoiled in appearance by frost, so far as the skin is concerned, are still quite plump, and have a large percentage of uninjured germs. Provided that is the case, the grain can be used for seed. But frost seems always to injure the wheat for bread making very considerably.

By Mr. Robb:

Q. Can you tell us the difference in gluten between the Marquis and the Red Fife?

A. The gluten has not been determined. We have no reason to suppose it would be materially different. Red Fife has not such a conspicuously large quantity of gluten. Its high bread-making strength is due chiefly to the good quality of its gluten. The quality and quantity of gluten in Marquis wheat appear to be about the same as in Red Fife.

By Mr. Currie (Simcoe):

Q. Do they work corn flour in with Manitoba wheat?

A. I have never heard of it. I have no doubt it could be done to a small extent.

Q. Manitoba flour takes up such a large quantity of moisture that they can introduce a certain amount of corn flour into the bread, and make what they call home-made bread.

A. I have found it possible to do this in baking experiments, but the character of the bread is changed. I scarcely think that any large miller would risk his reputation by making any such mixture. Adulteration of flour occurs much less often than is usually supposed. I am convinced that nearly all the flour offered for sale in Canada is quite pure.

Committee adjourned.

Certified correct,

CHAS. E. SAUNDERS,
Cerealist, Dominion Experimental Farms.

THE TOBACCO INDUSTRY IN CANADA.

HOUSE OF COMMONS,
COMMITTEE ROOM No. 34,
WEDNESDAY, February 2, 1910.

The Select Standing Committee on Agriculture and Colonization met here at 11 o'clock a.m., the Chairman, Mr. M. S. Schell, presiding:

The CHAIRMAN.—I have pleasure in introducing this morning Mr. Felix Charlan, Chief of the Tobacco Division, Department of Agriculture, who will speak on the 'Cultivation and Curing of Tobacco in Canada.' Mr. Charlan has only been a resident of Canada for four years, and I think it is remarkable that he should be able to address us in English, in view of the fact that he could not speak a word of our tongue until he came to this country. He does not propose to talk at very great length, but would welcome questions from members of the committee in the hope that the discussion will bring out useful information that will be of benefit to the country. I have great pleasure in calling upon Mr. Charlan to address you.

Mr. CHARLAN.—Mr. Chairman and Gentlemen,—I desire first to thank the Chairman for his complimentary introduction and hope the committee will extend their indulgence to me, should I not be able to express myself as fluently in English as they may expect.

Let me say at the outset that I shall be very brief. This is not the first time that I have had the honour of appearing before the Committee on Agriculture and Colonization. On two previous occasions, it was my good fortune to speak to you about the culture of tobacco in Canada. This morning, I think it will be best for me to attempt to outline the progress which has been made in tobacco growing in this country since I last appeared before you; that is to say, since the passage of the last resolutions with respect to Canadian tobacco. When last I appeared before you, more protection was being sought for the Canadian tobacco industry. I can now inform you that we were able soon afterwards to obtain the needed protection and that in consequence, we have made much of the progress that was anticipated at that time. And this brings me to the subject of my address this morning, which is 'The Cultivation and Curing of Tobacco in Canada.'

It might be well as a preliminary step to draw your attention to the financial results which have followed the work of the Tobacco Division. These, I may say, or at least some of them, are not as well known in the country as they ought to be, owing very likely in the first place to the fact that the work of improvement is necessarily very slow; secondly by reason of the fact that this is a very large country to carry on educational work in, and the people needing instruction are scattered over an immense area. The progress made in each district visited would seem, perhaps, small, and yet when we consider that progress in the aggregate, we must realize that a very great improvement has been made in tobacco culture. I hope to give you some details in the course of my address, but in the meantime, let me say that we have obtained some valuable economical results. I have with me samples of native grown

tobacco, which have been highly recommended by the Canadian manufacturer; and you will probably be surprised to learn that this tobacco can compete with any American variety imported into Canada, that is to say, for binder purposes.

Now as to the matter of education in tobacco culture and curing, the Minister of Agriculture decided two years ago to increase the staff of the Tobacco Division. Up to that time I had been working alone and was hardly able to respond to the numerous demands of the Canadian growers. The extension of the division work resulted in the establishment of three experimental stations, one at St. Jacques l'Achigan in the county of Montcalm and another at St. Cesaire in the county of Rouville, the third one at Harrow, Ont. We consider the first two parishes as the centres of tobacco production in the province of Quebec; the former being probably the oldest place where tobacco has been successfully grown in that province. It is several years since tobacco culture was first started there and it rapidly attained a great reputation. I must admit, however, that the reputation of the St. Jacques tobacco has been slightly lessened in the course of the last few years by reason of the smaller yields obtained by the growers from their fields. The reason for that decrease in the tobacco crop we are now endeavouring to ascertain, so that the existing conditions may be greatly improved. This is why an experimental station was established at St. Jacques. The other tobacco growing centre in the southern part of the county of Rouville is very promising. It gives me great pleasure to state that we have obtained at St. Césaire a tobacco that can compete with the product of any other district in the world. I shall be able to show you samples of that tobacco, and in that connection desire to say to the tobacco growers in the county of Montcalm, that if they will improve their methods of culture, they will very soon regain the position which they have lost.

The work of the Tobacco Division, from the educational point of view, has, up to the present, been confined to experiments with varieties. Since my arrival in Canada, I have not been able to meet anybody who could tell me the best kind of tobacco that could be grown in a particular locality. In Ontario, Burley is the variety chiefly grown. Of course, there are a few growers that raise the less important kinds of tobacco, more particularly, some smoking and cigar tobacco. However, it is useless, in my opinion to give very much attention to these latter growers, because our idea is to establish, if possible, the reputation of each tobacco centre in Canada and for that reason, we must promote the cultivation in each county, if not in each province, of the same kind of tobacco as the result of a selection which we have made. Two years ago, we were hardly able to exhibit a good sample of binder among the tobacco products of Quebec, but we started out with the idea of replacing all the tobacco imported from Wisconsin and Connecticut into the Canadian market, by a product of native growth. In consequence of our efforts to bring about improved cultivation, we have produced, and especially in the St. Césaire district, a tobacco which makes a fairly good binder. I have here some samples of that tobacco to show you. Two years ago, there were assembled in this room a number of Canadian tobacco experts, some of whom were manufacturers, and they were able to give the committee valuable information on the subject of tobacco growing. I hope we shall have further visits from these same and similarly well informed gentlemen, so that we may get the benefits of their knowledge and experience. Now, anybody who cares to look at this sample of Comstock Spanish (exhibiting sample) will probably admit that it is of the quality required to make a first class binder. You will notice first, the size and the shape of the leaf. Not a cigar manufacturer in Canada wants a bigger leaf for binder. He wants texture; we have it here. That leaf is strong, you can pull on it; it is also thin. Then you can get a good precentage of wrapper. That leaf is gummy and can stand a good sweating and a good fermentation. That tobacco has a very good aroma, therefore, it is sometimes used as a filler. For a binder only the best leaves are used and the bottom leaves, when sweated, are more easily used as

fillers. Some manufacturers in Montreal claim that they can use those fillers as well as the Havana filler. I would not like to say that the Canadian filler is better than the Havana filler, but it must make a pretty good cigar, since cigars produced from this tobacco are sold sometimes at ten cents a piece. Thus, we have accomplished sufficient to make us feel assured that we can produce in Canada the tobacco to replace the million pounds that we have annually imported in the parts from Wisconsin. I have read in certain tobacco journals that last year the records of the Department of Inland Revenue show an increased consumption of Canadian tobacco in this country of a little more than 1,000,000 pounds, and a decrease in the importation of American tobaccos during the same period of a like quantity. It is obvious, therefore, that the consumption of Canadian tobacco has exactly replaced the imports of American tobacco, not absolutely all those imports because we shall still need some for binder purposes, but this is the first year that Canadian native tobacco has taken such a place in the Canadian market and we could not expect to make a much better showing than that. The result from an economic point of view is that we have been able to keep in this country about half a million dollars more than we did two years ago. I think that is a very fair result, and the members of the Canadian parliament are partly responsible for it because of the law which was passed enabling the Canadian manufacturer to manufacture the Canadian product in the right shape.

I have here another sample of tobacco and it is just what we want to see in this country. It was handled by a very clever packer in Farnham last winter. This is the kind of product that we must offer the Canadian manufacturer in order to get a good price. I venture to say that this tobacco can be sold at about forty-five cents and sometimes fifty cents a pound, which is far in excess of the ten, fifteen and twenty cents that this tobacco brought four years ago. Moreover, while the manufacturer is able to sell that tobacco at forty cents a pound and make a very fair profit, he can buy the raw leaf from the grower at fifteen and sixteen cents a pound. That has been done by Mr. Fortier last year at St. Césaire. Instead of an average price of eight and nine cents, the Canadian grower this year has been getting fifteen cents a pound for the best crops. I think that this is a good result.

By Mr. Sproule:

Q. At fifteen cents a pound how much would the grower realize per acre on the average?

A. In money?

Q. Yes.

A. I think the grower can make a clear profit of from $120 to $150 per acre.

Q. How many pounds will the crop yield to the acre?

A. From 1,200 to 1,500 pounds according to the fertility of the soil. This past year has not been a very good one, but the previous year we obtained at St. Césaire from 1,400 to 1,600 pounds to the acre. Compute the total at fifteen cents a pound and you can see the return in money that you will get per acre. The expense of cultivation is not greater than it was two years ago, but has been rather diminished.

Q. Fifteen cents a pound is a pretty high price?

A. A pretty high price, but you must remember that it is for high grade tobacco. We are developing in Canada the culture of a high grade tobacco and trying by every means in our power to stop the cultivation of poor varieties. Unfortunately, we still have plenty of poor tobaccos, especially in Quebec.

Q. You think there is plenty of room for improvement?

A. Yes, because there are still plenty of these poor tobaccos grown. The advantage of growing such a high grade quality of tobacco, and we are trying to promote its cultivation throughout Canada or at least throughout the province of Quebec, is that we can use it as a binder and also as a filler. The large leaves like this (refer-

ring to sample) make a first class binder and the small ones instead of being lost because they have no flavour, as is the case sometimes with some varieties, can be used for fillers. I have been told by people who handle that tobacco that they can sell this unpromising looking product at about thirty-five cents or forty cents a pound.

By Mr. Meigs:

Q. Did you furnish the farmers with this seed?

A. We furnished the growers with that seed for about three years.

Q. Did you furnish seed to the growers in St. Césaire that year?

A. Only to a limited extent. Every year we make a distribution of seed to the Canadian growers. Of course, we cannot give a supply to every tobacco grower in Canada, but we make a distribution to the farmers' institutes in order that through their agency, the seed may reach the best growers. Now there is another point. We have shown the Canadian growers how to raise in this country the best tobacco seed. In addition, we have made experiments ourselves, especially on the experimental farm here, and these experiments have proved that we can grow in this country the best tobacco seed that we can get. Last year I grew tobacco from American tobacco seed and also from Canadian seed, and it was demonstrated that the latter not only gave a better yield, but a product that could stand our climatic conditions better. Now we are endeavouring to raise a sufficient amount of this seed at our stations to enable us to distribute it to the Canadian growers and thus meet all the requirements of Canadian tobacco cultivation. My expectation is that in two or three years from now, we shall be able to furnish every Canadian grower with the tobacco seed that he needs. The first requirement for placing our native tobacco growing industry on a sound basis is that the Canadian grower shall obtain the right kind of seed. Secondly, we require to check and ultimately to eliminate the production of the poor tobaccos to which I referred a few minutes ago. This result we shall accomplish by distributing only seed of first class quality, and the growers who get that seed will then have no excuse for going to the merchant and buying poor stuff over which we have no control.

By Mr. Currie (Simcoe):

Q. If that seed is grown for several years in Canada, does the plant become more rank?

A. Yes, generally. But sometimes the result of introducing tobacco seed into Canada is that a grower has, unknown to himself, a very good quality of tobacco in his plot or field without being able to take advantage of its superiority. Two years ago I made a selection during a trip through Ontario. A doctor in Leamington, who was not a very extensive grower, had in a small patch of garden a few tobacco plants. They were in a splendid state and I asked him where he got the seed for his plantation. He could not tell me the name of the variety, but I got from him some seed and tried it at the Experimental Farm. Then I ascertained that it was 'Big Ohio,' which had been imported by the Walkerville people. We tried that tobacco at the Experimental Farm first, and last year experimented with it at St. Jacques. I entertain the hope that this tobacco will be able to replace, in a very short time, all the Connecticut seed leaf grown in the province of Quebec, because it gives a larger leaf and a comparatively early plant. I have here a sample of that tobacco, and you will notice the length of the leaf. In this connection, let me say, that some people in Quebec want to get a great deal from their fields. They do not care so much for the quality as for a heavy yield. Accordingly they generally try the Connecticut seed leaf. But that variety is a very slow grower and sometimes about the last week in August or the first week in September, frost appears and spoils the crop. We will be able to harvest and store this new tobacco before the frost comes and hang it in the barns, where we shall have plenty of time to cure it in September, without fear of the of Quebec. I think that the only reason for the insufficient yields now obtained—for

cold weather. This tobacco was exhibited two years ago to some Canadian manufacturers and they state that it is just the kind they want for cut tobacco for smoking purposes. The leaf is very thin and the proportion of stem is small. The amount of stem has to be considered, because when the tobacco is stemmed in the factory, if the quantity is very heavy, it means a loss af about 25 per cent to 30 per cent of the weight. Therefore, the manufacturers prefer a tobacco that has only a very small stem, that is the advantage of this particular quality of tobacco. And just here, let me emphasize on the advantage of being able to travel and make observations in various parts of the country. Had I not been travelling in Ontario, I could not have noticed that tobacco, and should not now be in a position to distribute seed to the Quebec growers capable of yielding better results. I may say that at the Experimental Farm, we secured in 1908 a yield of about 2,400 pounds.

By Mr. Proulx:

Q. How much a pound would it bring?

A. We can sell that anywhere for between eight and nine cents a pound. This sample has been kept in a too soft condition. I had to do that in order to be able to show it to you, but it will not make any difference. When placed upon the market the tobacco will be in better condition than it is now.

Our idea is to make a good selection, and to make that selection profitable. We have worked for about two years on a special point that may seem unimportant to the people not familiar with tobacco culture. That special feature is the question of seed plants and seed beds. The greatest trouble that we experience in Quebec, and one that we have had to meet practically every year since I have been in Canada, is that the backward spring makes the transplanting of the tobacco plants at the proper time a very difficult thing. Generally, by reason of the cold temperature, the seed bed does not yield enough seedlings to plant a large extent of land. Furthermore, we have discovered that the reason of the insufficient results obtained by the Quebec growers on their seed beds was that the latter are generally overcrowded. They generally sow too much seed on the plots, and then the seed bed is too heavily burdened to flourish, and disease occurs very soon. Last year and this year we endeavoured to determine the right density of seed that we must sow on a given area of seed bed. These experiments have been checked at our station at St. Jacques, with this result, that we can say the proportion of seed should be about one-seventh of an ounce to one hundred square feet of seed bed. We have several times told the Quebec growers that their seed beds were too thick; but until now we were never able to demonstrate to them exactly the right amount of seed that must be sown. Now we have that data, and I think it will be very useful to the growers in both Quebec and Ontario.

I have brought, for your examination, two photographs showing the nature of our experiments on the seed beds of the Experimental Farm, and will pass them around. I consider they are the best tobacco seed beds that have been obtained in Canada up to the present time. The advantage of that kind of seedling is that instead of being obliged to make a selection at the time of the pulling out, you can pick the plants by the handful, and they all come sound, healthy and strong plants. This information will save time and probably money to the grower.

By Hon. Mr. Fisher:

Q. What is the name of that variety you were showing?

A. Comstock Spanish. It is one of the selections we made two years ago at St. Césaire, and the seed has probably been supplied by the Department of Agriculture.

Q. Mr. Fortier was distributing some kind of seed?

A. Yes. I gave to Mr. Fortier the address of the firm in Egerton, Wis., where we were in the habit of getting the seed, but now we try to distribute only Canadian seed, of which we have at present a very limited provision. Last year we had a very severe

We were obliged to buy some more seed from Mr. W. T. Pommeroy, but I do not think we shall be under that obligation any more.

By Mr. Dubeau:

Q. Do the growers generally know that the department distributes seed?

A. I am very glad you asked me the question. They should know it, but have experienced very much trouble with the Farmers Institutes in Quebec in that connection. We write to the President and Secretary of an institute for the names of growers who desire to be supplied with tobacco seed and we very seldom get answers from these people. I remember that last year I sent a pretty fair quantity of Comstock seed to St. Jacques l'Achigan, and the President of the Farmers Institute there was unable to distribute the whole of it; he has yet some of it in his possession. We make every effort to distribute throughout Canada the best kind of seed we can get, but sometimes the growers do not respond to our efforts.

By Mr. Douglas:

Q. Do you send out the seed free?

A. Yes. But we try to reach certain men in particular. With this object in view, we send the seed to the President of the Farmers' Institutes to be given to the best growers in the locality. Accompanying each sample of seed is a pamphlet containing instructions with respect to cultivation, unless such literature has been sent previously. In this way, we endeavour to make sure that the growers will obtain from the Department of Agriculture first class tobacco seed, and doubtless in a very short time, they in turn will be able to make a more abundant distribution amongst their neighbours. It was the idea we had at first. We have noticed, however, that the result has not been as we anticipated, and we shall endeavour hereafter to make a larger distribution. I have at hand the name of nearly every Canadian tobacco grower, and although the list is growing every year, we shall be able, probably before long, to send seed to every individual grower. I think that will be the best way.

I noticed long ago that very many of the Canadian growers have a tendency of trying every kind of tobacco of which they hear of. That is a great mistake. We have endeavoured to develop in the Quebec centres the production of the binder types. We did that in order to promote the cultivation of those types which ripen early and adapt themselves to the climatic conditions of that province. We have tried to check in Quebec the culture of the tobaccos such as Burley, Blue Prior, and such like. Some people claim we are not progressive enough, but probably, the question, if discussed, would result in a decision in our favour. If we can secure a good reputation for the tobacco grown at St. Césaire and St. Jacques and the manufacturers needing Canadian binders can secure the requisite quantity of tobacco of the proper quality, that would be a very fair success. If we could demonstrate that we can grow in Quebec every kind of tobacco from the Turkish to the Burley, it would doubtless make a very fine exhibit, but it would not aid the manufacturer who wants to get tobacco of a given type and who will not be able to secure it, unless conditions improve, because the amount so far grown is insufficient. Those who desire Turkish tobacco for cigarette purposes would not be able to find it in sufficient quantity, nor would those who require Burley tobacco for chewing purposes be any more fortunate. On the other hand, if we adhere to the varieties that are successfully grown in the most important centres—for example the province of Ontario, where the Burley is generally cultivated—the Canadian manufacturer in want of Canadian Burley will know that he has only to send to his agents in Kingsville and Leamington to obtain any amount of it. More than that, he is conversant with its quality and he can accordingly place an order with the grower.

As a result of a little pressure from some of the manufacturers, we tried experiments this year with Virginia tobacco. Some two or three years ago I was asked by somebody if the Department of Agriculture would assist him in such experiments.

When we undertake to do that, we generally ask that the results of these experiments be published all over the Dominion, not because we bear the expense, or part of the expense, but because it is necessary in the interest of the general welfare of the Canadian grower. The gentleman in question did not understand that point very well. So we had to let him alone and he started experiments, which, I must say have been successful.

For two or three years we have had in Ontario an overproduction of Burley tobacco. Some two years since, I tried, in order to check that overproduction, the cultivation of dark tobaccos. I call it by that name, but it is really a smoking tobacco good for cutting and smoking purposes and sometimes for binder. These experiments have not been successful. Many of the dark tobaccos produced in Ontario are generally of a stronger texture than the ones we can get in Quebec, and the flavour is not very agreeable; it is very strong and objectionable. Most of the Canadian manufacturers to whom we have shown these cigar and pipe tobaccos grown in Ontario have found them very much stronger than they want. But if we can discover a Virginia tobacco that can be raised in Ontario successfully, for instance in Essex county, to take the place of some of the Burley grown in that same locality, the overproduction referred to will cease and the Ontario tobacco grower will be able to get a better price for his Burley. We have a very large demand in Canada for that kind of tobacco and also for the Virginia tobacco.

In order to ascertain if the Canadian conditions were adapted to the growing of Virginias, two years ago I paid a visit to South Virginia and North Carolina. I inquired about the conditions of culture in that part of the United States and ascertained that it would be possible to make a very fair, if not a successful trial in Ontario. An experiment had been made by the growers of whom I spoke some time ago, and we endeavoured to get the same results so that we should be able in a very short time to publish them in the country and enable the Canadian growers interested in the culture of the Virginia tobacco, to have any and every information necessary to make of it a success.

I have here a sample of the tobacco we have obtained on our station at Harrow in Essex County. That tobacco was sold to the Dominion Tobacco Company a few weeks ago and realized twenty cents a pound. If that tobacco had been graded more carefully we would have been able to get twenty-five cents and perhaps thirty cents a pound. Somebody spoke at the beginning of the meeting in regard to cigarette tobacco. That (holding up sample) represents a sample of Canadian Burley which has been flue cured. We showed it to some Virginia people and their first statement was that it was Virginia tobacco. It is not Virginia tobacco, but Canadian tobacco flue cured at the experimental station at Harrow. That stuff could not have been graded properly and I must apologize to the committee for it. But we have been very busy this year, and my idea was to have it graded at the factory. In spite of the inferior quality of some part of our crop we have been able to realize twenty cents a pound, which means that the good tobacco alone would easily realize thirty cents as compared with eight or nine cents formerly paid for Burley tobacco. Mr. Clark who is familiar with the conditions in that neighbourhood will corroborate that statement. The price was only about eight or nine cents a pound in Ontario; and from these figures you can easily see the probability of a much better price for the grower by the cultivation of this tobacco rather than by the cultivation of Burley. But let me say this tobacco could not be raised on any kind of soil. One must select the soil very carefully, and I must say that the land on which that sample was grown is not the very best. Next year we shall probably test the same kind of tobacco on another plot of the station and will perhaps get better results. Probably some of you gentlemen who are experts in judging Virginia tobacco might examine this sample and decide for yourselves whether the results which we have obtained are not pretty close to what we are aiming at.

By the Chairman:

Q. What yield per acre would you get?

A. Of that Virginian tobacco? Last year on the station at Harrow we only got nine hundred pounds to the acre. I must explain, however, that we have an American expert there who was brought from Danville and we have not yet succeeded in making him cultivate the tobacco in Canada according to Canadian requirements. He wishes to follow the methods of cultivation with which he has always been familiar in his own country, although we tried to make him understand that in trying to raise Virginia tobacco in Canada the conditions are totally different from those districts whence he comes, and what we want is to determine which methods are the best for Canada. However, I think we shall be on a better footing next year and thus be able to secure better results. With respect to Ontario we certainly have every reason to feel satisfied with the progress so far made. We consider this tobacco can be placed in Canada with the Canadian manufacturer at a price ranging from twenty to twenty-five cents a pound.

By Hon. Mr. Fisher:

Q. That is the price to the grower?

A. Yes, the price to the grower for tobacco in that condition. This is Canadian tobacco (exhibiting sample), and the other is American tobacco flue cured.

By Mr. Douglas:

Q. For what purpose is this tobacco being used?

A. That leaf is generally used for wrappers if fine enough; when coarse for a filler. That is the reason we have been able to sell the coarser tobacco to the Dominion Tobacco Company as fillers for plugs. The texture is coarser; but this tobacco is able to keep the juice and flavour better and so make a good filler. We can sell that tobacco at a price ranging from twelve to eighteen cents a pound.

By Mr. Currie (Simcoe):

Q. Tobacco is sometimes dried artificially, but this tobacco has been sun cured?

A. No, that is flue cured. I take this opportunity of saying that some people in Quebec are urging the growing of flue cured tobaccos, which is practically impossible in that province. However, we shall probably start experiments in due course if we are obliged to do so; I am perfectly sure we cannot raise this tobacco in Quebec and cure it properly. The raw leaf has been obtained from a variety of Virginia tobacco which ripens in eighty or ninety days. This other variety (exhibiting sample) is a still later variety; we could not, even in Essex, get it to ripen in time nor cure it so as to give the proper colour. If we grow this kind of tobacco in Quebec we shall probably experience the same trouble that we encountered this year in Ontario and we shall never be able to get the rquired colour except in a very exceptional year. When we go in for raising tobacco we must be practically sure of the results; it is useless to work all the year long if we have not the means of growing a successful crop or have anything to fear from frost or cold.

Now I can show you something very special that we obtained last year on the experimental station at St. Jacques, by crossing Canadian Comstock and Sumatra. From this crossing we have obtained a tobacco that I think will replace all the varieties at present grown in the province of Quebec. This particular tobacco has given this year a yield of about 1,800 pounds to the acre, whereas the other varieties grown in the vicinity did not give more than 1,200 to the acre. It does not show up very well, the leaf seems to be very short, but we must keep to the Comstock Spanish that we can obtain in the same locality. Here is the Comstock from which that tobacco has been obtained. You can see that Comstock is a good material but a little

small. The leaf of the hybrid is gummy, strong and thin, but some year we hope to produce a leaf that will be very much broader, thinner and if not stronger, at least as strong.

Q. I should think that would make a good wrapper.

A. The Comstock and Sumatra make a first class wrapper, and we have been fortunate I think in getting with that hybrid a tobacco which is larger than either parent.

Q. Than either the Sumatra or Comstock?

A. Than the Comstock.

By Hon. Mr. Fisher:

Q. That is a cross?

A. Yes. It is a cross between the Comstock and the Sumatra made two years ago at St. Césaire. The most interesting feature is the texture of the leaf, it is very thin notwithstanding that the tobacco was grown last year on heavy soil. The great trouble experienced in Quebec is that when we plant a lot of tobacco on heavy soil the texture deteriorates and we have only an inferior product. We expect that tobacco will be more easily transplanted everywhere, and that it will probably yield a much better product than the Comstock Spanish as we have it now.

By Mr. Currie (Simcoe):

Q. In smoking that tobacco is it as bitter as the Sumatra?

A. It is bitter, but we hope that it will be less bitter than the Sumatra.

By Hon. Mr. Fisher:

Q. Will it sell for as good a price as the Spanish Comstock?

A. The hybrid variety?

Q. Yes.

A. I think we can sell it for twenty or twenty-five cents a pound. I shall probably be able to show you another sample which is a little drier. This one (exhibiting sample) will show the shape of the leaf better.

Q. That is a hybrid too?

A. Yes, the same. The advantage of that tobacco is that it ripens very early. We can crop that tobacco in about sixty or sixty-five days, and grow it more easily than any tobacco grown in Quebec. The colour is very fine; it is very even, and the tobacco can be cured in five to six weeks as compared with seven or eight weeks required for Comstock Spanish. That is a very great advantage for the Quebec grower who sometimes experiences frost early in the fall.

Q. Have you seeded that tobacco?

A. Yes. But unfortunately the supply of seed is very small. We shall probably try to make a large distribution in one or two years.

Q. You can grow the seed here, can you not?

A. Yes. We have shown the sample to manufacturers who are very pleased with the shape of the leaf and the texture. We were asked to supply them with seed, but unfortunately we could not do that as the supply is insufficient.

By the Chairman:

Q. Does the soil need to be as rich for the growth of tobacco as for grain crops or meadow crops? Take grain crops for instance, does it need to be just as good land for tobacco.

A. Yes.

Q. It needs to be just as good land for tobacco as for grain crops?

A. Yes, and probably better land. Tobacco needs a very light and very rich soil. I advocate the cultivation of tobacco in rotation and not continuous cultivation, although that has been done for years and years in the northern part of the province

example in some parts of Montcalm, Joliette and l'Assomption—is the poor cultivation of the soil. The growers considered that the soil was inexhaustible and never made any return of the principals taken from the soil. Then we began our experimental station at St. Jacques. I do not know whether it is a matter for pleasure or regret, but I do not think that the land there is in any better shape than on the neighbouring farms. However, I hope we shall be able by proper rotation to place that little farm in better shape than it is at present and make a good showing for the benefit of the tobacco growers. We have been scarcely able to obtain at that station this year a yield of more than a thousand or twelve hundred pounds of Comstock to the acre; whereas at St. Césaire in the same period we were favoured with a yield of from 1,400 to 1,600 pounds to the acre.

By Mr. Sprouple:

Q. Have you tried growing tobacco on small plots?

A. Our smallest plots are an acre.

Q. That is a fair test?

A. A test could be made on a larger scale of course.

Q. How would those Quebec yields compare with what you get at Leamington?

A. In Ontario the conditions are practically the same as they are in Quebec, but in the former province we have to deal with a special disease due to some peculiarity of the soil I should say. I have noticed for two years past a patch where Burley cannot be grown any more. Burley was grown there for years and years until the land tired of it. We tried some cigar tobacco on the same land and it yielded us a good crop. Thus you see instead of growing Burley forever on the same land, if other varieties are cultivated satisfactorily crops can be raised. In the province of Ontario I would suggest that we should grow Virginia as well as Burley, but in rotation with other crops. We consider in Quebec the best rotation to be tobacco, cereals and clover; in Ontario by reason of the importance that is given to the cultivation of corn, a rotation including corn would probably be better. At the experimental station at Harrow we are endeavouring to establish a rotation of three years, but part of that station will have to be devoted to rotation of four years. Then we shall be able, in a very short time, to tell the grower which one of these rotations gives the best results. We do not want so much to obtain very large yields as to maintain the fertility of the soil. We consider that if the fertility of the soil is impaired it will not yield the same amount of crop; we must endeavour to get the best results possible and still maintain the fertility of the soil.

By Mr. Sealey:

Q. Would the ordinary rotation in preparation of the soil for roots be suitable for the cultivation of tobacco?

A. Yes, but most of the soils suitable for roots are not adapted for tobacco.

Q. You can make a successful crop of roots on a comparatively heavy soil. Of course the land itself requires to be high?

A. Yes, you cannot raise any good crop on low swampy land. You must get land that is well drained with rather light soil.

By Mr. Currie (Simcoe):

Q. A sandy loam?

A. The best soil for any kind of tobacco is a sandy loam.

By Mr. Sealey:

Q. Was your estimate of $120 and $150 the net profit?

A. That is the net profit for the last year. I hope that the results obtained by the Canadian growers in St. Cesaire last year will be maintained. I think it can storm on the 8th of July at St. Jacques, and the greater part of our field was spoiled.

be with a little effort. It is a question of organization amongst the growers and probably co-operative associations would be very helpful in promoting that result. Until now the yield has been very much smaller than the figures I gave.

Q. I would like to be sure as to whether the $120 to $150 was the total receipts or the net profits?

A. I consider that to be the net profits realized by some growers. Successful farmers that have been able to sell their tobacco crop at a price ranging from twelve to fifteen cents a pound must have realized that net profit per acre in St. Cesaire last year.

Q. What do you mean by net profit?

A. The net result after all expenses have been paid.

Q. The expense of labour and seed?

A. Yes, after the expense of labour, seed and everything has been paid.

Q. It would certainly seem to be the most profitable crop. Would it be practicable for you to grow the plant from seed at the experimental farm and send out a quantity to each county that would undertake the cultivation for an experiment?

A. I think every county can grow the seed under supervision of the president or some member of the Association of Growers. There is sufficient interest now manifested in the cultivation of good seed to warrant the inference that every grower in the association would pay special attention to the matter and look especially after the culture. Thus they should be able to select the best tobacco field in the locality and if necessary recoup the owner of the field for all the expense to which he has been put by reason of cultivating a special character of seed. It would I think be a very good way to proceed.

By Hon. Mr. Fisher:

Q. What Mr. Sealey asked you was whether you could grow seed here and send the plants over to the country.

A. The seedlings?

Q. Yes.

A. No; that is not practicable. It is no more practicable than the idea which prevailed at one time that one could grow tobacco in a parish and then hang that tobacco in another part of the same parish and have somebody to supervise the curing of it. It is not work that can be handled and carried on at a long distance.

By Mr. Sealey:

Q. I know of one family that have been carrying on the cultivation of tobacco every year for years and years. The practice has never spread to any other family in the county; although I believe it would be profitable if it were generally carried on. I would like to see the farmers encouraged in this matter; but to get seed, and make a hot bed, and then grow plants is seemingly a more troublesome operation than the average farmer would care to undertake. He might, however, make a success of it if he were provided with plants as in the case of tomato or strawberry plants.

A. We cannot do that. Tobacco is very sensitive, and if we do not transplant the seedlings under the most favourable conditions they are liable to contract disease. We have to exercise great care with the seedlings at the time of transplanting.

By Hon. Mr. Fisher:

Q. In other words the seedling must be grown on the same ground as that on which it is sown?

A. On the same spot where the tobacco is grown. Of course there are exceptions. You can get a few seedlings from Quebec to Ottawa, but on the whole a scheme is impracticable.

By Mr. Sealey:

Q. The average farmer in Quebec grows his own tobacco?

A. Yes. That is the only way I think.

By Mr. Sproule:

Q. Could you give us the quantity of tobacco that is produced in Ontario, as compared with that raised in Quebec?

A. I cannot supply you with accurate figures. We have no statistics of that character, and furthermore the amount of tobacco grown in Canada varies every year. Two years ago we practically had no tobacco crop.

Q. And some seasons it is a failure?

A. Some seasons it is a relative failure, owing to climatic conditions; but sometimes the growers stop cultivating tobacco because the price does not seem to be fair to them. That is what occurred in Ontario two years ago.

By Mr. Sealey:

Q. I understand you to say that last year's crop in Canada saved the country half a million dollars that would otherwise have gone to the United States for the purchase of leaf tobacco?

A. Yes. I know that one million pounds more of Canadian tobacco was manufactured in this country last year, or perhaps a little more, and a decrease to a like amount has taken place in the imports from the United States, which means a difference of two million pounds. Taking the value of that tobacco at twenty-five cents a pound, which we have to pay for the good Wisconsin binders, you have a total of about half a million dollars, anyway.

By Mr. Robb:

Q. Does the average farmer, and especially the French-Canadian farmer, grow enough tobacco for his own use?

A. Yes, he generally grows enough for his own use.

Q. You are not including that tobacco in the statistics which you gave?

A. No.

By Mr. Currie (Simcoe):

Q. Have you any statistics that would show to what extent Turkish tobacco is cultivated in this country?

A. No. Some people in the province of Quebec are interested in that tobacco. I must say that the sample shown to me of Turkish tobacco grown from a Russian variety imported into Canada two or three years ago did not seem to me to be very satisfactory. I am aware that the director of the Imperial Tobacco Company is now engaged extensively in its cultivation; but I am not very hopeful as to the good results that we can expect from the cultivation of this tobacco. I had an inteview with Mr. Davis on that very subject about a month or a month and a half ago, and I do not anticipate any very substantial results from their experiments. Turkish tobacco is a very small yielder, and considering the price of labour in Canada, I am very skeptical about any adequate return in money such as will compensate the grower for his outlay.

Q. Turkish tobacco is very highly flavoured, is it not?

A. The flavour of that tobacco is very high, but the question is, can we get in Canada the same flavour that is obtained from cultivation in Turkish or Russian soil at an adequate price?

By Mr. Burrell:

Q. Have you any information as to what they are doing with respect to the cultivation of toabcco in British Columbia?

A. I endeavour to keep in touch with tobacco in that province, and have been there on two occasions.

Q. You say you have visited that province twice?

A. Yes, two years ago. Last year I could not go to British Columbia owing to pressure of work in Quebec and Ontario. I was too busy at the time. I endeavour to keep in touch with the people in British Columbia and am very sorry that I have not been more successful in that respect lately. Two years ago we got from British Columbia some very nice samples of Kelowna-grown tobacco. Since then I have received another sample of Kelowna tobacco, and it appeared to be very much stronger than formerly. I do not know whether it is due to some defect in the sweating process or because it was from an inferior crop. At any rate, I do not find the product which was sent to me a year ago as good a tobacco as that which I had the pleasure of submitting to the committee two years ago.

Q They are growing quite a lot of tobacco in that province now?

A. I do not think the output has been very materially increased. According to the last information I was able to obtain, they have only about forty-five or fifty acres under cultivation. That area is absolutely insufficient. If they could restore to this Kelowna tobacco its former quality, not forty-five, but five hundred or one thousand acres should be devoted to its cultivation.

By Mr. Currie (Simcoe):

Q. What is the quality of this Kelowna tobacco?

A. I would say that it represents about a second grade of Havana filler.

By Mr. Burrell:

Q. Are they not producing out there a finer leaf suitable for wrappers by cultivating under cheese cloth?

A. That was tried under the supervision of our department, but I must say that it has been a failure. We were very strongly pressed in the matter and I could not refuse to accede to the request to make experiments under canvas. I was practically sure before we started that the experiment would be a failure and certainly it has not been the success that its promotors anticipated.

Q. I am told that this year, it has been a success?

A. I should like to know the price at which that tobacco has been produced. They have made a success of that method of culture in the United States, especially in Florida and Connecticut, because they have a protection of $1.85 on the imported Sumatra leaf. We have not the amount of protection in Canada that would enable us to produce, with profit, under canvas a tobacco which would represent a cost of about forty-five to fifty cents a pound and would not be very much better in quality than the hybrid variety that I showed you a few minutes ago.

By Mr. Currie (Simcoe):

Q. It would be pretty hard to beat the latter?

A. Yes, I think it would. We can grow the tobacco at a cost not exceeding six cents a pound, whereas the tobacco produced under canvas would represent a cost of at least thirty-five or forty cents a pound. Therefore, from an economic standpoint, the result of growing tobacco under canvas is not to be recommended in Canada. This hybrid tobacco is grown in Quebec on heavy soil and next year at St. Césaire by renewed experiments, I hope we shall be able to still further improve the quality.

Q. Would not a wrapper from such tobacco with a filler of Kelowna make a very good cigar?

A. I think so. I am of the opinion that we have in Canada the kind of tobacco required to make a good average cigar, I mean a cigar costing ten cents. I think the Canadian filler is at least equal to the filler we imported from Connecticut and Pennsylvania. I have here a sample of filler that certainly possesses a flavour quite as good as that from Pennsylvania. This filler was grown at St. Césaire two years ago.

By Mr. Burrell:

Q. Do you think they have the soil conditions for the successful cultivation of tobacco in British Columbia?

A. Yes, but there is no permanent water supply. That is a great drawback.

Q. But they have irrigation out there by means of which they get a supply of water?

A. Yes, but it does not give the same results as a good timely rainfall.

Q. They have constant irrigation there?

A. Yes, but it is not the same thing at all. Irrigation never gives the same good results as a natural rainfall. The best way to irrigate a tobacco field is to have a rainfall every week or fortnight; than is the very best system of irrigation that you can have.

By Mr. Robb:

Q. In other words you consider that the leaf requires a great deal of moisture?

A. Constant humidity in the soil and in the atmosphere; you cannot obtain that constant humidity from spring irrigation. Part of the time, it is too much water and the rest of the time, it is not enough. That is the great objection I see to irrigation. Of course, it is the only way they raise tobacco in Kelowna and we must try to make the best of it.

By Mr. Currie (Simcoe):

Q. Have we not in Canada the kind of tobacco which would enable us to produce a good stogie cigar?

A. I think we could make a good stogie cigar by using the large leaf, already shown to the committee. In my opinion, we shall easily be able to produce good stogie cigars in Canada. When the time comes that we can manufacture a first-class cigar, we shall always be able to turn out a second class article. For the stogie, we shall be at liberty to use that kind of tobacco (exhibiting sample). They could use that when sweated, either for a binder or filler. That is a very light variety. I do not think the percentage of nicotine in that tobacco is two per cent, whereas the average percentage of nicotine in Canadian tobacco is rather high. It generally runs from three to five and in some tobaccos to six and six and a half per cent. One objection to the Kelowna is its high percentage of nicotine. The Kelowna has a very good aroma but is only adapted to strong cigars.

Q. Could that nicotine not be sweated out?

A. The sweating diminishes the percentage of nicotine to a certain extent, but I do not think the diminution would be more than a half per cent.

Q. Could it be diminished by steaming?

A. I do not think so.

Q. In South Africa they steam very strong tobacco to get rid of the nicotine.

A. I come from a country where they have tried in every way to get a light tobacco. When we had a very strong leaf, we sometimes put it in water for a short time in order to expel most of the percentage of nicotine; and I must say that all those processes generally gave very indifferent results. There is this drawback that you cannot maintain the texture and the aroma of the leaf when you do that.

Q. Those processes rob the tobacco of its aroma?

A. Yes, most of the time.

Now, gentlemen, I did not come here to make a very elaborate speech. I am somewhat at a loss when I undertake to speak English and it would be more convenient for me, if you would question me upon any point as to which you desire more information. I have come prepared to give you information with respect to our work at the experimental stations as well as the methods of manufacture. Of course, we are not responsible for all the progress that has been made of late, but I claim that we have taken an active part in the improvement of methods of manufacture and that

has enabled us to exhibit a product greatly superior to the article formerly marketed. I have heard of one Canadian manfacturer who made considerable money last year by handling Canadian tobacco, that gentleman has rendered us very great service indeed because he was the first to enable us to turn out such a good article. The tobacco to which I refer could be exported, if it were not a question of price, and sold anywhere.

By Mr. Sealey:

Q. Could not something be done to draw the attention of the people more definitely to the advantage of growing tobacco; would it not be possible to get experimental plots in Canada?

A. Yes, but experiments carried on in that way are very expensive. We tried that two years ago. We had a list of growers to whom we sent directions and who were to work under our supervision. Of course, this involved a bonus. Everybody was willing to get a bonus, but when it was a question of work, nobody would undertake it. However, we sent directions to the growers and invited them to follow them out as closely as possible. The bonus was but small, amounting to a little more than twenty dollars, but to speak frankly, I must say that the work done was quite useless. When we sought for the results of these experiments we were hardly able to obtain any accurate information and sometimes the plots for which a bonus had been paid were found to be the poorest in the locality. Se we gave up that system and established larger stations in the most important centres, thinking that by the distribution of samples of tobacco obtained on those stations, and by making known the results obtained, we should be able to build up tobacco culture in Canada and meet its requirements, at very much less expense.

By Mr. Cash:

Q. Do you know anything about a variety of tobacco which certain Poles and Hungarians are raising in Saskatchewan?

A. I never heard of that tobacco. I am in touch with a few people who started to grow tobacco in Saskatchewan and Alberta and endeavoured to get samples, but did not succeed.

Q. I will send you down some.

A. Thank you very much. We receive letters sometimes from people throughout Canada who want to be encouraged in the cultivation of tobacco. I know by experience—and some of you know also—that tobacco cannot be grown everywhere; it requires a good soil and a good climate. In many parts of Canada the climate is too cold or the season too short and tobacco cannot be grown successfully. Sometimes the soil is not suitable. We have plenty of heavy soil which, however, is not adapted to the successful cultivation of this plant. Certainly, you could raise a crop, but the product would be so poor that you would not be able to find a market for it. A grower may cultivate such tobacco for his own consumption, but to place such a product on the market would be a very poor speculation; that man would be better employed in raising something else than tobacco. When I get applications of that kind I ask my correspondent to make a trial on a very small scale and to send me a sample of the product which he raises. I presume that in the majority of cases the product is poor, because no samples come to hand.

By Mr. Currie (Simcoe):

Q. The tobacco is so good he keeps it himself.

A. Very likely.

By Mr. Henderson:

Q. Do you maintain that you will ever be able to produce in Canada tobacco with a flavour and taste similar to the Macdonald tobacco which is turned out in

Quebec and which I understand is practically, if not absolutely, made from American leaf? The great objection to French Canadian tobacco is its aroma and flavour, and in a part of the country where I reside, we do not want to smoke tobacco with such peculiarities.

A. With regard to the cigar tobacco—

Q. I am speaking more of smoking tobacco. There is no doubt good cigars can be made from Canadian tobacco, but are you able to produce, by any process of curing, a tobacco which will assimilate in taste and flavour to the Macdonald tobacco of Montreal, which is used so extensively all over the country?

A. When we speak of manufactured tobacco, we cannot impart to the Canadian manufacturer the process used by Mr. Macdonald in turning out his tobacco. We do not know that process, it is a secret of the firm, they keep it as close as they can. If a manufacturer obtains a special flavour, the other manufacturers have to try to find out what that flavour is if they can and reproduce it in their own tobacco. Some manufacturer may be cleverer than his competitor, but we cannot say that, because a certain manaufactured tobacco—the Macdonald tobacco for example—is better to the taste than another, the raw tobacco used by that manufacturer is superior to the one used by the other. Then the question of individual taste is to be considered. You can smoke a very bad tobacco and when you are used to it find it to be the best tobacco in the world. Under the circumstances, it is impossible to answer your question very definitely. We must say that the Canadian tobacco must have a very good quality, otherwise we should never have seen the Imperial Tobacco Company, for instance, establish so large an industry in this country and spread its products manufactured from Canadian tobacco all through the Dominion. Furthermore, another factory was started in Quebec six or seven years ago with a very small capital and is now doing a very large business.

By Hon. Mr. Fisher:

Q. Do they use Canadian tobacco?

A. Practically, most of the tobacco they use is Canadian.

Q. And the Imperial Tobacco Company also?

A. The Imperial Tobacco Company use plenty of Canadian tobacco, although, of course, they import some. Mr. Henderson referred to Mr. Macdonald's tobacco. Two years ago, I was travelling in South Virgiania and I spent a week at Danville. I was inquiring into the cultivation of American tobacco and here and there I heard references to Mr. Macdonald. I do not know that gentleman at all and I cannot speak of his product because I do not chew, and most of his tobaccoes are chewing tobacco, or at least plug, but I found out that he has in Danville, and in some other places in the States, very large warehouses from which he imports most of the tobacco which he uses in Canada. Now, the tobacco that we use for the production of Canadian tobacco is Burley and we cannot make a comparison of the Canadian Burley with the Virginia. Mr. Macdonald probably uses some Burley but mostly manufactures Virginia tobacco. Thus, we should have to make a comparison between Virginia and Burley, two different tobaccos raised in two different soils and cured by two different processes. As you know, the Burley is air cured and the Virginia flue cured. That perhaps explains the difference in taste between the Macdonald tobacco and the Imperial Tobacco Company's process.

By Mr. Cash:

Q. As I understand, the peculiar taste of the Macdonald tobacco depends upon the flavouring put in?

A. Yes, mainly, and the nature of the tobacco that is used. Mr. Macdonald uses plenty of the Virginia tobacco, whereas the other manufacturers take mostly

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Burley. You can notice the flavour which curing imparts to the tobacco, a very special flavour, and that is the flavour you probably notice in the Macdonald tobacco.

Q. Is there anything put in to improve the flavour peculiar to Quebec tobacco?

A. I do not find that the flavour of the Quebec tobacco is objectionable. When these tobaccos are properly handled, they make a very fair product. This is a Canadian tobacco (exhibiting sample) and you cannot notice any bad flavour. On the other hand, here is another tobacco which has quite a good aroma.

The CHAIRMAN.—The facts which Mr. Charlan has given us this morning, show clearly the possibilities of development in the production of tobacco in the Dominion of Canada, and if we can produce ourselves the tobacco required in Canadian factories, rather than import that tobacco and send the money to our neighbours on the other side of the line, it will mean the addition of a great asset to our resources. The fact that there was consumed in our factories last year at least half a million dollars worth of tobacco that used to be formerly purchased from the United States, indicates the large possibilities which exist in this direction.

Hon. Mr. FISHER.—I desire to compliment Mr. Charlan on the fact that he is able to address this committee in the manner in which he has in English. It is always difficult for a beginner to speak in a foreign language, and your remember that four years ago, Mr. Charlan came to Canada ignorant of a single word of English, it is greatly to his credit that he has been able to give evidence as he has done this morning.

Witness retired.

Committee adjourned.

Certified correct,

F. CHARLAN,

Chief of Tobacco Division.

SWEDISH METHODS OF CROP IMPROVEMENT.

HOUSE OF COMMONS,
COMMITTEE ROOM No. 34,
WEDNESDAY February 23, 1910.

The Select Standing Committee on Agriculture and Colonization met this day at 11 o'clock a.m., the Chairman, Mr. M. S. Schell, presiding.

The CHAIRMAN.—Gentlemen, we will now come to order. We are pleased to have with us this morning Mr. George H. Clark, Seed Commissioner, Department of Agriculture, who will give us an address on the topics outlined on the order paper which has been given to you. It is not necessary for me to make any remarks in regard to the importance of high-class seed, so I will just call upon Mr. Clark, who will now address you.

INTRODUCTORY.

Mr. CLARK.—Mr. Chairman and Gentlemen, the testing of seeds and seed selection has for its object the improvement of our farm and garden crops. Part of the work is technical in nature. It has been carried on by the Seed Branch only during the past ten years. Work of a similar kind has been done in the old world, particularly among the Pan-Germanic peoples, during the past forty years or longer. We have profited from the experience of the experts in Germany, France and other countries who have spent long years at that work. We have had occasion frequently to correspond with them and we get some good information too from their bulletins. Last year our minister gave his approval to my going over to Europe to visit those seed control stations, to see their work at first hand, and to discuss our difficulties and our successes with the men whom I thought I was fairly well acquainted with by correspondence.

EUROPEAN COUNTRIES VISITED.

I was absent from Ottawa nearly three months—July, August and September. I spent about three weeks or a little more in England and Scotland; only a few days in each of Holland and Denmark; nearly a week in Sweden; about fifteen days in the principal seed-growing centres of Germany and France, and about three days at the large seed control station at Zurich, in Switzerland. I obtained a good deal of information that was useful to us in our work. In Liverpool, London and Hamburg I was able to get a pretty fair knowledge of how and where the red clover and alsike seed which we export from Canada reaches the consumer. We export annually about one million dollars worth of clover seeds.

On the continent of Europe the work in seed control is interesting. I was able to get information in the seed testing laboratories at Hamburg and Zurich of much benefit to us. As a result, we have installed some new apparatus and are making good use of the information gathered.

I would like at some future time to address this committee on the question of our supplies of field root and garden seeds. Nearly all our field root and garden seeds are imported from Germany and France. But I would prefer to have that subject left

over to another year. I desire to get some more definite information concerning it. For the present I will only say that I visited, in the large seed growing centres, quite a number of seed farms ranging from 1,000 to 6,000 acres each, and also many quite small farms where they grow seeds for commerce. The seeds of mangels, carrots and other field root and garden crops grown on the small farms are marketed by the small farmers as our farmers in Ontario market their clover seeds. It is only the large seed growers that are able to give any definite guarantee as to kind and vitality of seeds. I saw some high class stocks being sown in Germany and France. I saw too a great deal of seed which I hope and believe will not come to Canada. We do not get the poorest seeds grown in Europe, and I am sorry to say that we do not get the best.

By Mr. Blain:

Q. Why don't we get the best?

A. The high class stocks of seeds are sold wholesale by the large and best growers at a higher price in Europe than is charged for the average quality delivered in Canada.

A matter that impressed me more than anything else in Europe was the clean culture and excellent grain and grass crops, the intensive system of farming, and the great care taken by the Germanic people in the use of the highest class of seeds. They distinguish sharply between grain and seed grain. Practically all the seed grain used by the farmers of Germany, Denmark and Sweden is grown and selected specially for that use. They would not think of using commercial grain, as our farmers do. They could not afford to do so on their expensive land.

By Mr. Kidd:

Q. Is that the average farmer?

A. By the average farmer; yes.

By Mr. Jameson:

Q. How long have they followed that course?

A. They have been following it more intensively during the last ten years, but the work of seed selection was started there fully thirty years ago. The method of selecting seed grain in Germany has been modified during the last few years.

By Mr. Thornton:

Q. Does each farmer grow his own seed?

A. No; the selected seed is grown by farmers who make a specialty of growing it. The smaller farmers will buy a few bushels and use that on some of their best land, take the crop from that and use it again, and perhaps for three years, before they go back for another supply of selected seed.

By Mr. Blain:

Q. May I ask, are there not natural and climatic conditions which would cause them to grow better seed than we do in Canada?

A. No. Our climate and soil are superior to what they have in either Germany, Denmark or Sweden. We have an exceedingly good climate for most grain crops. Perhaps not in all of Canada, but in the greater part of Canada, we have a favourable climate for growing a high quality of seed grain.

By Mr. Thornton:

Q. Does their system of selection and growing go on under government supervision, or do the farmers do it among themselves, without any compulsion or legislation?

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A. It is done by the farmers themselves who make a specialty of seed growing. The German Agricultural Society assumes to inspect the crops of their members, which are grown for seed, and issue certificates showing the quality of the seed as it has been inspected growing, similar to what we do in connection with the Seed Growers' Association.

The care and cultivation of the land in Europe—how they utilize their land to the very best advantage—contained for me a good deal of encouragement, because I now more fully understand our immense natural resources in agriculture and can more clearly see the scope for improvement, which I hope to see brought about during the next twenty-five years. In almost every part of Canada you may see evidences of waste due to careless practices, and I do not know where you will see greater waste than in weed growth. The weed growth has been increasing, but it is gratifying to a person who has been endeavouring to stem that increase to see, in a country as old as Germany, where they have had their difficulties with weeds in past years, that they have succeeded at last in getting their land practically clean.

CONDITION OF AGRICULTURE IN SWEDEN.

The little country of Sweden, which is far to the north, contains the best object lessons which I think can be found in the world in the matter of the benefits that accrue from seed selection. The progress that has been made by Sweden during the last thirty or forty years is remarkable. You will see by the location, on the map hanging before you, that Sweden lies north of the 55th parallel. The south of Sweden contains the best of their agricultural country, although they have some agriculture almost to the Arctic Circle. They grow six-rowed barley, black oats and grass crops in the north. The principal agricultural country, however, is south of latitude 60. I travelled only in the province of Skëne, in the southern part.

Perhaps I might briefly refer to the agricultural conditions which obtained in Sweden some years ago. Many years ago a great deal of their agricultural land was held in estates. During the '80's large numbers of their agricultural population emigrated to the state of Minnesota. Thirty years ago the kinds and varieties of their common grain crops were not well fitted to withstand their severe climatic conditions. Sweden is a storm-driven and rust-ridden country. They had paid very little attention to the matter of variety, except in the southern part, and the crops were susceptible to lodging and rust. They lost heavily on account of those two factors. Forty years ago, Sweden ranked low in yield per acre among the countries of the world. They now have altogether in Sweden about 9,000,000 acres of cultivated land. Where they had formerly the large estates, they now have the land divided up into some 340,000 farms, or an average of about 25 acres to each farm. Sixty-six per cent of those farms consist of between five and fifty acres. At the present time fully fifty per cent of their population is living on the land. Each of those farms, taking the average, supports a family of seven people. In the south of Sweden we find intensive agriculture carried to its perfection. There is no waste. You can hardly find in the south of Sweden, among any of the farmers, what we would call careless practices. They make the best use of the land they have. They have no pasture land—as we would consider pasture land—and they have no farm fences. They told us they could not afford to use their land for pasture. The land is valued at from $150 to $400 an acre, according to quality and location, and we did not see in the south of Sweden what we would consider 'good' land, as we understand it in Canada. It has been made good by careful cultivation, proper rotation of crops, the keeping of dairy cattle and swine, and artificial manure.

By Mr. Best:

Q. How do they keep the dairy cows the year round?

A. They are largely kept in the stables. I have some photographs here that will

show you a field with dairy cows that are being fed tethered; the herd is ranged along two sides of a field and are eating their way through a green crop of peas, oats and vetches.

In Sweden, above all other countries, they have brought to a high state of perfection the work of growing and selecting seed grain and other seeds. At the present time, Sweden ranks among the first five European countries in the yield of grain per acre. Considerable areas of their grain are grown far to the north, much farther than we are growing grain in quantity in Canada. If we take the south of Sweden alone, where the climatic conditions are not dissimilar to those of the north of Scotland, except that they do not get the same benefit from the Gulf Stream as they do in Scotland, the average yield per acre of their principal crops is second only to Great Britain.

HOW IMPROVEMENT WAS MADE.

How Sweden has brought about this transformation in the condition of her agriculture is an interesting study. The nation learned fully thirty years ago that agriculture, which had been somewhat neglected, was the most potent factor, the mother industry, in the life of their people, and the one which must be considered first. They gave agriculture more attention. They undertook what they called a re-parcelling of the land. It is not for me to discuss—in fact, I don't know—how that re-parcelling was brought about. The government gave liberal appropriations for agriculture, even to the extent of fifty per cent of the money required by agricultural organizations for progressive educational undertakings. They established what they call 'People's High Schools' throughout the rural districts. In those advanced schools they teach, among other subjects, the English and German languages and the various branches of science in their relation to agriculture. Those schools are calculated to give instruction of direct benefit to the boys and girls who live on farms and who are between the ages of twelve and twenty years. The training given is quite similar to the training I received during the first two years I was at the Ontario Agricultural College. They now have forty-six of these schools in which agriculture is taught scattered over the 9,000,000 acres which they have under cultivation. Their agricultural education is made easily convenient to the people who live on the land. Those schools of agriculture have been one of the strongest forces in raising the standard of intelligence of the Swedish farmers, making them more contented and progressive at home and bringing their agriculture up to its present high standard.

Prof. C. C. James, Deputy Minister of Agriculture for Ontario, accompanied me on a visit to one of their high schools at Svalof. We found it equipped and manned quite as well as any of our high schools in the cities or towns of Ontario or Quebec. They have about an acre and a half of land connected with the school and on this land they have demonstration work for the pupils.

By Mr. Robb:

Q. Are those schools for agricultural education exclusively?

A. They are high schools for the farmers. They are located away from the towns.

By Mr. Staples:

Q. What about their financial support? How are they supported?

A. We were told that half the cost of maintaining the schools was raised by the people themselves and the other half voted by the Swedish government.

By Hon. Mr. Fisher:

Q. Are they the regular high schools?

A. They are regular high schools, but the science of agriculture is the principal subject taught in the greater number of them. They are high schools for the farmers.

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In the high schools for the towns and cities, which I did not visit, the subject of agriculture is supplaced by technical instruction, which is modified according to the industries in the centres where they are established.

THE WORLD'S MOST FAMOUS SEED BREEDING STATION.

The world's most famous seed breeding station is located in Sweden, at a place called Svalof, which is about five hours' run by boat and rail from Copenhagen. It is the only station in the world, I think, that is devoted entirely to the improvement of crops. The administration and station work is divided into two sections, one for scientific and one for commercial work. The scientific staff is composed of Dr. Nilsson and five specialists, together with their assistants and some laborers. Each devotes all his time to the study of one, or, at most, three kinds of their common field crops. Dr. Nilsson himself, with an understudy, works with wheat and oats, Dr. Witte with grasses and clovers. Another specialist gives all his time to the selection of rye, which is one of their important crops, another to the improvement of barley, peas and vetches, and still another to potatoes. The scientific staff has about forty acres of land and receives a subsidy from the Swedish government to the extent of fifty per cent of the expenses. By their processes of selection they produce new strains or varieties from year to year, each of which is an improvement, for certain of their soils or localities, over any they previously had. When they have increased the quantity of seed of the best sorts to ¼o acre plot, they hand over the new selections of seed to the General Swedish Seed Company, which has 5,000 acres of cultivated land, of which 1,500 acres are at Svalof, surrounding the experiment station grounds.

The seed company takes those small lots that are produced by the experts and increases them in quantity, until they have 100 acres or more of pure seed of these new selections. They then sell the seed to the farmers at a reasonable price. When that seed breeding station was established in 1885 it was intended to do the work of seed selection that had been followed in Germany for a number of years; it was expected to overcome the conditions they had to contend with, because of which large quantities of their grain crops were lodged. It was the lodging and the rust of their grain crops which reduced the yield and made farming unprofitable. Prof. Nilsson, when he commenced, followed the German system of seed selection. The Canadian Seed Growers' Association adopted the German system of selection. When Prof. Nilsson commenced in 1886, he selected the best heads from the crops they then grew in Sweden, as well as procured new sorts from other countries. He continued that system of selection from 1886 to 1905 and obtained some very good results, so far as purifying the seed and increasing the yield of their common sorts was concerned. But he made little gain of any kind with Chevalier barley, which had been bred by Hallett of England from a single plant; and he was wholly unable, by that method of selection, to get new sorts that would resist the storms and rust. By that method of selection our farmers have been able to purify their seed and obtain material gain in yield per acre during the first three or four years; but the main benefit they derive from continued selection of large heads of wheat, oats or barley, after their seed is once pure, is in maintaining its purity.

METHODS OF SELECTION NOW FOLLOWED.

In 1892 Dr. Nilsson commenced to base his selections on an individual plant. He went to those fields where the crops had been driven down by storm and were badly rusted, and selected only those plants which had shown their ability to resist the storms—only those plants which showed that they had a stronger straw and which were comparatively free from rust. He would take the good grain from each plant and sow it in a row by itself. I saw at Svalof about 150 of those rows of wheat, each

about seven inches apart, the object being to reproducee field conditions as nearly as possible. When the grain is nearly ripe he is better able to judge of the value of the plants he had selected by the individual rows, each being the progeny from a single plant of supposed merit, and from the individual rows he selects only two or three that prove to be the best and give promise of earliness, high yield, strong, rust-proof straw, and good quality of grain. All the good seed from these selected rows is used for increase on larger plots, from which he makes determinations as to the yield and tests the grain for brewing or milling purposes. When he has found a new sort that will be better for the farmers of Sweden, or any particular district in Sweden, than anything he had before, he hands it over for increase to the General Swedish Seed Company, whose growing crops he also inspects. By this process of selection Nilsson and his staff have been able to increase the yield of grain crops in the south of Sweden by fully thirty per cent.

By Mr. Thornton:

Q. How many years would he be selecting that way before he handed them over?

A. From the crop produced by an individual plant to ten acres of wheat requires five years.

We have always thought that our wheat, oats and barley were naturally self-fertilized. Dr. Nilsson made clear to me that he had found during the process of his work a goodly number of these plants that acted as hybrids, and under conditions that made clear to him that they had been cross-fertilized naturally in the open fields from which the selections had been made. The scientific staff at Svalof does considerable artificial crossing of varieties and intends to continue that work in the hope of constructing in one individual plant, characteristics that may not be discovered in a single plant as produced in nature. But Professor Nilsson frankly stated to me that artificial crossing was an uncertain and slow process of bringing about crop improvement when compared with using the abundance of material provided by nature and available to the specialist, whose most difficult task is to discover these individual plants of outstanding merit, which he calls 'mutants.' I do not believe that in Canada we can hope to get thirty per cent increase from the adoption of Nilsson's methods, because we do not suffer to the same extent that they did from the lodging of our grain crops. During the past ten or fifteen years our farmers have been able to get varieties that are stronger in the straw. Probably only ten per cent of the increase obtained in Sweden is due to productiveness alone. The increase obtained was largely due to the ability to select varieties stronger in straw and of greater rust resistance.

THE WORK WITH GRASSES.

The work of Dr. Witte with grasses and clovers was one of the most interesting pieces of work in plant improvement I think I have ever seen. He had timothy selected for sandy soil, timothy for clayey soil, and timothy specially suited for pasture land. His selections of timothy were markedly better than the grass we know by that name here in Canada. If the selections of grasses they now have in Sweden were suitable for growing in our soil and under our climatic conditions and would give the same results here, they would be worth hundreds of thousands of dollars by reason of the increase in yield and improvement in the quality of our grass crops. He selects grass plants from fields, along roadsides, or any place where they have been reproduced in nature for many years, cuts off the top, digs up the roots, and puts them in his vasculum; he transplants them into his breeding plot, studies them from the standpoint of a botanist, and then increases the best of them by root divisions and transplanting. He cannot use the seeds as the grasses cross-

fertilize naturally. From the larger plots so increased he makes comparative determinations as to yield and quality of hay, and finally transplants the superior new varieties into an isolated place and there increases them from the seed.

BREEDING AND SELECTION OF CLOVERS.

He has perennial red clover. He showed me some of his strains of red clover on plots that were five years old, alongside of American clover, English clover, Chilian clover, and some of the Russian clover. Some of the Chilian plants were still alive, after five years. There were also a few remaining plants of the so-called perennial red clover of England. The clovers from the other foreign sources had all died, most of them after the second year. The two selections of Swedish red clover looked as though they might have been the second year's growth. When we asked him if it was perennial, he said, 'Well, I don't know; this is the fifth year and it shows well this year.'

To produce these new sorts of red clover, Dr. Witte selects and transplants same plants of the hardy wild varieties in an isolated plot alongside of a selected plant of the best cultivated kind and lets the bees do the cross-fertilizing; then he sows the seed in an isolated place and when the crop is ready to come into bloom the following year, he hoes out and discards all the plants that are not of good quality and which do not give promise of hardiness. The seed from these is again sown in an isolated place. It is from the best and hardiest plants that reproduce true to type that the Swedish red clover has been produced.

By Hon. Mr. Fisher:

Q. Has he any merchantable quantities?

A. Not as yet; Dr. Witte is sending me about three or four ounces of the seed.

POTATOES.

I spent half a day with Dr. Lundburg who has been working with potatoes for many years, giving all his time to their study. He has been endevouring to overcome the potato blight. In Canada we know pretty well what potato blight is. His work of selection has been largely with a view to getting new varieties which will resist the blight. He had found that when potatoes are about ten or fifteen years removed from the seed itself, as distinguished from the tuber, they gradually become more susceptible to the blight. The disease on the variety would then tend to increase from year to year. After a potato has been removed from the seed proper for ten or fifteen years, it seems to have less vigour; perhaps like an apple tree, which, when it has reached 50 or 60 years of age, has passed the climax of its vigour and ceases to grow with the vigour it had when younger and therefore becomes more susceptible to disease. Likewise the potato tends to lose its vigour and, in the opinion of Mr. Lundburg who had charge of this work, should be reproduced occasionally from the seed itself. The system of selection of those vines and tubers which give the best results and which seem to be disease resistant is identical with that followed by the members of the Canadian Seed Growers' Association.

FIELD ROOT SEEDS.

They grow and select field root seeds. They have applied the same system of selection in the production of mangels for feeding as is applied in Germany for the production of sugar beet seed. They have mangels which they have selected specially for heavy clay land, and other sorts which they have selected for lighter soils; they have several different sorts. When I asked the manager of the General Swedish Company how much of this seed he would have to spare for the Canadian

seed merchant this year, he smiled and said he was sure they would not want much of his seed; he was sure his price would be too high. He told me that it would not be advisable for Canadian merchants to buy his seed until they had first taken small lots of it and tested it, to prove that it would give good results and be satisfactory under our soil and climatic conditions. I traced some of the high class mangel seed, varieties that are thought to be best in Europe, to the trial plots of one of the seed merchants near Toronto, and I found that what they consider to be best in Europe proved to be inferior to many other sorts that are not well thought of in Europe. The sooner our farmers who make a specialty of growing and selecting seed begin to produce select strains of mangel and carrot seed in Canada and select them for our soil and climate, the sooner will they be able to overcome the difficulty of poor seed supply and the sooner will they get more satisfactory crops from their mangels and other field roots than at present.

SEED SELECTION IN CANADA.

The system of selection which has given such excellent results in Sweden has already had a fair commencement in Canada. Our Canadian Seed Growers' Association has met with a good measure of success from the methods that were until recently followed by the German seed growers. I am glad to be able to say that the regulations of the Canadian Seed Growers' Association have been so amended as to make the matter of seed selection much less difficult for our farmers. Even the farmers who make a specialty of growing seeds sometimes find it difficult to make the selection of large heads of grain from their standing crop at a time of year when most of the grain crop is ready to be harvested. We have amended the regulations of the association so that the seed grower who commences with pure registered seed may continue to grow seed that will be inspected and registered by the association so long as he continues to select carefully from the sheaf enough to keep his seed plot pure. He may do that work of selection on rainy days or during the winter months.

If, as Dr. Nilsson has found, when we commence with an individual plant and keep the seed from that plant pure, the amount of variation from year to year is so slight that even a specialist such as he can scarcely make use of it to advantage, then we may obtain the maximum results, and without expecting from our seed growers that work which few of them seem disposed to do, by starting them with first class foundation stock which has been produced from an individual plant. For the next few years I shall expect more from our experts in the work of selecting individual plants of outstanding quality. Farmers have a right to expect them, as specialists in the work of seed selection, to produce the foundation stocks from single plants. That has already had a fair start in Canada. It started many years ago, casually; the Red Fife wheat was produced in that way by David Fife selecting one individual plant. For a time it was known in the district about Toronto as Fife's Rust Proof wheat. The Dawson Golden Chaff fall wheat was selected and increased from one individual plant by a farmer whom I know near Paris, Ontario. During the past four years Prof. Zavitz, of Guelph, has produced No. 21 barley, the most popular barley to-day in western Ontario. The seed of that barley is held in quantity for sale at the present time at from $1 to $1.50 per bushel. Dr. Charles Saunders, of the Experimental Farm, has a special strain of Red Fife, which gives promise of good quality, yield and earliness; and at the Macdonald College Prof. Klinck has some excellent strains of oats, bred up from indiviual plants.

By Mr. Robb:

Q. Is that No. 21 barley six-rowed?

A. Yes. It is a strain of the Mandscheuri variety.

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By Mr. Rankin:

Q. Does it come by cross-fertilization?

A. Dr. Nilsson believes that the 'mutants' which he selects are produced by natural cross-fertilization, which takes place but rarely with wheat, oats and barley, though a great deal more frequently than most experts think. The 'mutants' or sports so produced are said to be quite numerous in our common rain crops and easily observed by a person who gives all his time to the study and improvement of one kind of grain; but relatively few of the sports are of value and worth selection and increase.

Q. So that the new varieties are brought about by natural cross-fertilization?

A. All the new varieties in Sweden are brought about, as Dr. Nilsson thinks, by natural cross-fertilization. The work that has been done in crop improvement in Sweden is well worth the time of any member of this commitee, if he has to go to Great Britain, that would be required to cross over into the south of Sweden to see it. It is from Copenhagen but two and a half hours by boat before you are in the south of Sweden, and two hours by rail will take you to Svalof.

By Mr. Staples:

Q. Why did you select Sweden as the best place to spend so much time?

A. There is no country in the world so much talked of in this particular work as Sweden. The seed breeding station at Svalof is now a household word with men engaged in the work of plant selection. No other work that has been done will compare with it. There is no other station in the world, so far as I know, where they engage a staff of trained specialists, each to give all his time to the study and improvement of one kind of crop.

By Mr. Robb:

Q. Where do they find the best markets?

A. They do not export very much of their cereal seed; it is used in Sweden. They do export some to Germany and to Denmark. Their varieties are bred for their climate. When brought to Canada these varieties do not give good results as a rule; they do in some cases, but not as a rule. We must select our own seed under our own soil and climatic conditions.

By Mr. Thornton:

Q. Do they attribute the increased value of aricultural land and the number of people on the land to this system?

A. They claim that the value of their land runs parallel with the cereals that it will produce. It is a grain growing country. Of course they are near the best markets.

Q. How is it the farms are so small?

A. It is largely a social problem. Evidently the people who live on the land prefer to buy what land they are able to purchase and pay off a mortgage than pay rent. They prefer to own their farms, and the small holdings have to pay a minimum of taxation. I never expected to go over large areas of land without seeing weeds of some kind, but I must confess that on the farm of the General Swedish Seed Company, and on a good deal of the land just around Svalof, you would go a long distance before you found anything on the land but one particular kind of grain, for which the seed had been sown. I saw other places where weeds were along the roadside, but they are very careful; they have no fences, no places for weeds, insects and fungus pests to breed.

By Mr. Sharpe (Lisgar):

Q. The government does not own the seed farm land?

A. As far as the commercial seed farm is concerned, it is self-sustaining. The government gave a vote of $20,000 per year to the scientific staff. It is a private organization, affiliated with the agricultural organizations of Sweden.

By Mr. Staples:

Q. The government?

A. The government of Sweden provides a subsidy.

Q. And what is the average yield per acre?

A. In the south of Sweden the average yield of wheat ranges from 25 to 35 bushels and of oats from 45 to 70 bushels per acre, according to the season. In exceptionally favourable years, such as 1908, the average yields are even higher than the figures given. The station report for 1908 shows 71 bushels of Square Head wheat per acre from a field of 100 acres belonging to the General Swedish Seed Company.

By Mr. Sharpe (Lisgar):

Q. What was the average yield per bushel thirty years ago?

A. Seventeen bushels of wheat and 31 bushels of oats per acre, taking the average of ten years prior to 1880.

By Mr. Staples:

Q. What is the quality of the soil?

A. It is a sandy loam; they have also some clay loam. Their land has been under cultivation for many centuries.

Q. Not very heavy soil?

A. Not dissimilar to what you will find in the Ottawa valley. Not as fertile as our land. It has been cropped too long for that. Most of the soil we saw varied from sandy loam to clay loam.

By Mr. Blain:

Q. Were they troubled, forty or fifty years ago, with weeds, as we are troubled in Canada?

A. They have had all the different kinds of weeds. They do not sow seed that is not pure, even their clover seeds. They import very little clover seed. They do not sow weed seeds and do not allow weeds to go to seed. They have not been troubled seriously with weed growth during the last ten years, perhaps because of the intensive cultivation and the care they take with their crops.

By Hon. Mr. Fisher:

Q. Do they grow the seeds for the whole of Sweden in that district, at that station, or are there other establishments of a similar kind in other parts of the country?

A. Fifteen hundred of the 5,000 acres belonging to the General Swedish Seed Company are at Svalof; there is another block near Malmo, and one near Stockholm. The scientific staff have a trial station five degrees and also one ten degrees north of the principal station at Svalof.

The CHAIRMAN.—I am sure we have had a very valuable address, one fraught with a great deal of interest and from which I think Canadians can learn some important lessons. I do not think there is anything more important than the production of the highest class of seed. I am sure that if we in Canada will pay more

attention to the production of pure seed, as well as strong, vigorous and fertile seed, we can increase our crops very considerably. It has been a thought-provoking address and one which I think will be thoroughly distributed when the pamphlets are printed. I trust the information we have received will be disseminated throughout the length and breadth of this country, that it will be read by farmer, politician and statesman, when it will be seen what can be accomplished by better production of seed. We are pleased to have had this address from Mr. Clark.

Committee adjourned.

Certified correct,

GEO. H. CLARK,
Seed Commissioner.

APPENDIX

TO THE

PRECEDING REPORT

INTERIM REPORTS.

FIRST REPORT.

The Select Standing Committee on Agriculture and Colonization present their First Report as follows:—

Your Committee recommend that 20,000 copies of the evidence of each member of the official staff at the Central Experimental Farm who testifies before this Committee in the current Session of Parliament, be printed forthwith, in pamphlet form, in the usual numerical proportions of English and French, as advance sheets of the Committee's final report, for distribution, as follows:—

17,600 of each to Members of Parliament; 800 copies of his own evidence be allotted to each member of the said official staff, 1,500 copies to the Department of Agriculture, and 100 copies of each to the use of the Committee.

HOUSE OF COMMONS,
December 1, 1909.

SECOND REPORT.

The Select Standing Committee on Agriculture and Colonization, present their Second Report, as follows:—

Your Committee recommend that five thousand (5,000) copies of the evidence of Mr. Felix Charlan, Chief of Tobacco Section, Department of Agriculture, taken by the Committee in the current Session of Parliament, be printed in pamphlet form forthwith (2,750 English, 2,250 French), as advance sheets of the Committee's final report, for distribution as follows:—

3,500 copies to Members of Parliament; 600 copies to Department of Agriculture and 900 copies to the use of the Committee.

HOUSE OF COMMONS,
February 3, 1910.

THIRD REPORT.

The Select Standing Committee on Agriculture and Colonization, present their Third Report, as follows:—

Your Committee recommend that twenty thousand (20,000) copies of the evidence of Mr. George H. Clark, Seed Commissioner, taken by the Committee in the current Session of Parliament, be printed in pamphlet form forthwith, in the usual numerical proportions of English and French, as advance sheets of the Committee's final report, for distribution as follows:—

16,900 copies to Members of Parliament; 3,000 copies to the Department of Agriculture, and 100 copies to the use of the Committee.

HOUSE OF COMMONS,
February 24, 1910.