APPENDIX TO THE REPORT OF THE MINISTER OF AGRICULTURE.

EXPERIMENTAL FARMS.

REPORTS

OF THE

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do	do	Indian Head, N.-W.T.	Angus MACKAY.
do	do	Brandon, Manitoba	S. A. BEDFORD.

FOR

1888;

ALSO, BULLETIN 4 OF THE EXPERIMENTAL FARM.

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APPENDIX

TO THE

REPORT OF THE MINISTER OF AGRICULTURE

ON

EXPERIMENTAL FARMS.

OTTAWA, 30th January, 1889.

SIR,—I have the honour to submit for your approval the following report relating to the establishing and equipping of the several Experimental Farms in the Maritime Provinces, Manitoba, the North-West Territories and British Columbia, with some particulars of the work accomplished at the Central Experimental Farm during the year past.

Appended you will also find reports from the Chemist, Mr. Frank T. Shutt, from the Entomologist and Botanist, Mr. James Fletcher, from the Horticulturist, Mr. W. W. Hilborn, and from the Poultry Manager, Mr. A. G. Gilbert. Reports of progress are also presented from Mr. Wm. M. Blair, Superintendent of the Experimental Farm for the Maritime Provinces, at Nappan, Nova Scotia; from Mr. A. Mackay, Superintendent of the Experimental Farm for the North-West Territories at Indian Head; and from Mr. S. A. Bedford, Superintendent of the Experimental Farm for Manitoba at Brandon. In all of these I trust you will find much information useful to the farmers of this Dominion, and evidences of satisfactory progress in this important work of Experimental Farming in which you are so deeply interested.

I have the honour to be, Sir,

Your obedient servant,

WM. SAUNDERS.

The Honourable

The Minister of Agriculture,

Ottawa.

EXPERIMENTAL FARMS.

Since the last annual report was submitted, much progress has been made towards establishing the several Experimental Farms, and in their organization and equipment. In pursuance of this object journeys have been made eastward as far as Halifax, Nova Scotia, and westward to Victoria, British Columbia. The agricultural needs of the different sections in the provinces and provisional districts composing the Dominion of Canada enquired into, so that in the location of the Experimental Farms the positions chosen should, as far as is practicable, be representative of the larger areas of tillable land, and the soil on each farm of that varied character which would make it suitable for the many different classes of experimental work which it is desired should be carried on at each point.

EXPERIMENTAL FARM FOR THE MARITIME PROVINCES.

To obtain information of a character sufficiently reliable to justify recommendations as to the most desirable points for the location of an Experimental Farm to serve the purposes of the three Maritime Provinces jointly, three visits were made to these Provinces at different seasons of the year and farms were inspected in each province.

In Prince Edward Island the district in the neighbourhood of Charlottetown was visited, and the work being carried on at the Government Stock Farm near Charlottetown enquired into. In New Brunswick the lands lying along the route of the Intercolonial Railway from Sackville to St. John were examined, special attention being paid to the beautiful valley farms in Sussex, and to those in the immediate vicinity of Sackville. In Nova Scotia all the more important points on the lines of railway were visited, from the boundary line of New Brunswick to Halifax, from Spring Hill Junction to Parrsboro', from Truro to Pictou, and from Windsor Junction to Bear River. Much attention was given to the examination of the soil, to such topographical features of the country as would have a bearing on the prevailing winds, which in many districts materially modify the climate, and to other important features essential to the successful working of an experimental farm. Since for many reasons it was expedient that the farm for the Maritime Provinces should be within easy reach of the farmers in each province, special attention was given to inspecting lands in the border Counties of Westmoreland, in New Brunswick, and of Cumberland and Colchester in Nova Scotia. During most of these journeys I was accompanied by Col. Wm. M. Blair, whose intimate acquaintance with the agriculture of the Maritime Provinces, acquired by a life-long experience there, was of great service to me.

While many arguments could be presented in favour of the selection of an average farm, there were good reasons for seeking to combine in the land to be recommended points of advantage which would permit of experimental work being conducted which would be both generally and specially useful. The advantages sought were: Suitable soil of varied character; reasonable shelter from prevailing winds with comparative freedom from early frosts; a central location easily reached by visitors from each of the Provinces, and near the main line of travel. The land finally chosen was at Nappan, Nova Scotia, within half a mile of the station on the Intercolonial Railway, about eight miles from the boundary of New Brunswick, and a point easily reached from Prince Edward Island. The land consisted of two farms containing in all about 300 acres, nearly 100 acres of which is wooded with spruce, larch, beech, maple and other useful trees, the remainder cleared and almost free of

stumps. The cleared land may be divided into three classes, approximately as follows: Marsh or dyke land, valuable for hay production, 50 acres; lower upland, 50 acres, and higher upland, 100 acres. The soil is chiefly clay loam, more or less mixed with sand, becoming heavy or light as the clay or sand predominates, with some parts gravelly; and with a subsoil in the main varying from clay to gravelly clay, with more limited areas of a sandy or gravelly character. Taken as a whole this farm fairly represents the better class of farms adjacent to the boundary of the two larger provinces, while at the same time the wooded land is so placed as to furnish excellent shelter for orchard and other purposes. Most of the upland lies on a commanding slope, facing the west, overlooking the inlet from the Bay of Fundy from which an extensive view can be had of the surrounding country. The Intercolonial Railway passes through the lower part of the property. Geographically its position is central for the three provinces, it combines the necessary variety of soil, with a fair proportion of marsh or dyke land to supply hay for feeding stock, while the uplands are very suitable for the growth of cereals, grasses, roots and fruits, or for pasture. Possession of the land was obtained early in the year and as soon as practicable after spring opened from 30 to 40 acres were got ready for crop, a number of varieties of cereals were sown and a large assortment of fruit trees, vines and ornamental trees planted. Plans were prepared for a stable and barn, and dwellings for the superintendent and farm foreman, and these buildings are now in course of erection. During the summer underdraining and general preparation of the land for future work has been energetically carried on, fuller details of which will be found in the appended report of the superintendent in charge, Mr. Wm. M. Blair.

THE MANITOBA EXPERIMENTAL FARM.

Prior to the selection of a site for an experimental farm in Manitoba, two visits were made to that Province, and the character of the land and the conditions surrounding agriculture there, carefully enquired into. The investigations extended from Selkirk, 21 miles east of Winnipeg, to the western boundary of the Province, including special inspection of farms about Selkirk, Winnipeg, Stonewall, High Bluff, Portage la Prairie, Carberry, Brandon, Oak Lake and Virden. The country north of Brandon was also examined as far as Binscarth, and from this point along the line of the Manitoba and North-Western Railway to Portage la Prairie. In addition to the railway journeys these inspections have involved over 500 miles of driving, which has given excellent opportunities for becoming acquainted with the character of the soil and the condition of the settlers over a large part of the Province. During most of these inspections I was accompanied by Mr. S. A. Bedford and Mr. Angus Mackay, both of them well known practical farmers, who have been successful in the North-West and have had many years of experience there. From these gentlemen I received much valuable information.

Among the primary requirements to be combined in a site for an experimental farm for Manitoba are a variety of soil, a sufficient supply of water of good quality and a situation within convenient reach of a railway. With these advantages secured there are good reasons for preferring a location near one of the larger centres of population, such as Winnipeg, Portage la Prairie or Brandon, and much time was devoted to the examination of farms in these districts, so that no points should be overlooked which might aid in forming a correct judgment. Among the farms which combined many advantages was one near Brandon, which was finally chosen for the purpose. This farm consists of 640 acres of land, lying north-west of Brandon, and within a mile and a half of the business centre of that place. It is a beautiful site; the land slopes nicely to the south, and the farm is well seen from the Canadian Pacific Railway for several miles, and can also be seen from the city. The land extends to the Assiniboine River, which is always a considerable stream, and from the higher land a fine view of the entire farm can be had. The lower portion, next the river, contains from 150 to 200 acres of excellent meadow land, which produces annually a strong growth of native grasses. The soil on this flat is

a rich, dark, clay loam, from 2 to 3 feet deep, with a clay subsoil, and lies from 10 to 20 feet or more above the usual level of the river. Beyond this the slope upward is continued, beginning with a dark, heavy, clay loam, which gradually changes to a rich sandy loam, averaging 12 to 15 inches deep, with a subsoil varying from sandy to clay. This includes from 200 to 250 acres and leads to the foot of the bluffs which form the boundary of the valley. The bluffs vary in the angle they present to the land below, some of them rise with a gentle slope to the top, others are more or less precipitous, the spaces between them being broken up by ravines or coulées in which grow a great variety of shrubs and plants with a few small trees. These ravines will afford excellent sheltered locations for testing fruit or forest trees or shrubs. The soil on these slopes is a sandy loam, much of it of very good quality, from 9 to 15 inches deep, resting on a gravelly clay subsoil. On some of the heights, which include about 100 acres, the soil is of poorer quality, with more or less gravel mixed with the loam, on other parts is found a good, dark, deep sandy loam.

A never failing spring of excellent water issues from the higher land in one of the ravines in sufficient quantity to fill a 2-inch pipe, and the point from which this arises is high enough to admit of the water being carried to the upper storey of such buildings as may be erected on the lower slope. A second spring of almost equal volume arises from a bank on the road allowance adjoining this property which could also be utilized if required.

The river valleys in all parts of Manitoba and the North-West are more subject to frost than the higher lands, the difference in temperature usually varying from two to four degrees, but the Assiniboine valley at this point being nearly two miles wide, with gradually sloping banks, it would not probably be subject to temperatures as low as would prevail in valleys of lesser area. A slightly increased tendency to frost would make portions of this farm fairly represent the more frosty districts north while the height of land which would be freer from frost than the surrounding country, would better represent the more southern portions of Manitoba.

The advantages possessed by this site are many. It has a large area of soil which fairly represents the great grain-growing districts of Manitoba. The sheltered ravines in the bluffs represent to some extent the bluff country. It has every variety of soil needed for experimental purposes, and an abundant and never-failing supply of good spring water which can be conveyed to almost any part of the farm below the bluffs. It is very central for the larger number of farmers settled along the main line of the Canadian Pacific Railway, and when the railway now building from Brandon to Rapid City is completed, this farm will be easily reached from all the northern settlements in the Province. Should the proposed line to the south be built it will be equally accessible to that large farming district. Further, the quantity of land still unsettled between Brandon and the United States boundary to the south, coupled with the vast stretches of excellent land situated north and west of Brandon, offer homes for tens of thousands of settlers; probably in no part of Manitoba is there so large an unoccupied belt of almost uniformly fertile land. The farm is in full view of the passing trains, so that all travellers and settlers passing through can see it, and being but 1½ miles from the business centre of Brandon, it is within walking distance of that city.

Brandon is 132 miles west of Winnipeg, 76 from Portage la Prairie and 27 from Carberry. It is 32 miles east of Oak Lake, 48 from Virden, and 78 miles east of the Manitoba boundary.

Possession of this farm was not had until the beginning of July. Since then very satisfactory progress has been made under direction of the energetic superintendent, Mr. S. A. Bedford. The farm has been greatly improved, a large area of land ploughed and prepared for crop next year, between 3 and 4 miles of fence erected, roads graded, trees planted, buildings repaired and other important improvements made. Further details of this work will be found in Mr. S. A. Bedford's report which is appended.

EXPERIMENTAL FARM FOR THE NORTH-WEST TERRITORIES.

To acquire the information necessary to enable me to report on suitable sites for the proposed Experimental Farm for the North-West Territories two journeys were made to that country, one in December, 1886, the other in October, 1887. During these visits a wide area of country was traversed, careful examinations of the soil were made and diligent enquiries concerning the climatic conditions which have obtained since the first settlement of the country. The entire district from Moosomin to Fort Qu'Appelle, a distance of 121 miles, was driven over, frequent examinations of the soil made and inquiries instituted regarding the water supply and other conditions affecting agriculture, especially in the vicinity of Moosomin, Wapella, Whitewood, Broadview, Grenfell, Wolseley, Indian Head, Qu'Appelle and Fort Qu'Appelle. Similar investigations were also made in the neighbourhood of Regina, Moose Jaw and Calgary, Medicine Hat and other important stations along the main line of the Canadian Pacific Railway. Inspection was made of portions of the Moose Mountain settlement and the following Indian Reserves:—Crooked Lake, near Broadview, the Assiniboine, near Wolseley, Piapot's and Muscowpetung's, near Regina, and the Sarcee Reserve, near Calgary. While enquiring into the agriculture of the districts named, in addition to railway travel more than 400 miles of country was driven over, which afforded opportunities for accumulating many facts needed as aids in this enquiry. During the period of the latter visit an excellent opportunity was afforded of seeing the agricultural products of many of the localities named at the agricultural exhibitions then being held, twelve of which I had the privilege of attending.

Notwithstanding the excellent crops which have been obtained during the past year or two, at many points in the far west, it was thought best, seeing that the great bulk of the population is at present found in the eastern part of the Territories, that I should pay particular attention to that part of the country situated between the Manitoba boundary and Moose Jaw.

Since by far the larger part of the land open for settlement, probably two-thirds, or three-fourths within the limits named, is open prairie, it was deemed best to suggest that an open prairie section be obtained for the purpose of an Experimental Farm, rather than one with sheltering bluffs of trees, with the view of showing what can be done by tree planting to provide the shelter needed in the open country. Other important points were also considered, such as average condition of climate, character of soil, water supply, central location, accessibility, &c. In order that an Experimental Farm in that country may be seen and easily reached, it must be located near a line of railway. The settled portions of the plains in the Territories within the railway belt, may be said to lie within a distance of 188 miles, that is from the Manitoba boundary to Moose Jaw. Beyond this the settlements are few in number, are placed at long distances from each other with a comparatively sparse population, and by far the larger number of the inhabitants within the 188 miles referred to are settled in the eastern part of this area. For the first 20 or 30 miles within the boundary, the soil and the conditions of agriculture are similar to what is found in the adjoining lands in Manitoba, but west of this changes occur and the climate becomes gradually drier. The greater part of the soil, whether clay or sandy loam, is dark in colour and in most places rich in organic matter from the Manitoba line to within a few miles of Regina, where it changes to a heavy clay loam of a yellowish brown colour. This loam is strong and fertile, and when sufficient moisture is available, will give excellent crops of grain and roots. This soil covers a large area extending westward and southward, but is singularly uniform in character; north and west of this belt, much of the soil resembles that found in the eastern part of the Territories.

In conducting an Experimental Farm the work should eventually cover all branches of agriculture and horticulture which promise to be useful to the farmers in the territory or province in which it is located. The land should be suitable for the growth of a great variety of cereals, grasses and other field crops, roots and

vegetables, also small and large fruits and forest trees of many different sorts. While some of these products will thrive on a heavy clay soil, others will not succeed on such soil, hence it is most important that such a farm should possess a variety of sandy and clay loams, so as to admit of the testing of all desirable classes of products. The furthest western point within the settled belt referred to along the line of railway, where suitable soil was found, associated with other necessary and favourable conditions was near Indian Head where several desirable sections of land were examined and with other sites further east duly reported on. Finally section 19, Township 18, Range 12 west, was chosen as the site for the Experimental Farm for the North-West Territories. The land adjoins the town of Indian Head on the easterly side, it lies north of the railway, which skirts its boundary for about a mile. The surface is slightly undulating, sloping towards the south, excepting at the north-east corner where the land inclines to the north, nearly all of this farm can be well seen from the railway.

Through this section, running in a winding irregular manner are two coulées or ravines, which occupy, including their sloping banks, probably 30 acres. In one of these a small creek flows during the early spring months fed by a chain of three lakes which are 6 miles distant: one of these is a mile and a half long, the other two about half a mile each. This creek dries up during the heat of summer, but by means of two dams built across this coulée a small lake is formed and a good supply of water is retained, ample for the requirements of stock and for general farm purposes during the season. At the date of my second visit, October 5, 1887, there was in this coulée a large reservoir of clear water, in some places several feet in depth. The other coulée has a running stream flowing through it during the spring months, supplied with water from springs in the Squirrel Hills, 6 or 7 miles south of the town. Good water is obtained in abundance in the town at a depth of from 25 to 30 feet, but on the Experimental Farm it has been found necessary to dig to the depth of 80 feet or more to obtain a good supply.

The soil is of excellent quality. The north half of the section is covered with a black friable clay loam, mixed with a little sand, from 1 to 3 feet in depth, with a yellowish brown clay sub-soil. The larger part of the south half has a heavy clay loam with a clay sub-soil. It has also about 80 acres of sandy loam, mixed with some gravel on the higher knolls. There are 40 acres unbroken along the railway track of sandy loam mixed with gravel, and the remainder of the section, excepting about 30 acres, included in the coulées has been under cultivation for several years past. Along the banks of the coulées the soil is variable, but chiefly sandy loam, and the inclination of the banks is such as to admit of cultivation to the water's edge, except in a few places, while the winding course of these ravines give gentle slopes with every aspect. There were no trees or shrubs growing on this land; it was all bare prairie.

The slopes in the coulées will be advantageous as starting points for tree planting, also for garden vegetables and fruits, because during the summer the soil in such situations is more moist during the dry period, and in winter the snow lies deeper in the ravines than it does on the exposed pairie. The ravines would also afford some shelter and good pasturage for cattle.

The town of Indian Head has a population of about two hundred, possesses fair hotel accommodation and has a flour mill and elevator. It is 104 miles west of the Manitoba boundary, 74 miles east of Moose Jaw, 44 from Regina and 105 north of the boundary of the United States. It is in the centre of a large and thriving agricultural settlement, extending to the Qu'Appelle River and north of this through the Pheasant Plains for about 20 miles and south of the Canadian Pacific Railway for about 10 miles. A good trail runs *vid* Qu'Appelle to Prince Albert, and another through the Pheasant Plains to the Methodist Colony and the Montreal and York Colonies. Not only is the situation of this farm central, but the soil is of that varied character which would represent the sandy and clay loams which cover the greater part of the land east of this, also the area which lies to the north and north-west, while the heavy clay loam on the south half of the section, although different in

colour and texture, would sufficiently represent the large belts of clay loam to the west and south. The supply of water, which is of much importance in the North-West, is ample, of good quality and not difficult to obtain. Its nearness to Indian Head, less than one mile, brings the farm within walking distance of hotels where visitors can obtain accommodation, also affording excellent facilities for obtaining mail matter and supplies in general.

The district has a good record of crops and it is rare to find so many desirable features for experimental work in agriculture, horticulture and forestry combined in a single section of bare prairie land as are found in the farm referred to. It may appear at first sight that a section of land comprising 640 acres is an unnecessarily large area to devote to experimental purposes, but when the requirements of pasture are considered, and the fact that in order to farm successfully in the North-West one-third at least of the cultivated land should be in summer fallow every year, also that the experiments in forest tree planting will in time cover a very large surface, it will be seen that much more land will be needed there than would be required in a farm for similar purposes located outside of the prairie country. The magnitude of the territory is such and the interests at stake so important that a sufficient quantity of land for satisfactory work in all these departments should be provided.

The relatively short distance between the two farms selected as sites for the Experimental Farms for the North-West Territories and Manitoba—182 miles by rail—will naturally raise the question as to the necessity for two farms so near each other. In the remarks on the Experimental Farm for Manitoba, the chief reasons are given which influenced that selection. The Brandon site fairly represents the Province of Manitoba also the country for nearly 30 miles into the Territories, beyond this changes begin to take place in the climate, which become more marked by the time Broadview is reached. From thence westward towards Moose Jaw the climate is very different from that which prevails in Manitoba, the rainfall is usually less and occasional hot winds prevail during the summer, which are, I believe, unknown further east. These and other climatic peculiarities, oblige the farmers in the Territories beyond the narrow belt to which reference has been made, to adopt different methods in treating the soil to prepare it for crop. There are also important differences in the soil itself as to texture and character. The farm at Indian Head has soil which represents these peculiar characteristics which the Brandon farm has not. Further the farm at Indiam Head is an open prairie section, was without a tree or shrub when purchased, while the Brandon site is partly a valley farm with sheltered ravines clothed with shrubs and small trees. The question of forest tree growing is of very great importance to that vast country included in the Territories as well as to Manitoba, but experiments carried on at Brandon, while reliable for Manitoba, would be no safe guide to the farmers on the wide stretches of prairie in the Territories. The differences of climate, soil and situation are abundantly sufficient to warrant the establishment of the two farms, and with experimental operations in agriculture, horticulture and forestry carried on at each, a vast amount of useful and practical information will soon be gained which will be of great value to farmers in every part of that country and meet in large measure the varying conditions to which they are individually subjected. Where the differences referred to clearly exist, the question of distance between the two farms is not a matter of much importance, as the special operations to be carried on at each point can be made quite as useful and instructive with the farms only 182 miles distant from each other as they would be were they 500 miles apart. The climate and other variations referred to, while important in their influence on field crops, fruits and forest trees, have comparatively little effect on stock, hence the work carried on in this direction, may, with judicious economy, be varied so as to avoid unnecessary repetition, and different lines of experiment with different classes of animals, conducted at each place.

Possession of the Indian Head farm was had early in the spring, when the superintendent, Mr. Angus Mackay, began the work. Evidence of the vigour with which this has been carried on will be found in Mr. Mackay's report, which is appended. The change in the appearance of the place is most marked, some v r; useful results

in grain tests have already been obtained, especially with two rowed barleys, several varieties of which have been tried; the grain produced has been plump and bright, with an average weight of 54 pounds to the bushel and would no doubt command very good prices in the English market for malting purposes. Some very promising sorts of early ripening oats have been tested and several varieties of wheat, including the early ripening Ladoga from Russia. With the large acreage of land which has been summer fallowed and got into good condition for crop next year, there will bo abundant facilities for carrying on many other important tests which could not be begun earlier for want of suitably prepared land. The forest tree and fruit tree plantations have stood the summer very well and it will be interesting to know how they will stand the test of the winter. The farmers of that country are also deeply interested in the results of the tests being made with different varieties of fall wheat, full particulars relating to all these points may be found in Mr. Mackay's report. Plans for suitable buildings for this farm were prepared during the winter, the contracts let and the work is being pushed forward as fast as circumstances permit.

EXPERIMENTAL FARM FOR BRITISH COLUMBIA.

Two visits were made to British Columbia, the first in December, 1886, the second in September, 1887, for the purpose of enquiring into the conditions of agriculture there and of ascertaining where suitable sites for an experimental farm for that Province could be found which would combine such advantages as were needed to make such an institution generally useful to the farmers of that country. During these visits I had the opportunity of examining many farms on Vancouver Island as well as on the mainland. On the Island, farms were inspected in the vicinity of Victoria, also in the farming districts of South Saanich, Somenos and Chemainus, travelling to the terminus of the island railway at Nanaimo.

On the mainland the fertile delta lands of the Fraser River were examined and diligent enquiries made into the character and capabilities of the land in many other districts which the time at my disposal would not permit me to visit, particularly with regard to those comparatively large areas of meadow and prairie lands on the south side of the Fraser River and extending to the United States boundary, including the Langley Municipality and the districts of Chilliwack and Sumas. On the north side of the Fraser River the country situated along the line of the Canadian Pacific Railway from Vancouver and New Westminster eastward to Fort Yale, a distance of about one hundred miles, was made a special subject of enquiry, and the land carefully examined at every promising point.

The requirements which it was thought desirable to embody in this site were:

1st. Land of good quality, combining an area of meadow land suitable for stock-raising and grain-growing, with higher meadow and bench lands suitable for fruit culture.

2nd. Land situated high enough above the banks of adjacent rivers to prevent its being overflowed during the highest floods.

3rd. Accessibility by rail and water.

4th. A central location which would be fairly representative of the greater part of the farming lands in the coast climate.

Of all the farms visited and examined none appeared to combine so many advantages as a part of the land composing the Agassiz farm, adjoining the station known as "Agassiz," on the mainland and also on the line of the Canadian Pacific Railway. The land offered here for the purposes of an experimental farm and which was finally chosen as a site for that institution, consists of about 300 acres immediately adjoining and opposite the railway station and fronting on the track for about half a mile. Along the western boundary runs the road leading to the Harrison Hot Springs, which are five and a half miles distant. About thirty-five acres of this land has been brought under cultivation, including nearly three acres of orchard, the young trees in which are coming well into bearing. There are about 200 acres of prairie land which was cleared many years ago and is now covered with a growth of fern and small underbrush. There are a few acres of higher bench land partly

wooded, which would be well suited for fruit growing, and nearly fifty acres of timbered land, containing fine specimens of Douglas fir and cedar. The farm is protected on the north by a mountain which rises more or less precipitously immediately in rear of the bench land.

The soil, with the exception of that on the bench land, varies from a rich sandy loam mixed with clay, to a loam, almost entirely clay, from nine to twelve inches in depth, with a porous subsoil, in some places sandy, in others sandy clay, resting on gravel which is found from five to eight feet below the surface, and affords good natural drainage. The bench land inclines towards the south and is covered with a dark sandy loam of good depth and quality with a variable subsoil. All of this land is sufficiently elevated to prevent its being overflowed by the Fraser River, even in the highest floods.

Good water can be obtained anywhere at a depth of fifteen to twenty feet in the underlying gravel. There are also several small springs along the base of the mountain in the rear which might be utilized if required.

Agassiz is situated seventy miles east of the town of Vancouver and sixty-two miles from New Westminster near which are the fertile delta lands of the Fraser River, estimated at from 75,000 to 100,000 acres. It is 28 miles from Mission and 44 from Port Haney where by crossing the river the agricultural municipality of Langley is reached. There is also a steamboat landing within two miles of the experimental farm, where the river steamers call twice a week during the season of navigation, by which means the farming districts of Chilliwack and Sumas can be easily reached. Eastward the distance to Hope is 18 miles, to Fort Yale 32 miles, and 86 miles to Lytton, near which point the drier central area of tillable land in British Columbia begins. It will be seen that this site is very central, having clustering around it some of the best agricultural districts on the mainland. It is also on the railway which is the great highway for travel through that country and is accessible by water, while in the character and variety of the soil, its good natural drainage, the ease with which the greater part of the land can be brought under cultivation and its freedom from danger of flood, are advantages seldom found combined in one site.

The clearing of heavily timbered land in British Columbia is a most labourious and expensive undertaking, costing from fifty to one hundred dollars an acre and upwards, and occupying much time. Had an uncleared lot been selected the time required to bring such land into condition for tillage, would have delayed farm operations there to any extent for several years. With the selection made no such delay will be necessary, and the farm may soon be made useful to the agriculture and horticulture of that Province.

Delay which has been unavoidable has occurred in the acquiring of the property so that nothing could be done on it until very late in the season. Nearly 100 acres have been cleared of the small undergrowth, and about twenty acres ploughed, and thus sufficient land has been made available for such experimental work as it may be thought desirable to undertake there during the coming season.

CENTRAL EXPERIMENTAL FARM.

Seed Testing.

The work of testing the germinating power and purity of agricultural seeds for the farmers throughout the Dominion, afforded much occupation during the winter months, and there were many practical points arising out of these tests which involved much correspondence. The number of samples received for test during the winter of 1886-7 was 187, while the winter of 1887-8 brought 795, an increase which points to the growing usefulness of this part of the work, and the appreciation in which it is held by the farmers. The tests last year included 446 specimens

of wheat, 80 of barley, 146 oats, 26 peas, 59 grass seeds, 6 rye, 5 Indian corn, and 27 of vegetable seeds.

The early autumn frosts which injured the grain in many parts of Manitoba and the North-West Territories, have left many of the settlers with nothing but frozen grain for seed. It has been frequently demonstrated that grain which has been frozen to some extent, does in the fertile soils of the western prairies, often produce very good crops, the fertility of the soil proving a sufficient offset to the weakened vitality of the grain, where the freezing has not been very severe, but to what extent the grain may be frozen without destroying its usefulness for seed, can only be determined by actual test in each case. Realizing the important bearing of this question on the harvest of next year, arrangements were early made for grain testing, and the farmers of Manitoba and the North-West Territories were invited through the press to send samples of frozen grain to the Central Experimental Farm, to be tested for vitality and vigour of growth. A large number of samples have already been received and reported on, and others are daily arriving. The tests thus far completed, indicate that nearly one-third of the frozen grain of which samples have been sent, would if used as seed next year be almost certain to result in partial or complete failure.

In the Maritime Provinces frequent rains during the harvest period have injured the vitality of much of the grain, especially of the oats and barley, which, in many instances, sprouted before it could be saved. Some samples have already been received for test, and more are expected; the importance of sowing good seed possessing a full measure of vigour and vitality is becoming better understood by careful farmers everywhere.

Seed Distribution.

This also has been actively carried on, involving much correspondence and labour. 2,150 sample bags were sent out by mail during the early part of the year; 1,529 of these were Ladoga wheat, the remainder barley, both two-rowed and six-rowed, also oats and forest tree seeds. Each sample was accompanied by a circular of instruction, and a series of printed questions with blank spaces for replies, which when filled and returned will supply much useful information regarding the varieties distributed for test. From the small bags of Ladoga wheat sent out by mail during the spring of 1887 many farmers have now a good stock for future sowing, ranging in the more successful cases from 20 to 100 bushels. Useful and prolific sorts of grain may thus in a short time be made available to the general public at comparatively small cost, and with new and promising varieties frequently introduced, and the information thus gained freely distributed, farmers in all the Provinces of the Dominion will be kept well informed as to the most prolific sorts for their respective districts and in this way, the average yield of the farms over the entire Dominion may soon be materially increased.

Experiments with Cereals.

During the past season forty-nine varieties of barley have been tested, including twenty of the two-rowed sorts. Twenty-six of these barleys have been grown in field plots, the dates of sowing, germinating and harvesting recorded, also the quantity of seed used and the yield. All of the varieties have also been grown as single plants, fifty kernels being planted in each instance in two rows of twenty-five each with one foot of space between each kernel and two feet between each variety. Several of the best examples of each sort were gathered for exhibition purposes, and one of each threshed and cleaned separately, the number of ears and individual grains counted and the percentage of yield thus ascertained. Three or four of the most vigorous of the remaining plants were similarly treated, and the others were all harvested together and like records obtained. Thus the yield of a single selected plant of each sort has been ascertained, also the average of three or four of the next in vigour as well as the average of the remainder.

A similar course has been pursued with seventy-four varieties of spring wheat, fifty-six of which have been grown in field plots, also with eighty varieties of oats, of which sixty have been tested in field culture. By these experiments a very large sum of most valuable information has been obtained relating to the earliness, productiveness and vigour of all these different sorts, the results of which will be given to the public as fast as they can be arranged and properly compiled.

Similar tests are in progress with more than 100 varieties of fall wheat sown as single plants and eight varieties of the same in field plots. Twenty different sorts of rye have been similarly sown, four of them in field plots.

The labour involved in the separate planting, care in noting time of germinating, relative vigour of plants, dates of ripening and in separately harvesting, curing, weighing, threshing and cleaning all these different sorts of grain has been very great, but all has been carefully and systematically done and the results reached will be reliable as to the outcome of this season.

Tests have also been made with different fertilizers on wheat on the permanent plots laid out for this purpose, of which there are twenty in all, of one-tenth of an acre each. These tests have included experiments with barn yard manure, both rotted and fresh; mineral phosphates raw and treated, wood ashes, ground bones, nitrate of soda, and mixtures of these fertilizers, with unfertilized plots for comparison; as this land was part of what was cleared last year and hence had never been under crop before, the experiments will need to be several times repeated before reliable deductions can be drawn from them. It is proposed to sow the same variety of wheat on these plots from year to year, using the same sort and weight of fertilizer each season, and to institute during the coming year similar experiments with barley and oats.

Experiments have also been carried on in hybridizing cereals, particularly wheat, and several crosses produced from which it is hoped that useful new varieties will eventually be obtained.

Corn.

Fifty-three varieties of corn have been grown, but since through delay in transit the seed did not arrive for two or three weeks after the usual time of sowing, these could only be tested for the weight of fodder produced up to a given period. Experiments have also been conducted with twelve varieties of corn planted in rows three feet apart two rows of each. In one row the grains were planted four inches apart, in the other one inch apart, and the relative weights of the product noted.

Experiments with different fertilizers and combinations of fertilizers were made on sixteen plots of corn of one-tenth of an acre each, one-half of each plot being sown with Mammoth Southern fodder corn in rows, the other half in hills with Canada Yellow corn. Records have been taken of the weight of the crop produced in each case. These plots are also intended to form part of the permanent experimental work of the farm.

Sugar Beets.

Four varieties of sugar beets have been grown side by side in plots of equal size and the weight of the crop on each plot ascertained. The seeds of three of these varieties were sent to the Central Experimental Farm for test by Wilfred Skaife, Esq., President and Manager of the Berthier Sugar Beet Factory at Berthierville, Quebec, under Nos. 1, 2 and 3. These were samples of the seed which had been imported for distribution among the farmers who were engaged to grow sugar beets for the factory. The seed from Wanzleben with which these were compared was obtained from Haage & Schmidt, seedgrowers, Erfurt, Germany, and is said to yield "the greatest percentage of sugar of all beets." Samples of the roots grown from each of these were submitted to the chemist of the Experimental Farms, Mr. T. F. Shutt, and an analysis made of them, the particulars of which will be found in his report. The Wanzleben variety yielded the smallest percentage of sugar, the other

three were found to be fully up to the average in the proportion of sugar they contained.

Other Root Crops.

Seed of many different varieties of carrots and mangolds were obtained and sown on the 7th of May under similar conditions and in nearly uniform soil. They came up about the 22nd of May and were making promising growth when they were almost entirely destroyed by the severe storm which passed over the farm on the 6th of June. These plots covered about six acres of ground. Part of this land was subsequently sown with turnips and yielded fair crops. Another smaller field in which mangolds and carrots were sown for feeding purposes escaped the severity of the storm and produced good returns.

Hay.

The hay crop was fairly good, but the area had been much lessened by the ploughing up of such portions as had nearly run out, and the total product was about fifty tons. To provide for renewal of this crop some timothy was sown in the autumn, with rye, to which the clover will be added in spring, and more land will be seeded with grass and clover during the coming season, with spring grain.

Potatoes.

One of the special features of the experimental work during the past season has been the testing of a large number of varieties of potatoes. No less than 251 sorts of this useful tuber have been grown side by side under similar conditions. Notes have been taken on the weight of the seed planted, the growth of the plants, whether vigorous or weakly, and the yield of each. The process of testing the quality of these numerous varieties is still going on, and will take much time to complete. Careful notes are being taken on that important point. The result of this will be the accumulation of a large store of useful information, which will have a practical bearing on this crop. In addition 237 new varieties have been produced from hybridized seed, among which are some of much promise. These will require to be grown for one or two more seasons before their relative merits can be definitely ascertained. All of those varieties which have been grown and do not promise fairly well, will be discarded and the tests conducted next year with the selected sorts, supplemented by such of the newer kinds as may be obtainable.

Fruit Trees and Vines.

Several large orchards have been planted with standard varieties and new sorts of extra hardy fruits, chiefly from trees planted last year in nursery rows. Many of these have made fair growth and promise well. Additions of new varieties have also been made to the vineyard and to the small fruit plantations. and new plots of strawberries and raspberries planted. Full particulars of this work will be found in the report of the horticulturist appended.

Forest Trees.

Portions of the northern and western boundaries of the farm have been laid out for forest tree clumps, and some of these have been planted. They include two mixed clumps containing 1,321 trees, composed of ten or twelve different varieties, which have been put out along the northern boundary, and clumps along the western line of black walnut 618 trees, butternut 269, Scotch pine 415, and smaller groups of European larch and oak. Work will be continued in this direction in the spring, and additional clumps planted with young trees from the nursery rows.

A considerable degree of attention has been given to the question of growing forest trees and different methods are being tried. Young trees have been grown from seed, seedlings have also been purchased from nurserymen who make a specialty of growing forest trees from seed; young trees have also been taken from the woods and planted in nursery rows. Obtained from these three different sources there are

now more than 100,000 trees on the Central Farm, many of them large enough for clump planting. It is proposed to send a good proportion of these young trees next season to the experimental farms in Manitoba and the North-West Territories.

Among the principal deciduous trees which have been grown from seed are black walnut, butternut, elm, ash, oak, maple, locust, chestnut, and catalpa. A special form of screen was built last spring for the purpose of growing evergreen trees from seed, as they need partial shade in order to grow them successfully. Under this screen there was sown beds of Riga pine, a very valuable timber tree from Northern Russia, a straight growing variety of the Scotch pine which is very hardy and promises to be useful in the North-West. The seed was obtained from trees in one of the Russian Government forests near Riga. A number of other promising varieties of pines and spruces have also been planted. Many thousands of young trees have grown from the seed sown, and it is hoped that a foundation has thus been laid for plantations of the hardiest sorts of valuable timber trees suitable for the colder parts of the Dominion. Two or three years more of growth will be required before these evergreen trees will be large enough to send out for planting.

Avenues, Hedges, &c.

The larger trees which have been planted out in avenues and rows bordering the main roads on the farm number 879, of which 287 are elms, 365 sugar and red maple, 66 Norway maple, 84 linden, 23 ash, 38 mountain ash and 16 catalpa. A hedge of Norway spruce composed of 1,427 trees, planted three feet apart, has been planted along the southern boundary, covering more than three quarters of a mile, while the hedges of Arbor Vitae contain 5,207 trees, planted fifteen inches apart, and extend in all to a length of nearly a mile and a quarter. A very large proportion of these trees have made fair growth, are now well rooted, and will probably make a good showing next year. The avenues and hedges will soon add much to the beauty and attractiveness of the farm. Groups of ornamental trees, both deciduous and evergreens, have also been planted about the several dwellings.

Draining.

This very necessary work has been continued during the year, and since the spring opened three and a-half miles and 189 yards of tile drains have been laid. Five main outlets each eight inches in diameter are now provided, which it is believed will be sufficient to promptly relieve the entire farm of surplus water. There are a number of small branch drains yet to be laid, but hereafter much of the work in this department can be done during the less busy periods in the year by the farm hands. The entire system of drainage thus far completed covers more than ten miles.

Road making and grading.

The numerous and unsightly stone piles which last spring greeted the eye at almost every point, have been turned to good account by burying them in the roads, the largest boulders have been placed in the bottom, these covered with smaller ones, reserving such stones as were easily broken for the top. These latter were broken and spread, the surface rounded and covered with sand or earth. In this way the main roads have been very substantially made, and the stone disposed of where it will always serve a good purpose. Some necessary grading for the roads and about the farm buildings and dwellings has also been done.

Buildings.

Since the last report was presented, much progress has been made with the buildings. The commodious stable has been finished and the farm horses comfortably housed, and in the barns there is now provided accommodation for stock. A new root house 100 by 25 feet has been built, and a poultry building erected and stocked with a good selection of the most promising breeds of fowls. The dwellings for the officers composing the working staff, and a cottage for a stableman have

been finished, and the new chemical laboratory with the adjoining office building and museum are now approaching completion, so also is the structure to be used as a store house for seeds and for seed testing and propagating. The additional space which this will give for the important work to be carried on in seed testing is greatly needed; the increased accommodation soon to be provided will, it is expected, meet all the necessary requirements in this direction.

Poultry Department.

A special building of a substantial and convenient character has been provided for poultry, and a number of choice specimens of the leading varieties reared during the summer from eggs obtained in the spring. The great increase in the exports of eggs and poultry within the past few years and the ease and success with which fowls are kept shows that Canada is well situated for producing enormous supplies of these valuable commodities. Experiments will be conducted at the Central Farm with the object of ascertaining the relative merits of the different breeds for egg laying and especially winter laying and as table fowls, and, by crossing the more promising sorts, endeavour to find out what strains will be most hardy and profitable for farmers in different parts of the Dominion. This department is being managed by an experienced poultry breeder, Mr. A. G. Gilbert, whose report will be found appended.

Donations and Exchanges.

During the year, a further gift of a large collection of the seeds of trees, shrubs and plants of Europe and Asia have been received, through the kindness of the Director from the Royal Gardens at Kew. Mr. Chas. Gibb, of Abbotsford, Quebec, to whose liberality we are already so much indebted, has generously donated another large collection of seeds from Russia. An acknowledgment is also due to the Hon. Norman S. Coleman, U. S. Commissioner of Agriculture, for some new varieties of grain and fodder plants, and a further consignment of seeds of several varieties of trees have been received from the Royal Agricultural College at Tokio, Japan. Exchanges of publications have been made with nearly all the Experiment Stations of the United States, and with some of those in Europe.

Seed Grain from India.

Among the seed grain obtained for test at the Central Experimental Farm, the first season were 28 varieties which were selected from grain offered for sale at the Corn Exchange in London, England, representing the produce of the principal grain growing countries of the world; among these there were found different varieties of wheat from India, under the following names: Indian Kurrachee, Indian Hard Calcutta, Indian Red Calcutta, and Indian Club Calcutta. These varieties proved to be unexpectedly early in ripening, competing closely in this respect with wheat obtained from high latitudes in the northern part of Russia. The Indian wheats thus far tried do not, however, compare well in vigour or fertility with those of northern countries. Subsequently, though the courtesy of Col. T. C. Denison, of Toronto, I was permitted to peruse some correspondence between Arch Deacon Denison, of Taunton, England, and a Moravian Missionary labouring in the higher altitudes of the Himalaya Mountains, Mr. A. W. Heyde, of Kyeland, in the Kangra District. From the information contained in these letters, it was evident that there are in that country early ripening varieties of both wheat and barley, which it would be desirable to test in Canada. Under instruction of the Minister of Agriculture, correspondence was opened with the Government of India, and though the kind interest taken in the subject by the late Viceroy and Governor General of India, Lord Dufferin, enquiries have been instituted in the districts to which reference has been made, and also in a general way throughout the Empire, for the purpose of ascertaining what Indian grains are likely to be suitable for experimental cultivation in Canada.

A communication from the Under Secretary to the Government of India at Simla, under date of 9th October, encloses the following printed note prepared by the Reporter on Economic products to the Government of India, and also states that "the Governments of the North-Western Provinces, and the Panjab have been asked to instruct the directors of agricultural departments in their respective Provinces to obtain a supply of seeds of the grains mentioned in the note" to be forwarded to Canada.

NOTE ON INDIAN GRAINS, &c., LIKELY TO PROVE SUITABLE FOR EXPERIMENTAL CULTIVATION IN CANADA.

Written in connection with a correspondence recently before the Government of India.

Climate of Canada.

"I venture to think that the suggestion made by Professor Saunders for sending the seeds of plants grown in Spiti and Lahoul to the Dominion of Canada will not be found as hopeful a project as the sending of seeds of plants grown during the winter months at lower altitudes if not even from some parts of the plains of India. It is proposed to try the Indian seeds in Manitoba and in the plains to the north-west. The following table shows the mean temperature and rainfall of the summer or agricultural months in Manitoba:—

—	April.	May.	June.	July.	August	Sept.	October.
Mean temperature	39·2	51·2	63·6	65·9	64·8	51·3	40·0
do rainfall	0·80	2·72	3·84	2·75	2·12	3·73	0·54

By April the snow disappears and ploughing commences; and by the end of July, harvest has generally begun. In September night frosts occur, and often of such severity as to destroy the crops. The farmer of the north-western tracts of Canada has, therefore, to fear more the frosts of spring and autumn than the extremes of climatic changes between summer and winter. The snow is dry, and although not heavy, it is sufficient to protect fruit trees and winter crops; while the soil is rich and warm, and the summer nights have refreshing dews. Thus the agricultural season may be said to be from the latter end of April to the middle or end of August. There is a sudden rise in temperature and rainfall in May, the temperature steadily increasing until July and August.

Corresponding climates of India.

In India we have two crops, the *rabi* or spring crop, and the *kharif* or autumn. The former is sown in October and November and ripens in February to March; the latter is sown and reaped in the intervening months. The crops of the plains of India that might prove useful in Canada would, therefore, be some of the spring crops of the Panjab that mature in from three to four months. The depression of temperature in the middle of the rabi season might preclude crops that require a longer period such as plains wheat, but the minor crops that are sown in December and January and ripen in March to April are grown under a climate like that of Canada, viz, with an increasing temperature till harvest time. The autumn crops of the plains would be altogether unserviceable. This distinction of *rabi* and *kharif* seasons prevails throughout the lower Himalaya, the effects of a marked rainy season overcoming to a certain extent the influences of temperature. Above 10,000 feet the shortness of the warm weather and less monsoon influences force a summer season crop which, in some respects, resembles that of Canada; but the cultivation

above that altitude is scanty and poor, so that it is doubtful whether any crops occur in Spiti and Lahoul (the regions specially mentioned by Professor Saunders, and which are above 10,000 feet in altitude) that would be worth sending to Canada, excepting the wheat and barley of those localities.

"Of the stations situated on the inner ranges, Kailang (the capital of Upper Lahoul) is on the one side or to the south of Spiti; and Leh, on the Indus across the middle or great Himalaya, is to the north of Spiti. The climate of Spiti is not systematically recorded, and hence the selection of Kailang and Leh. But it is believed these two points will exhibit the characteristic features of the higher Himalayan regions specially mentioned by Professor Saunders—or the Himalayan regions that have as a rule only one crop a year. Zanscar to which the Professor alludes is an unimportant valley between the two points selected.

Simla and Murree on the outer ranges may be accepted as representing the Himalayan tracts that have both a spring and an autumn crop. Of the Panjab plains, Sialkot and Multan have been chosen as having during the winter and spring seasons, a climate that closely resembles the summer of Manitoba; while Pithoragarh in Kumaon (in the North-Western Provinces) is intermediate between the plains and the higher Himalayan regions where a fairly good agricultural system prevails.

A comparison of these tables of temperature and rainfall will show that the crops that mature in Leh and Kailang during July and August might be sent to Canada; that practically all the crops grown in Murree and Simla, but more especially those sown and reaped from January to June, might also be sent; that of Multan and Sialkot it would be safe to send only the crops reaped in early spring, *e. g.*, those sown in October and November and reaped in March; and that of Pithoragarh, all the crops that are sown in October to January and reaped in April to May, might be sent. It will be thus observed that in the regions named both rainfall and temperature approximate, during the periods specified above, to those of Canada; so that the number of Indian agricultural products which might be grown in Canada is increased very considerably beyond the list that could be furnished were attention to be confined solely to Spiti, Lahoul and Zanscar.

"The following are the principal crops that might be sent to Canada, grouped under four heads, obtained by reducing the seven regions discussed above to four. Thus, by uniting Leh and Kailang into one, we have a representation of the upper agricultural Himalayan region; Simla and Murree corresponding to the second or intermediate Himalayan region; Pithoragarh, to the third or Lower Himalayan region; and Multan and Sialkot to the fourth, or the division of the plains which possess crops that might be found suitable for Canada. The high rainfall in the countries to the east and south-east of Kumaon would render it in all probability hopeless to procure crops from those parts of India even although in point of temperature they may have a winter climate not unlike the summer of considerable portions of Canada.

The following table displays the temperature and rainfall of four stations on the Panjab Himalaya, two on the outer and two on the inner ranges:—

	Usual Rabi Season												Usual Kharif Season.												Altitude above the sea.
	Oct.		Nov.		Dec.		Jan.		Feb.		Mar.		Apr.		May.		June.		July.		Aug.		Sept.		
	Mean average Temperature.	Rainfall.	Temperature.	Rainfall.	Temperature.	Rainfall.	Temperature.	Rainfall.	Temperature.	Rainfall.	Temperature.	Rainfall.	Temperature.	Rainfall.	Temperature.	Rainfall.	Temperature.	Rainfall.	Temperature.	Rainfall.	Temperature.	Rainfall.	Temperature.	Rainfall.	
																									Feet.
Leh	40·1	0·42	30·5	0·03	23·2	0·08	17·8	0·23	19·3	0·23	31·0	0·19	40·8	0 09	47·1	0·10	56·0	0.20	61·6	0·46	60·2	0·40	52·4	0·13	11,500
Kailang	42·1	0·40	32·0	0·66	24·1	0·60	21·2	4·87	18·3	3·07	29·2	3·33	36·4	3·34	45·8	1·72	54·1	1·20	61·1	0·95	60·3	0·87	54·4	0·66	10,000
Simla	55·9	1·37	48·8	0·33	14 8	1 06	10·6	2 84	41·1	2·71	49·5	3·02	58·4	2·82	63·4	4·67	67·1	7·87	64·2	19 30	62·9	18·12	61·4	6·02	7,000
Murree	58·4	2·18	49·1	1·72	43·2	1·22	38·8	2·78	38·7	3·40	48 4	3 70	57·0	4·27	61 5	3·8	71·3	2·43	68·3	10·98	66·5	14·01	65·1	6·09	6,300
Multan	77·2	0·11	66·1	0·07	56·6	0·25	54·6	0·39	58·3	0·27	70 3	0·51	79 7	0·34	88·7	0·48	93·9	0·39	91·6	2·22	89·2	1·26	86·8	0·78	420
Sialkot	74·8	0·60	62·1	0·36	53·2	0·84	52·2	1·41	53 0	1·78	65·7	1·86	77·0	1·63	84·9	1·18	90·7	3·19	86·6	11·58	85·2	9·13	83·1	3·24	860
Pithoragarh (East of Almorah in Kumaon)	61·1	1·32	57·1	0·05	53·3	0 79	48·7	1·83	50·3	2·38	59·0	2·11	67·0	1·39	68·2	3·31	71·4	7·27	71·1	12·71	70·3	11·02	69·8	4·83	5,300

"1. THE CHIEF CROPS OF THE HIGHER NORTH-WESTERN HIMALAYAN REGIONS THAT MIGHT BE FOUND SUITABLE FOR NORTH-WEST CANADA.

In the upper tracts of Lahoul only one crop is got; it is sown in May and reaped in September. The crop consists of barley, wheat, and buckwheat—barley being the chief. But Lahoul is not self-supporting although Spiti is; wheat, barley and rice are regularly imported from Kulu. There are no vegetables or minor crops grown, peas are cultivated to a certain extent.

"*1st, Wheat.*—There is said to be grown a peculiar form with six tiers of grains to each ear; this is met with in the district of Patten in Lahoul and from Kibbar downwards to Spiti.

"*2nd, Barley.*—In some parts of Lahoul a double harvest is got, barley occupying the soil for only about ten weeks. This form of barley is known as *tangzad*, and is probably the best form to send to Canada. It is followed by the form of buckwheat known as *bosotan*. This ripens in two months. In bad years the buckwheat does not ripen, so that the practice of taking only one crop is considered safer; a barley which requires a longer time to ripen is in that case sown in one field and the ordinary form of buckwheat in another, both sowings occurring in May. Parched barley flour made into porridge is the everyday food of the people of Spiti. It is also eaten boiled with butter and green herbs into a kind of soup; wheat flour is generally eaten in this way in Lahoul.

"*3rd, Buckwheat.*—There are two species of this grain grown in the Himalaya, with perhaps several cultivated forms under each, which are known to the hill tribes. The species are (*a*) *Fagopyrum esculentum* and (*b*) *F. tataricum*. Much confusion exists in the vernacular names given to these plants, and it is probable that the *orgal* or *daràn* (referred, by Stewart, to *F. emarginatum*—a form now reduced to *F. esculentum*) may be *F. tataricum*. Stewart gives the following Panjab vernacular names for *F. esculentum*—*Kàla trúmba;* Chin, in the Jhelam basin (chin, china, or chena is by most authors given to Panicum miliaceum) *Karma, bres, Katú. Brapú, drawo* in the Chenab; *Bres, Katú, phaphra* in the Ravi; *Káthú* in the Bias; *Bras, phâphrâ, ugoújal, tsabri* in the Sutlej, *Kâthú trâo*, in Spiti; *Trào, rjao*, in Ladak; *Kaspat* in the Panjab—the bazaar name.

"For the other form most of the above names are also given, but *orgal or úgal* seems more frequently applied to it.

"Buckwheat may be said to be the staple food with the Lahoulis; it is boiled whole and eaten as gruel, or roasted and made into flour, which is then baked into cakes and mixed with *chawg* beer and formed into dumplings.

"*4th.*—The inferior millet—*China* or (Chena?) *Panicum Miliaceum*—is said to be grown to a small extent in Spiti. But up to 7,000 feet most of the millets are also grown, and it may be doubted which might succeed best in Canada. Seed should be got in Kulu or Simla.

"There are no fruit trees to speak of in Upper Lahoul and Spiti; the apricot grows, but does not seem to fruit well, and the same remark may be made of the walnut. Both these fruits might, however, succeed in Canada, and although they doubtless are there already our higher Himalayan kinds might prove better suited to the colder tracts of Canada than the European forms of these fruits which are generally cultivated in Canada and America. The Himalayan horse-chestnut would also probably thrive; the fruits of the last mentioned tree are in the Himalayan tract sometimes used to feed horses.

"The system of cultivation pursued in Lahoul and Spiti is simple, and the produce not of the first quality. The field is artificially irrigated; when the water has soaked in, the seed is scattered broadcast and ploughed. Except perhaps a little weeding nothing more is done, although every now and then as required the field is flooded from the neighbouring rivulet. The irrigation pursued in these higher Himalayan tracts would perhaps not be so necessary in Canada, since in the latter country the rainfall is greater than in Lahoul and Spiti. Imported rice is used along

with barley in the brewing of the beer known as *chawg*. Many wild plants are eaten as vegetables, but none are cultivated. Thus there is nothing of much value in Lahoul; but, passing lower down the hills into upper Kulu, there are crops of greater importance which may be added to the above. About 24 per cent. of the cultivated area of Kulu produces two crops, but although every field is not twice cropped there is both a *kharif* and a *rabi* season. A spring or *rabi* crop is rarely grown in land to be cultivated in the *kharif* season with rice, of the *rabi* crop 92 per cent. consists of wheat and barley in the proportion of 3 of the former to 1 of the latter; of the remaining acreage 5 per cent. is under poppy and 1 per cent. under tobacco, leaving 2 per cent. for lentils and oil-seeds. Of the autumn or *kharif* crop 83 per cent. consists of the following crops: rice 25 per cent., maize 12 per cent. *sariári* (*Amarantus paniculatus*) 14 per cent. The last mentioned plant is known around Simla as *bathu* or *chau*. *Kodra* (*Eleusine corocana*) 8 per cent., *Káthú*, (*Fagopyrum esculentum*) 6 per cent., *Kodra* is one of the grains from which *Sur* (spirits) or *lugri* (beer) is commonly made; bread is also prepared from its flour, but for the purpose of Canadian cultivation, it may be doubted whether the *Amarantus*, buckwheat or millets, would ever likely meet with favor. They do not yield grains which Europeans would seem likely to eat readily, and it would therefore be desirable to send such crops as might be expected to meet with favour. Among these an important place should be given to :—

"*5th, Rice* (*Oryza sativa*).—This is the most important of the autumn crops in Kulu, but it can only be grown where water is plentiful. All irrigated land is devoted to this crop. The rice is first sown in flooded nurseries and then transplanted when some seven or eight inches in height. It is dibbled into the inundated ground, the plants being about six inches apart each way, and the field kept flooded for at least two months afterwards. There are three forms of rice met with in Kulu, and these are known as *basmati*, *jatu* and *sukadas*, the first-mentioned being the finest and most expensive kind. But the rice from Yarkand would succeed far more likely in Canada than any Indian form. The winter in Yarkand is too severe for wheat and barley to be sown in autumn, but a summer wheat, barley and rice are sown and may be seen being reaped in adjacent fields.

"These remarks regarding rice are equally applicable to the hill rices of Simla, Murree and Pithoragarh, although it is probable that the rices from the higher altitudes of Kulu would be preferable to any others. In most parts of India a rice is known as the 60 days' rice because it only occupies the soil for that period. It is not known whether a form exists on the hills that possesses this property, but such rice, if it does exist at high altitudes, would be preferable for Canada to any others. Plains' rice would in all probability be quite unsuited unless Sialkot or Multan possess a form grown in sixty days during the coldest months.

"*6th,* PULSES.—There are several pulses grown at Kulu, and most of these would succeed well in Canada; but it is probable those from the plains or lower hills would grow equally well. In Kulu the following are grown *Kult* (*Dolichos biflorus*); *mah* (*Phaseolus radiatus*): *matar* or *kalon* (*Pisum arvease*); *masur* (*lentils, Ervum lens*); gram, *chola* (*Cicer arietinum*). *Glycine soja*, the Soy bean, is said to be grown in Yarkand, and would perhaps do in Canada if seed from Alpine stock were procured. Of the pulses perhaps none would be so much appreciated as gram. Experiment alone will determine whether it will succeed, but as a cold season crop it is grown throughout India, and in Kulu it is also cultivated as a rabi crop; so that it seems possible it would succeed well enough in Canada if seed from Simla or Kulu were procured.

"The form most likely to prove suitable is the white kind generally known as Kabuli, but there is a truly Alpine species, *Cicer soonjaricum*—a pure white seed much appreciated in India for sweetmeats—grown at altitudes from 4 to 12,000 feet, chiefly in Kulu and Ladak.

"*7th, Maize or Indian corn.*—This is a comparatively recent crop in India, having come originally from America; but as the result of Indian cultivation several well marked forms have been produced, the most striking being those which grow

high up the Himalayas. It is doubtful, however, if even these would succeed in Canada, but as the grain could easily be procured in Simla, or better still in Kulu, it might be worth while sending a selection of samples. Maize from the plains would be quite useless, but if procurable Yarkand stock would be better than Himalayan.

"*8th.*—In Kulu and in most parts of the hill stations *Ipomœa Batatas* sweet potatoes, are grown. In Kulu they are known as *Kachá ú*. It seems probable these may have been introduced into Canada already, but if not they might be worth trying.

"*9th.*—The Jerusalem Artichoke (*Helianthus tuberosus*) grows so freely at 8,000 feet in Simla, that it is perhaps worth while mentioning it in this list.

"Potatoes are also of course grown all over the hills, even up to 12,000 feet at Kailang. An indigenous tuber that is even more extensively grown may be added to the above list of higher Himalayan products, namely:—

"*10th.*—*Colocasia antiquorum*, the *ghuiya*, an aroid, the corms of which are largely eaten by the hill tribes, and grown up to 9,000 feet in altitude. After boiling they are rendered wholesome, especially if a little acid be added to the water in order to dissolve the mechanically poisonous crystals which are contained in the cells of most aroids.

II.—The Intermediate Himalayan Regions.

(Represented in these notes by Simla and Murree).

Having included Kulu in the previous remarks, the plants of the present region have been practically disposed of. Millets, rice and pulses occupy the land after the removal of the rabi (or winter) wheat and barley. It is commonly stated that several forms of *Chenopodium* are grown at high altitudes in Lahoul. This may be the case, but they seem more prevalent at about 7,000 to 9,000 feet. They are sown about midsummer and ripen in autumn.

11th.—*Chenopodium album* the *betu sag* of the plains of India; the *gua sag, lunak, irr*, or Kala bathu of the Panjab hills; and the *em* of Ladak, yields a small grain but the leaves are also eaten as a spinach. There are many very distinct varieties.

III.—The Lower Himalayan Regions.

"In addition to what has been said regarding Kulu and Simla rices, it may be here added that some of the forms of Kumaon rice hold a high place in point of quality. The *básmatí* and *hunsraj* rices of Kumaon sell for 5 to 6 seers (12 lbs.) for the rupee (2 shillings.) The wheat of this region also might be sent with some hope of its succeeding. Millets, pulses and ground tubers and bulbs are also extensively grown, as well as a large number of forms of gourds, pumpkins, melons, and cucumbers. The cucumbers of the lower hills attain a large size (? according to some writers these are melons not cucumbers) and with the hill tribes constitute an important article of diet. Although Canada already possesses a large number of these vegetables, it is probable that some of the Indian forms would be esteemed as valuable *additions*. The seed might be procured from Kumaon. The Soy bean (*Glycine Soja* or *bhut*) is largely grown and ripens in October. This is perhaps the most nutritious of all pulses and the one that hitherto has commended itself most to Europe. It seems probable that Canada would be found too cold for it, but seed might be procured in Kumaon both of the black and of the white variety.

IV.—The Plains.

"The above remarks have to a large extent covered all that need be said here. It seems very doubtful if any of the plains' wheat, rice or barley would grow in Canada; but any of the other minor *rabi* crops which are sown in December and January, and ripen in March or April might be added to the list given, such as the *rabi* pulses, more particularly gram and glycine. It seems probable that of all the crops recommended gram (especially the white Kabuli form—*Cicer Soongaricum*)

stands the best chance of proving useful, and therefore seed from all four regions might be furnished of that plant.

GEORGE WATT,

Reporter on Economic Products.

SIMLA, 21st May, 1888."

"In a letter since received from Lahore from E. B. Steedman, Esq., Director of Agriculture, Panjab, information is conveyed of the despatch of four boxes containing seven bags of wheat and seven of barley for experimental test, in this country and since then advice has been received of another box containing samples of barley and gram which has been sent from Calcutta. Mr. Steedman says "I also forward copies of notes received as to the cultivation of the different samples sent. It must be remembered that the conditions of cultivation in Lahoul and Spiti are very different from those in the other tracts of Kangra, Palampur, Kulu, Seoraj and Simla. In Lahoul and Spiti the wheat and barley are sown in the spring after the snow melts and are reaped at the end of the summer. In the other tracts they are sown in the autumn and are in the ground through the winter. Lahoul and Spiti are also almost beyond the area affected by the monsoon rains. They receive only a slight rainfall between 15th June and 30th September, while in the five other tracts the rain is heavy during these months. "Kungi," the disease mentioned, is rust and is brought on by damp, cloudy close weather. We do not suffer very much from it in the Panjab proper, but I am not able to say to what extent crops suffer in the Himalayan Districts. In one or two places the outturn seems to me to be put much too low in the notes. I expect that from 8 to 12 maunds—a maund of grain weighs 80 pounds—for wheat and 10 to 14 maunds for barley is a fairer estimate of the annual outturn."

The following are the notes referred to by Mr. Steedman:

BRIEF NOTE ON THE CULTIVATION OF WHEAT AND BARLEY GROWN AT HIGH ELEVATIONS IN THE SIMLA DISTRICT.

Wheat.

"About the 14th July the grass on the field is cut down with a sickle and scattered about. The grass rots within three weeks and serves as manure. From 15th August to 14th September the land is tilled, and from 15th September till 14th October the wheat is sown. The land is ploughed a second time before the sowing, sometimes a week before if time admits. The land is manured for a month and a half after the wheat sprouts. Reaping commences by 11th June, and ends about 28th July. The wheat is sometimes subject to a disease called "*Gàndi Garyim*" the effect of which is to make the grain round and black and to reduce it in weight. It is then useless for human consumption. Wheat is generally cultivated on Barani lands of high elevation. Three and one half seers* of seed produce about one maund (40 seers) of wheat.

* A seer is equal to two pounds.

Barley.

"The same remarks apply to barley, except that barley is not so subject to the disease above mentioned as wheat, and that five and one half seers of seed produces about two maunds of barley.

W. COLDSTREAM.

Deputy Commissioner.

SIMLA, 10th July, 1888.

NOTE ON THE CULTIVATION OF WHEAT AND BARLEY IN THE KANGRA DISTRICT, AVERAGE ELEVATION, 3,000 FEET.

Question.	Answer as regards Wheat Cultivation.	Answer as regards Barley Cultivation.
"Nature of land used	Is sown in both irrigated and unirrigated lands.	Is sown in both irrigated and unirrigated lands.
Sowing time.	From 1st November to 15th December If the rains are seasonable the crop is sown at once, but if the rains hold off the sowings are deferred till the third week in January, after which no wheat is sown.	From 15th October to 15th November in both kinds of land.
Harvest time.	From 1st to 20th May in irrigated, and from 20th April to 10th May in unirrigated lands.	From 20th to 30th April.
Manuring and irrigation	Both kinds of lands are manured, but only the irrigated lands are watered, namely, the lands are manured before ploughing and irrigated afterwards. After ploughing the seed is sown, and irrigation is not resorted to till plants are well up on the ground. If the January and February rains fail, further irrigation is called for.	Both kinds of lands are manured and irrigated as wheat land.
Average produce per acre.	The maximum produce per acre is eight maunds, and the minimum two maunds.	Same remarks as wheat.
Diseases.	In unirrigated lands the wheat crops are not subject to any disease, but in irrigated lands, if the January and February rains are heavy the crops generally suffer by a disease called "*kungi*" which dries up the grain and roduces it to dust.	No disease at all.

"NOTE ON THE CULTIVATION OF WHEAT AND BARLEY IN THE PALAMPUR DISTRICT, AVERAGE ELEVATION, 3,000 FEET.

Wheat.

"An acre of irrigated land yields about five maunds of wheat. Manure is used, but not in sufficient quantities. The time for sowing is the first three weeks of January, and for harvesting last week of May and first week of June. The wheat is subject to a disease called "*kungi*," which occurs when there is a failure of rain.

Barley.

"An acre of irrigated land yields about eight maunds of barley. Manure is not available in sufficient quantities. The corn is sown in Asanj, *i.e.*, September and October, and the crop is cut in May.

NOTE ON THE CULTIVATION OF WHEAT AND BARLEY IN LAHOUL, AVERAGE ELEVATION, 11,000 FEET.

"Sown in Besakh (March and April) cut towards the end of Asanj (beginning of October). For wheat a stony (pathreli) soil is preferred, and for barley a clean, clayey soil free of stones. For both crops the soil is abundantly manured, and the

lumps of earth are broken down. Both are irrigated. When the shoots are six inches high, weeding is performed; a week after weeding is finished a watering is given, and afterwards waterings are given at intervals of ten or twelve days till the harvest is ripe. The crop is weeded again when the ears begin to form. The average outturn is fivefold. Both crops are sometimes, but rarely, attacked by a disease which blackens the ears and grain.

"In sowing, the pebbles are first cleared out of the soil; then manure is applied: then the land is ploughed and the seed sown, and the soil levelled with a roller.

The seed now sent was grown in *Keirdang* and *Gookir* villages.

"NOTE ON CULTIVATION OF WHEAT AND BARLEY IN THE SPITI VALLEY.

The average altitude above the sea of the cultivated land in Spiti is 11,000 feet. The fields are irrigated by channels fed by the Mountain torrents. Both wheat and barley are sown in April; if the snow lies late earth is thrown upon it to make it melt quickly. Both crops are manured plentifully with cattle, goat and sheep dung. The first watering is given 40 days after sowing, and thereafter waterings are given at regular intervals till the crop ripens. The harvest is reaped in August.

"The Nono (Governor of Spiti) puts down the outturn as 20 fold, but Major Hay's estimate is probably more correct, *i. e*, 14 to 1 for barley and 10 to 12 to 1 for wheat. The crop is liable to be injured by frost, but seems to be subject to no kind of disease.

NOTE ON CULTIVATION OF WHEAT AND BARLEY IN KULU.

The grain sent was produced at an elevation of 7,000 feet above the sea, about 100 miles to the North of the Village from which the Seoraj grain was obtained, in the Bias Valley.

"The barley is sown between 5th and 25th September, and reaped from 15th June to 14th July; wheat sowings go on during the whole of September, the harvest is reaped at the same time as that of barley. Manure is thrown on the soil, and also sheep and goats are penned on the field before sowing, for both crops. The soil is not irrigated. A too heavy snowfall is fatal to the crop; heavy rain causes the disease called *Kungi*, before described; and in case of drought in April or May a green insect (here called *Mangnu*) attacks the ear. The outturn of wheat averages from 5 fold in bad seasons to 10 fold in good; and of barley 8 fold to 16 fold.

NOTE ON CULTIVATION OF WHEAT AND BARLEY IN SEORAJ.

"The grain sent was produced at an elevation of about 7,000 feet above the sea, in the Sutlej Valley.

Wheat.

"Ploughing commences about August 15th. The seed is sown between 5th and 25th September, and the harvest reaped in July. A comparatively poor soil is preferred. The land is manured before sowing commences, generally by sheep being penned on it for some nights. No irrigation is used. The outturn is reported as 4 fold but is probably greater. The crop is subject to a disease called *Kungi* described as a red dust gathering on the ear, due to excessive moisture in the soil at sowing time.

Barley.

"Ploughing commences about 15th August. Sowing goes on from the end of September to the beginning of November. Reaping begins generally about the end of June. A rich soil is necessary. No manure is given till the young shoots are 5 or 6 inches high, when manure that has been collected and kept is thrown on the field as a top dressing. No irrigation is used. The outturn is reported 6 fold but is probably greater. *Kungi* (described above) is the only disease to which it is liable.

True Copy.

PESTOUJI, *Superintendent.*"

OFFICE OF DIRECTOR OF LAND RECORDS
AND AGRICULTURE, PANJAB,
LAHORE.

These agricultural products of India which have been collected with so much care by the Government of India for the benefit of Canada, will be distributed among the several Experimental Farms, where they will be carefully tested and reported on. It is expected that some of these varieties of grain so long and successfully cultivated in India, will prove useful in the provinces comprising this wide Dominion.

Exhibits of Farm Produce.

Special exhibits of the products grown at the Experimental Farms were displayed at the Provincial Exhibition at Kingston, the Industrial Exhibition at Toronto, the Western Fair at London and the Central Canada Fair at Ottawa. The collections contained specimens of the different varieties of grain grown at the Central Experimental Farm, about 200 sorts in all, including bunches of heads from the field plots, as well as single plants of each sort. Large collections of potatoes were also shown, as well as field roots, fodder plants and beans. Photographs were also displayed of many varieties of strawberries and raspberries grown on the farm and represented exactly of the natural size. Samples of grain grown on the Experimental Farm at Indian Head, N.W.T., were also shown and collections of native grasses from both the Manitoba and North-West Farms. A small display of fruit consisting of some fine specimens of apples, pears and plums obtained from a small orchard on the Experimental Farm at Agassiz, British Columbia, was also an attractive feature. These exhibits attracted much attention, the various articles were arranged so as to be as instructive as possible. This effort to convey practical information to the visiting farmers was much appreciated and very favourably spoken of; while none of the collections were entered for competition, that shown at the Industrial Exhibition at Toronto, was awarded by the Directors a silver medal and a diploma in recognition of its excellence and usefulness.

Acknowledgments.

My warmest thanks are due to all the officers of the Central and branch Experimental Farms for the willing aid they have rendered in carrying on the important work we have in hand. The records of what has been accomplished are shown more in detail in the several reports appended. On the Central Farm the growth of the different varieties of cereals and other crops have been watched with the most careful interest by the farm foreman, Mr. John Fixter, to whose accurate records I am indebted for much of the information gained.

WM. SAUNDERS, F.R.S.C., F.L.S., F.C.S.,

Director Experimental Farms.

REPORT OF THE CHEMIST.

(FRANK T. SHUTT, M.A., F.I.C., F.C.S.)

LABORATORY OF THE CENTRAL EXPERIMENTAL FARM,
OTTAWA, 1st December, 1888.

WM. SAUNDERS, Esq., F.R.S.C., F.L.S., F.C.S.,
Director, Dominion Experimental Farms,
Ottawa.

SIR,—I have the honour to submit to you the second annual report on the work of the Chemical Department of the Experimental farms accomplished by me since last February, the date of my first report. This report consequently contains but the result of nine months' labour. It consists of first an epitome of the chemical analyses made of various substances relating to agriculture, and secondly, an account of my inspection of English and Continental Laboratories, and of some of the Experimental Stations of Germany visited during the past summer.

WHEAT.

In the concluding paragraph of my last report mention is made of a series of analyses of various wheats, chiefly the Red Fife and Ladoga varieties—then just begun. The original Ladoga grain was imported from Russia and was grown in a latitude some 600 miles north of that of Ottawa, where the summer is consequently much shorter than in our North-West Provinces. During the summer of 1887 a large number of farmers in the various Provinces of the Dominion cultivated this wheat from samples supplied to them by the Experimental Farm at Ottawa. Accompanying the samples was a request to sent in a report on the growth, yield and length of time required by this wheat to mature. It was also requested that a specimen of the grain reaped from the sample be forwarded to the Farm. By this means it was expected that definite and reliable information would be obtained as to whether this wheat ripens earlier than the Red Fife and would thus be likely to escape some of the early frosts occasionally so detrimental to the wheat crop of the North-West. All important as the questions of yield and early ripening are, there remains another of equal consequence—the composition of the wheat. This could only be ascertained by chemical analysis. To arrive at the respective values of the Red Fife and Ladoga wheats from the chemical standpoint—was then the object of the investigation. In February, when the work was begun, we were unable to obtain the flour of the Ladoga wheat manufactured by the Roller process. The analyses of all the samples was consequently made on the whole grain, and are thus strictly comparable. My report on this work was completed last June, but publication has been deferred in order that the results of some direct determination of the gluten in Red Fife and Ladoga flours, from samples of these varieties of wheat lately ground might be added. This report will be issued in bulletin form for distribution among the agricultural population and others interested in this important matter. It contains, in addition to a full account of the constituents of the wheat, the deductions which may be drawn therefrom. I shall here, therefore, give but a synopsis of the extent of the work and the conclusions reached.

Twenty-eight samples of wheat were analysed, as follows: twelve of Ladoga, six of Red Fife, three of Saxonka, two of Kubanka and one each of the following

varieties, Onega, Red Fern, Clawson, Wellman's Fife and Blue Stem. The Ladoga specimens include the original importation from Russia and grain grown from this seed in the North-West Territories, Manitoba, Nova Scotia and New Brunswick. One sample of the Red Fife was grown in Ontario; the others in the North-West Territories and Manitoba. Of the other wheats I need not here make further mention, as full and detailed accounts of their composition appear in my report before mentioned. After a thorough examination into the composition and physical qualities of these wheats I am enabled to draw the following conclusions:—

1. That the Red Fife and Ladoga wheats have an almost equal proportion of gluten, as determined by chemical analysis; the difference being however in favour of the latter variety.

2. That by the cultivation of the Ladoga grain in the North-West a marked increase in the percentage of gluten has taken place in some instances.

3. That there appears to be a direct ratio between the percentage of albuminoids and the weight of grain, viz., the heavier the individual grain the greater the proportion of albuminoids.

4. That with respect to size, weight and hardness of the grain, the Ladoga compares very favourably with the Red Fife.

5. That the Manitoba hard wheats (Red Fife and Ladoga) most certainly equal in value the best grown in the States of Minnesota and Dakota; and this deduction is made from my own and Prof. Richardson's results.

6. That the crude gluten as determined by mechanical means is present in the Ladoga and Red Fife flours in almost identical proportion.

Sugar Beets.

During the past summer several varieties of sugar beets have been grown at the Central Farm. Nos. 1, 2 and 3, are from seeds supplied by Wilfred Skaife, Esq., president and manager of the Berthier Sugar Beet Factory of Berthierville, P.Q. The Wanzleben variety was from seed purchased from Haage & Schmidt, seedsmen of Erfurt, Germany.

On analysis they are found to contain the following amount of sugar:—

No. 1	12·52	per cent.
No. 2	12·50	"
No. 3	12·00	"
No. 4. Wanzleben variety	10·38	"

The quantities of sugar in different varieties of sugar beets may vary much. The minimum percentage is about 8, and the maximum about 15; the greater number of specimens yielding between 11 and 12 per cent. The first three of those examined possess therefore an average amount, while the Wanzleben variety falls below the mean.

As the beet-root sugar industry promises to be one of great importance in Canada, the investigation into the value of the respective varieties of sugar beets will be continued during the ensuing year.

Marl.

During the past year several samples of this fertilizer have been received for analysis accompanied with a request for information as to its value and use. As large deposits of this mineral occur in different parts of the Dominion which are of easy access to agriculturists, I propose as soon as time permits, to write a bulletin that will put before the farming community the true worth of this substance and at the same time give full instructions as to the most advantageous methods of its use and application as a fertilizer. In the meantime I insert here the following reports lately issued as being of general importance:—

LABORATORY OF THE EXPERIMENTAL FARM,
OTTAWA, 8th November, 1888.

J. A. BARRON, Esq., M.P.,
Lindsay, Ont.

DEAR SIR,—I have submitted the sample of marl sent by you to chemical analysis, which shows it to have the following compo-ition :—

Moisture	·20
Volatile and organic matter	1·61
Clay and sand	·50
Lime (CaO)	53·27
Magnesia (MgO)	·77
Iron and Alumina (Fe_2O_3, Al_2O_3)	·59
Alkalies	traces.
Carbonic acid (CO_2)	42·60
Phosphoric acid (P_2O_5)	·28
Soluble silica (SiO_2)	·12
	99·84

Carbonate of lime ($CaCO_3$) 95·12.

This is an exceptionally pure specimen of marl, consisting essentially of carbonate of lime. Phosphoric acid is present in small quantities, but the alkalies are to be found only in traces.

The value of marl as a fertilizer depends, 1st, on its chemical composition, and 2nd, on its mechanical texture.

The important ingredient of marl is lime, present in the form of a carbonate. The presence of phosphoric acid and the alkalies, especially potash, increases the value of this fertilizer, as both are essential ingredients of plant food. But besides supplying these elements (lime, phosphoric acid and potash) directly for the growth of plants, marl has a tendency to liberate the combined phosphoric acid and potash in soils that have been hitherto insoluble and unavailable for plant use. Marl also promotes, though slowly, the oxidation of humus in peaty soils, converting the inert nitrogen of the same into an active form.

Its mechanical condition should be such as to allow it to easily disintegrate when exposed to the weather, and thus be in a condition to mix thoroughly with the soil. Its application then to clayey soils is to render such mellower and lighter to work, and at the same time to allow the roots and rootlets of the plants more easily to penetrate and thus gain nourishment from an increased area. Its influence on sandy soils is to render them heavier and vastly improve their absorptive powers for moisture and manure.

Marl may therefore be advantageously and profitably applied to soils known to be deficient in lime and also to clays and sandy loams, both for the supplying of this element and the improvement of their mechanical condition.

The best time for application is in the autumn, the marl being then carted on to the fields and spread. The action of the atmosphere, the rains and frost during the ensuing winter should then thoroughly disintegrate it, and thus allow a perfect mixing with the soil in the spring.

FRANK T. SHUTT, M.A., F.C.S.,
Chemist, Dominion Experimental Farms.

Without giving *in extenso*, the reports written on the following specimens analysed by me, I will here simply state their composition, and add such remarks as may be necessary to a correct knowledge of their value and use, in addition to those contained in the foregoing report.

The following table shows the composition of a specimen of marl forwarded for examination and report by Mr. J. H. Vanderlip, of Erin, Ont. :—

Moisture	·30
Organic and volatile matter	2·29
Clay and sand (insoluble in acid)	·77
Iron and alumina (Fe_2O_3, Al_2O_3)	·50
Lime (CaO)	51·61
Magnesia (MgO)	1·32
Carbonic Acid (CO_2)	43·10
Phosphoric Acid (P_2O_5)	·20
Soluble Silica (SiO_2)	·24
	100·33

The large percentage of carbonate of lime, 92·16 per cent. and the small quantity of insoluble matter, make this a marl of great value as a fertilizer. Its easy disintegration by water will allow it, after exposure to the weather, to freely mix with the soil.

This sample was taken from a swamp, and it contains 2·29 per cent. of organic matter due to the accumulation of vegetable matter while the marl was being deposited. This would possess nitrogen in a form more or less readily convertible into plant food. The notable quantity of phosphoric acid, evidently derived from the same source, also enhances its value.

Mr. Robert Armstrong, Kirkfield, Ontario, sent in two samples of marl which he wished to have analysed and reported upon with the view of introducing them as fertilizers in his locality.

No. 1:—

Moisture	16·68
Organic matter	6·01
Clay and sand	1·27
Iron and alumina (Fe_2O_3, Al_2O_3)	·40
Lime (CaO)	41·35
Magnesia (MgO)	·50
Soluble silica (SiO_2)	·11
Phosphoric acid (P_2O_5)	·26
Carbonic acid (CO_2)	33·00
Alkalies	·06
	99·64

Carbonate of lime ($CaCO_3$) 73·83.

This is a very fair sample of marl, though not equal in value to either of the foregoing examples.

No. 2:—

Moisture	4·53
Organic matter	19·51
Clay and sand	8·82
Iron and alumina (Fe_2O_3 Al_2O_3)	·74
Lime (CaO)	36·69
Magnesia (MgO)	1·06
Soluble silica (SiO_2)	·03
Phosphoric acid (P_2O_5)	·05
Carbonic acid (CO_2)	28·70
	100·13

Carbonate of lime ($CaCO_3$) 65·53.

This marl is very hard and of a slaty nature, and does not disintegrate or crumble in water. It is therefore of little value to agriculturists in its present condition.

and could not be recommended as a remunerative fertilizer. If, however, the marl were first well burnt it would be found to be more amenable to the action of the weather. Its application, if easily and cheaply obtained, might then be attended with profit.

River and Swamp Muds.

Four samples of "mud" or "muck" from different localities in Prince Edward Island have been received and analysed. This investigation has established by scientific proof the great value of these materials as fertilizers. That it is well worthy of the attention of farmers, in whose neighbourhood these muds are found, can no longer be matter of opinion or speculation. From these remarks, however, it must not be inferred that all samples of mud or muck have the same value. As we have seen in the case of marl, specimens from different localities vary in their composition and hence the necessity and importance of a chemical analysis in each case before conclusions as to the intrinsic worth can be drawn.

The organic matter which swamp mud and like substances contain, is the result of the partial decay of plants. Organic matter as a food for plants, depends for its value upon the percentage of nitrogen it possesses. The nitrogen of such humus is, as has been already stated, more or less easily converted into forms which can be used by plants, according to the amount of rainfall, temperature and condition and composition of the soil, and the nature of the nitrogen-holding substance. The amount of nitrogen, therefore, in a sample, is of paramount importance, and this is only obtainable by means of an analysis. Although phosphoric acid and potash appear to be always present (and when in notable quantities certainly to its enhancement as a fertilizer) it is chiefly as a nitrogen supplier that this mud must be considered and valued. From the relatively high percentage of nitrogen that these samples contain, I have no hesitation in affirming that their application to all soils deficient in nitrogen, whether clays or sands, especially where wheat or other grain crops are to be grown, will be attended with marked success and profit.

The samples analysed are all from the vicinity of Cardigan Bridge, P.E.I. It would therefore be unwise to infer that all "muds" of that island or of the Maritime Provinces are of equal value. Before generalizations can be made many more samples must be examined, and these from various localities. The analytical evidence from those already investigated, however, points strongly to the fact that we have in these swamp and river muds, a very valuable nitrogenous fertilizer.

The analysis of sample sent by Mr. J. W. Alley, of Cardigan Bridge, P.E.I., gives the following results:—

Moisture	1·89
Clay	16 66
Sand	59·33
Organic matter	11 73
Oxide of iron and alumina	6·26
Lime	1 09
Magnesia	63
Alkalies	·43
Chlorine	·66
Soluble silica	·29
Phosphoric acid	·14
Carbonic acid, &c.	·89
	100·00

Nitrogen in organic matter, ·254 per cent.
Insoluble in acid (clay and sand), 75 99 per cent.
Common salt corresponding to chlorine, 1·08 per cent.

Three specimens from Mr. F. D. McCormack, of the same place, are tabulated below:—

——	No. 1.	No. 2.	No. 3.
Moisture	2·28	1·57	12·34
Clay and sand (insoluble in acids)	68·22	76·30	4·07
Organic matter	14·68	7·32	72·06
Oxide of iron and alumina	10·16	7·68	3·60
Lime	·91	2·76	3·75
Magnesia	·89	·81	·25
Alkalies	1·02	·88	·99
Chlorine	·83	·40	Traces.
Soluble silica	·28	·20	·60
Phosphoric acid	·16	Traces.	·55
Carbonic acid, &c	·52	2·08	1·79
	100·00	100·00	100·00
Nitrogen in organic matter	·336	·243	1·70
Common salt, corresponding to chlorine	1·45	·66	

By a consideration of these figures it will be seen that Mr. Alley's sample and No 2 closely approximate each other in their composition and consequently in their value. No. 1 stands higher than these two on account of the greater percentage of nitrogen, phosphoric acid and alkalies. No. 3 is the best of all, and must be ranked as a first-class nitrogenous fertilizer. Besides the large quantity of this element which it possesses there is present over three times the amount of phosphoric acid found in the other samples. Under the term alkalies are included the oxides of potassium and sodium, commonly known as potash and soda. The value of potash far exceeds that of soda from an agricultural standpoint, for potash is an essential component of, and occurs in considerable quantities in, all plant tissues, while soda is absorbed by plants only in very small amounts, and most certainly cannot be substituted for potash as a plant food. It is, therefore, of importance in most instances to ascertain the relative percentages of these substances present in a fertilizer, so that its correct value may be arrived at. Contrary to my expectations I found the amount of potash so small in comparison with that of the soda as to render a separation of the two of little value. We find a reason for this excess of soda when we notice the chlorine present—the two being evidently combined as common salt. This salt is, no doubt, derived directly or indirectly from sea water.

Besides supplying nitrogen, humus—a generic term used to denote the result of partial decay of vegetable matter whether in soils, peat or swamp muck—may be considered of value from the products of its ultimate decay in the soil; chief among which is carbonic acid, most useful in conjunction with water in rendering soluble other plant food. It forms an admirable absorbent of moisture and ammonia, and from its mechanical texture and lightness is of great value in mellowing heavy clays and in "binding" sandy soils.

Although the application of peat and allied materials directly to the soil must in most instances be beneficial, yet for profitable use such substances as contain humus should first be submitted to a process of fermentation, whereby, as has already been pointed out, the nitrogen may be converted into an easily assimilable form. This, to some extent, is brought about by a simple exposure to air in heaps, but much more quickly by compositing with dung, fish, &c. I would therefore suggest to farmers who live in the vicinity of these river and swamp deposits to compost it during the winter with farm yard manure and then spread the result on the fields in the spring before ploughing.

Since writing the above I have received the following information:—The sample sent by Mr. Alley is from the bottom of the Cardigan River, the deposit where it was dug being about six feet in depth. He reports that farther down the river there are beds which extend for long distances, some approximating 20 feet in depth. Mr. McCormack reports that samples I and II are river mud taken at different spots in the vicinity of Cardigan Bridge. Sample III is from a swamp, the deposit being about three feet deep. The swamp is flooded during the greater part of the year.

Soil.

One sample of soil was analysed by me during the past year. It was forwarded by Dr. Bell, of the Geological Survey. I append the letter asking for my examination and report on the composition of the same, as both appear to me to be of sufficient general importance as to merit their insertion here.

Letter from Robert Bell, M.D., LL.D., Assistant Director of the Geological Survey of Canada.

Geological Survey, Ottawa, 3rd May, 1888.

Frank T. Shutt, Esq., M.A., F.C.S.,
Chemist Dominion Experimental Farms,
Ottawa.

Dear Sir,—I beg to send you a sample of soil from the Halibury Farm, on the west side and near the north end of Lake Temiscaming, and to ask if you will have the kindness to make a chemical examination of it. I spoke to our own chemist, Mr. Hoffmann, about it, but he said it was more in your line than his and recommended me to send it to you. I think it of importance to know something about the nature of the soil from a chemical point of view, as it prevails throughout a large tract around the above lake, and, in spite of its very light colour, it is capable of producing good crops. The sample I send was collected by myself immediately below the vegetable mould in a newly cleared piece of land. When ploughed up for the first time this soil looks hard and "cloddy" but soon falls to powder under the influence of the weather. It is not confined to any particular level, but is found at all heights and on both sides of the lake. Its almost white colour forms a singular contrast to the bright green of the vegetation growing upon it and I am curious to know if you can discover any chemical reason for the fertility of what might be taken for an unpromising soil. I shall, therefore, feel obliged if you can spare time to examine it and let me know the result, as I should like to refer to it in my report on the geology, &c., of the district. I may mention that attention is being directed to the country around Lake Temiscaming as a field for colonization. Many families have already settled there and some townships have been surveyed on both sides of the inter-provincial boundary.

I am, dear Sir, yours respectfully,
Robert Bell.

Analysis and Report.

Moisture	1·79
Clay and sand (insoluble in hydrochloric acid)	77·20
Volatile and organic matter	3·70
Iron and alumina (Fe_2O_3, Al_2O_3)	12·37
Lime (CaO)	1·12
Magnesia (MgO)	traces
Phosphoric acid	very heavy traces
Alkalies (K_2O, Na_2O)	·83
Soluble silica (SiO_2)	·03
Carbonic acid and undetermined	2·96
	100·00
Nitrogen in organic matter	·087
Carbonate of lime ($CaCO_3$)	2·00

Sulphates and chlorides are absent.

The soil is a clay loam of a light colour, and contains but little sand.

"I regret that the time at my disposal has not allowed me to make a more complete analysis, but from the figures already given the soil shows itself as one containing in fair proportions all the elements conducive to plant growth. Its mechanical condition or texture seems favourable to plant growth. I think it should be one that is sufficiently loose to allow the root fibres and air to freely penetrate and at the same time retain heat, moisture and fertilizing materials. The physical condition of a soil as well as its composition must be considered when endeavouring to ascertain its relative fertiitly. Indeed, the one is well nigh as important as the other; hence the value that is to be placed upon the latter portion of this report."

At the time of making the above report I was about leaving for England, and consequently could not make as full an analysis as I desired. Sufficient however was done to show that the soil is by no means an unfertile one, though not ranking as first class. Dr. Bell's testimony as to its fertility, bears out the result of my examination.

REPORT ON WELL WATER FROM ANTRIM P.O., ONT.

LABORATORY OF THE EXPERIMENTAL FARM,
OTTAWA, 2nd April, 1888.

WILLIAM SAUNDERS, Esq., F.R.S.C.,
Director, Dominion Experimental Farms,
Ottawa.

SIR,—I have the honour to report as follows respecting the quality of the well water of Mr. R. C. Sparrow, Antrim P.O. The well is said to be dug 25 feet and then bored to the extent of another 25 feet. Accurate information as to the naturo of the soil and the proximity of the well to the barnyard or other source of contami nation is wanting.

Chemical Analysis.

Free ammonia,	parts per million	.....	2·18
Albuminoid ammonia	" "	.....	·54
Oxygen absorbed in 15' at 80 F.	" "	.....	4·58
" " in 4 hrs. at 80 F.	" "	.....	7·82
Chlorine	" "	.....	190·00
Total solids	" "	.....	1,195·00

Phosphates, very heavy traces.

The water has a disagreeable odour, is slightly yellow and contains small quantities of sediment.

This water I must unhesitatingly condemn as a potable water, and would advise the immediate discontinuance of its use for drinking purposes and watering cattle.

Not knowing the exact position of the well, I am unable to say whether cleaning it out would be of much value. I am inclined to think, however, from the composition of the water, that the well acts as a cesspool to some degree, and in such case would probably have to be abandoned.

Respectfully submitted,

FRANK T. SHUTT, M.A., F.C.S.
Chemist, Dominion Experimental Farms.

It is hardly necessary for me perhaps to emphasize the tremendous importance both to man and beast of a pure water supply. I called attention to this subject in my last report, and suggested that an opportunity should be afforded to farmers (a small fee being charged if found necessary) of having their drinking water analysed. When the new laboratories are completed a special set of apparatus will be devoted to this work, and every facility for prosecuting this branch of chemical work will be furnished. Those desirous of having a sample of water examined should first write for instructions for collecting and sending the same.

TRIP TO THE CONTINENT FOR THE PROCURING OF APPARATUS; THE INSPECTION OF LABORATORIES, &C.

In the month of June last I left Canada for a short tour in England and Germany for the purpose of selecting the apparatus required in our new Laboratories and, at the same time, of inspecting the fittings and appointments of laboratories of universities, technical schools and institutions akin to our Experimental Farm, where analyses and experiments of an agricultural nature are carried on. At the same time it was intended to note the character and method of carrying out of agricultural experiments in these countries.

With regard to apparatus I may state that after visiting the chief houses in Germany I was enabled to make such a selection as was immediately required for use, and to such an extent as the means at our disposal would at present permit. I may point out that by thus ordering direct from the manufacturers not only is the quality guaranteed but also a great saving in cost effected.

As in my last report, I shall now give but an outline of the size and general appointment of the laboratories visited during the summer and pass over such details as would not be of interest save from a strictly scientific standpoint.

University College, Liverpool.

In England my first visit was paid to the Liverpool University College. The new chemical laboratories of this institution were erected in 1886, and have been so constructed and finished that for completeness, general arrangement and the introduction of modern improvements they stand among the very first in England.

The building is large and handsome, being constructed, in Romanesque style, of brick and terra cotta. There yet remains to be added to it two large laboratories before the completion of the design. The cost as it now stands, exclusive of site, was £16,000.

On the ground floor there is a theatre for practical work—the only one of the kind I believe in existence. The dimensions are 48 ft. 6 in. by 42 ft. 6 in. and is 19 ft. 6 in. in height. Here a large number of students can perform simultaneously with the demonstrator all experiments in qualitative analysis, and for the purpose of teaching large classes in this work it is said to answer admirably. For this end the benches are arranged in ascending and concentric tiers—the demonstrator's table being so placed as to be in view of the whole class. The benches are in sections, and thus form segments of the tiers, each bench accommodates two students, being 8 ft. long. They are fitted with gas and water supplies, fume chamber and cupboard for the storing of chemicals and apparatus. The preparation room is connected with the theatre. A lavatory, sulphuretted-hydrogen room, rooms for gas engine, dynamo and storage purposes occupy the rest of this floor.

The lecture theatre is on the second floor and giving accommodation to 212 students. Apparatus and diagram rooms, a private laboratory and museum complete this floor. Still higher are to be found rooms for microscopic and spectroscopic work. The building throughout is supplied with warm, fresh air, heated in underground channels by means of hot water piping. The heated air rises in vertical flues or passages

in the walls. Before entering to the rooms it passes through a spray of water to cleanse and moisten it—its currents being accelerated by a fan driven by the gas engine. Ventilation is secured by gas burners, and by means of a furnace at the base of a shaft, down which all fumes and vitiated air pass.

The organic laboratory, at present being used for quantitative analysis, is 28 ft. by 24 ft. Its walls are lined with glazed brick. The rooms throughout are supplied with hot and cold water, steam, hot air baths, fume chambers and evaporating niches. The working benches are of pitch pine with waxed walnut tops, presenting a very handsome appearance and at the same time withstanding the corrosive action of strong acids and alkalies. The gas and water taps are arranged in front of the benches, just below the top. The pipes from the same lead to nozzles issuing from the bench top at the back of the table; a most desirable arrang ement and one we have adopted in the new Farm laboratories.

The details of the laboratory fittings, &c., were worked out by Dr. Campbell Brown, the Professor of Chemistry, who by his valuable counsel has enabled the architect, Mr. Waterhouse, R. A., to design and construct this model of laboratories.

Owens College, Manchester.

The laboratories here were also designed by Mr. Waterhouse, in conjunction with Prof. Roscoe. The College, of which the laboratories form a part, is a magnificent pile in stone. Two large laboratories, each 50 ft. by 30 ft., and 29 ft. high, furnish accommodation for qualitative and quantitative work, and afford working places for about 100 students. On the same floor are balance rooms, rooms for gas and organic analysis, library and organic-chemistry lecture room. The lecture theatre, holding about 400 students, has adjoining it a lecturer's laboratory and is supplied with sinks, draught closets, &c. A laboratory for medical and evening classes is in the basement, where are also a metallurgical laboratory furnished with furnaces, lavatory, dark rooms for photographic and spectroscopic work, store rooms, &c. Evaporation niches are placed at intervals in the walls of the laboratories, and porcelain hoods to carry off fumes, and sulphuretted hydrogen closets are on each bench. All these are connected by glazed earthenware piping with the draught of the main chimney, which also carries away the vitiated air of the rooms. Fresh air is supplied by a down shaft, being drawn over hot water pipes and entering the rooms through gratings in the walls. Prof. Dixon, ably assisted by Dr. Cohen, has charge of the chemical department.

Manchester Grammar School—Chemical Laboratory.

Here, although the area is limited, accommodation is afforded for about 90 students in the laboratory—the arrangement being apparently perfect. The usual draught closets are found on the tables and between the windows. A special room is devoted to operations with sulphuretted hydrogen. The lecture room, apparatus room, preparation room and balance room are on the same floor—the second. A foul air shaft with central smoke flue withdraws all noxious gases from the rooms and draught places.

Yorkshire College, Leeds.

This college, together with University College, Liverpool, and Owens College, Manchester, is affiliated with Victoria University—now so widely known for the excellency of its science degree. Applied science in all its branches, as well as the fine arts and languages is here taught. I shall, however, as heretofore, confine myself to a brief description of the accommodation for teaching chemistry.

On the ground floor is the chemical lecture theatre, 65 feet long by 37 feet wide. It will seat nearly 400 students. Its lecture table is 21 feet long, amply supplied with all necessaries, and behind it is a draught closet, blackboard and a diagram frame, which latter is let down through a slit in the ceiling from a room above by suitable machinery. The table in the draught closet just mentioned can be run

either into the lecture room or into a preparation room behind it. A special laboratory, combustion room, metallurgical laboratory, museum and photographic room complete the accommodation devoted on this floor to chemistry.

On the first floor is the main chemical laboratory—the finest in the Kingdom. It is 62 feet long and 59 feet wide, and is used for both qualitative and quantitative work, the only division being a row of five columns—an arrangement highly spoken of. The benches provide room for about 50 students, and are furnished with water and gas, vacuum pumps, &c. At one end of this laboratory is the sulphuretted hydrogen room, distillation and engine rooms. The draught closets are situated between ten windows—there being none on the tables. Evaporation niches and places for distillation are ranged along one wall. Distilled water is conveyed by glass tubing from the still reservoir to glass taps in the columns before mentioned, from which it can be drawn off by the students. The walls of the laboratory are lined with white, glazed brick. The steam cupboards are of heavy brass and are of very substantial make. Dr. Arthur Smithells, the professor of chemistry, was away when I called, but through the kindness of the secretary I was shown over the college.

The City and Guilds of London Central Technical Institution, South Kensington, London.

This building was erected for the advancement of technical education, and by the adoption of the latest improvements in fittings, ventilation and heating is to-day one of the most efficient of all technical colleges.

As many of the details of the laboratories here are much the same as those already mentioned I shall not repeat them. The chemical lecture room, with attached preparation room, is on the ground floor. On the second floor are two large laboratories for advanced work, and also one for special operations. An electrochemical laboratory, crystallography room, another lecture room and a room for experiments involving unpleasant smells, furnished with a large flue, occupy the rest of this flat. The third floor consists of a large laboratory for junior students, dark room, balance room, photometric and polariscope room and a laboratory for gas analysis. The chemical fittings throughout were planned by Dr. Armstrong, the professor of chemistry, and are excellent.

The Chemical Laboratory, Cambridge University.

This building was not quite ready for occupation when I visited it, nevertheless it had so far progressed as to be very evident that when finished this university would possess a laboratory furnished with all the facilities and conveniences required at the present day in all the branches of chemical work. Before deciding upon the plans Professors Dewar and Liveing visited all the newly erected laboratories on the continent. The architect, therefore, with their assistance, has been able to erect a well arranged building thoroughly equipped throughout, for as has been said "a careful study of the plans of the chief continental and English laboratories recently erected has led to the adoption of every appliance which has proved successful." Its estimated cost is about £31,000. There is laboratory accommodation for 175 students working at once. The draught closets are here placed in the windows, and each is furnished with a separate flue. This plan is in vogue at Munich. The drains from the bench sinks and wastes are iron troughs, pitched on the inside, and run just below the floor, the boards of which in such places are movable. This is to allow easy access at all times to any part of the drains which may be temporarily choked The bench tops are of finished teak, a wood very highly spoken of for this purpose.

To enter into a detailed account of the various rooms for chemical work in this magnificent building, would occupy more space than is at my disposal, I can therefore but say that in addition to lecture rooms and students' laboratories, there are provided rooms for special operations; as for instance, there are two rooms for conducting experiments with easily inflammable materials, distillation of ether, &c., and another for working with chlorine and bromime. The usual store rooms, preparation and specimen rooms are throughout the building.

The laboratories of the Universities of Oxford and King's were also seen, but require no special comment here.

AGRICULTURAL LABORATORIES, &c., IN ENGLAND.

In England among those visited were the laboratories of Sir John Lawes and Dr. Gilbert, at Rothamsted, of the Royal Agricultural Society, Hanover Square, London, Royal Agricultural College, Cirencester, the Agricultural College, Downton, and those of the Aylesbury Dairy Company, London.

Experimental Farm and Laboratory of Sir John Lawes, Rothamsted, Herts.

For the past fifty years, unassisted by Government aid, Sir John B. Lawes, associated with Dr. Gilbert, has carried out experiments in agriculture upon his estate in Hertfordshire. Such has been the work of these gentlemen, that one may say that its value is incalculable. It is consulted, not only in England, but throughout the world, as of standard authority in questions of agricultural practice and science. Investigations extending nearly over half a century, and conducted with great skill and the utmost thoroughness and accuracy, have yielded results which may be said to have revolutionized the science of agriculture.

The present laboratory erected in 1855, where the chemical portion of the work is conducted by Dr. Gilbert with the aid of ten assistants, is found now to be too small. Consequently a new laboratory is about to be built, as well as another store-room, where can be placed the almost innumerable samples, which having accumulated during so many years, fill to overflowing the present quarters.

I was conducted over the farm and laboratory by Dr. Gilbert, to whom I wish to return my best thanks for his kindness in explaining to me the nature of the various experiments they were carrying out. It would be impossible to give any detailed account of these here, and it must suffice if I now merely outline some of the more striking ones.

In wheat, experiments have been made by growing it consecutively in the same soil for forty-five years. To some plots have been added farm-yard manure, to others artificial fertilizers, and in one instance the wheat has been grown without any manure. This latter plot yielded last year 14⅞ bushels of wheat, an amount equal to the average of the first 18 years, obtained from the same plot, showing the immense amount of fertilizing material in the soil which is gradually and from year to year rendered fit for plant food by the various atmospheric agencies. The value, however, of fertilizers is demonstrated by the fact that from some plots on which they had been used, an average of 35 bushels was obtained. The experience here has been that other things being equal, nitrogenous fertilizers, and especially nitrates (as nitrate of soda), are of the greatest value to the wheat crop.

A very important and interesting experiment with wheat is one in which five years ago the plot was uncropped—the grain being left to fall when ripe upon the ground and sow itself. Two years ago a few stunted ears were to be seen, but now not a single one. The rapidity with which the weeds have grown and choked the wheat entirely out of existence is amazing. From this result Sir J. Lawes infers that our wheat of the present day is of artificial development, and if the land were left uncultivated, fields would soon become so overrun with hardy weeds that the artificial crops would become killed out.

Another interesting and important experiment is that with grasses. The field in which this is conducted is of seven acres, and is divided into 20 plots. When observations were first made, in 1856, the herbage was uniform. Since then by the application of different fertilizers, comprising farm-yard manure, super-phosphate of lime, ammonium and potassium salts, the growth of the true grasses and leguminosæ

has been greatly modified. While on one plot there is now to be seen only a single kind of grass, on another we find several with one or two sorts predominant, and so on.

Much of the work undertaken at Rothamsted may be indicated as follows, but many investigations of a special nature cannot here be touched upon.

Field experiments, including comparative experiments with different fertilizers; rotation experiments, both with and without manure; experiments on growing the same crop year after year on the same land, with and without various fertilizers. The plants experimented with include those of all farm crops. Analyses, either partial or complete, are made of all the products of such investigations.

Experiments with soils. Over 1,650 samples of soil have been submitted to mechanical analysis. These specimens were taken at depths of 9, 18 and 27 inches, and, for special purposes, from two to four times this latter depth. Many have been subjected to full chemical analysis. Also the absorptive capacities for water and ammonia of many samples have been ascertained.

Rainfall and drainage experiments. To estimate the rainfall a gauge of one-thousandth of an acre and two other smaller ones are used. The nitrogen, present as ammonia and nitric acid, the chlorine and sulphuric acid have been determined in a number of the samples. Three drain gauges of one-thousandth of an acre are in use. The quantity of water percolating through 60, 40 and 20 inches of soil is ascertained. The water so collected is frequently analyzed. Besides these large gauges there are several series of smaller ones, arranged when special investigations are being carried on with fertilizers, &c.

Experiments with animals. Since 1847 several hundred animals have been experimented upon—chiefly oxen, sheep and pigs. Elucidation on the following points, amongst others, has been sought:

1. The amount of food, and of its several constituents, consumed in relation to a given live weight of animal within a given time.
2. The amount of food, and of its several constituents, consumed to produce a given amount of increase in live weight.
3. The proportion and relative development of the different organs or parts of different animals.
4. The proximate and ultimate composition of the animals in different conditions as to age and fatness, and the probable composition of their increase in live weight during the fattening process.
5. The composition of the solid and liquid excreta in relation to that of the food consumed.
6. The loss or expenditure of constituents by respiration and cutaneous exhalation.

Other investigations include the determination of the losses and changes which take place in the making of ensilage; the value of various substances as food-stuffs for fattening, production of milk, etc., etc.

Experimental Farm of the Royal Agricultural Society, Woburn.

At the Experimental Farm of the Royal Agricultural Society at Woburn, a similar work was begun in 1877. The primary object was to test by actual farm practice the accuracy of the estimated values of manures obtained by the consumption of different kinds of foods. Experiments on the continuous growth of wheat and barley, similar to those at Rothamsted, are also being made. A field of 16 acres is devoted to rotation experiments. There is also ground set apart for experiments in the growth of grasses and clovers, and a field for experiments with permanent pastures. Altogether there is about 50 acres under experiment.

Without inserting a large number of tables it is difficult to give an account of the results of these experiments. It is gratifying to learn, however, that similar

results in the main have been obtained at Woburn as at Rothamsted. Thus, plots unmanured for eight years, produced last year 23 bushels of wheat to the acre, showing that the amount of reserve fertility is hard to exhaust. Where only ammonium salts or nitrate of soda is used alone an increase in the produce has been obtained. It would appear that on the season depend the relative values of these two forms of nitrogen; nitrate of soda being used with greater advantage than ammonium salts in dry weather, the reverse being true in a wet season. Mineral manures alone give no appreciable increase over the unmanured plots. A combination of mineral fertilizers and ammonium salts or nitrate give the best results. On certain plots the nitrogenous fertilizer was omitted for a single year, the result being that the yield scarcely exceeded that of the unmanured plots. The renewed application the following year gave in return again the same increased yield. The analyses of the farm are made by Dr. Voelcker and his assistant, Dr. Leather, in the Society's laboratory in London, where also samples of linseed cake, fertilizers and of all kinds of agricultural products are examined for the members of the Society.

Rotation experiments with the ordinary four course of roots, barley, seeds, (clover, &c.) wheat, were inaugurated in 1877, and a comparison made of the produce when manuring with various fertilizers, including decorticated cotton cake and maize meal. They also include the comparison between manuring with the dung obtained by feeding certain quantities of these latter materials, and artificial manure calculated to contain the same amount of fertilizing constituents.

The results show that the maize meal did not produce more than the cotton-seed cake, relatively much richer in nitrogen—owing, no doubt, to the unexhausted supply of the element in the land operated upon. There appears to be a slight advantage in favor of manuring with the materials direct rather than with the dung obtained by feeding these materials—the amounts of both being calculated to contain the same proportion of nitrogen, potash and phosphoric acid.

At neither of the foregoing institutions are pupils taken. Sir John Lawes says that "experimenting and tuition cannot run together successfully. Our work is in one direction; others must take up that of tuition." This conclusion has been arrived at by all engaged in strictly experimental work and the principle has rightly been adopted upon our Dominion experimental farms.

The Royal Agricultural College, Cirencester.

This college was established at Cirencester, in 1845, under Royal patronage. It is well equipped for teaching the principles and practice of agriculture, having attached to it a mixed farm of 500 acres—400 acres of which are arable. The college buildings proper include a museum, lecture theatre, class rooms, chemical and biological laboratories, private rooms, dormitories studies, chapel, dining hall, library, &c. The farm buildings, erected at a cost of £4,000, are furnished with modern appliances, are very compact and include stables, piggeries, cattle boxes, &c.

The dairy, built in 1885, is a separate building of substantial structure. It comprises rooms for (*a*) the cooling and setting of milk and raising of cream, (*b*) the mechanical separation of cream by centrifugal force, and the churning and making of butter, and (*c*) for the manufacture of cheese of various kinds. It is furnished throughout with the modern appliances and utensils supplied by the Aylesbury Dairy Company. The dairy is worked on strictly scientific principles, the milk of each cow being weighed every morning and evening. Milk analyses are made and a record taken of the feeding and milk produced. The cow house is a separate building, well equipped with double stalls, to which the water is laid on. The breeds are—Shorthorns, Jerseys, Guernseys, Ayrshires, Red Polls and Kerries, and are excellent specimens of dairy cattle. A herd of about 500 Cotswold sheep are maintained—the produce from which is regularly sold. The farm is managed by a rent-paying tenant, but the college reserves to itself its use for instruction of the students in practical agriculture. It is said that "the practical business character of the farm

is more thoroughly ensured by undivided attention and large outlay of private capital." Classes are held every day upon the farm by the Professor of Agriculture and the Farm Bailiff.

A certain amount of experimental and research work with the cultivation of cereals, grasses, &c., and the comparative values of artificial fertilizers, in which the senior pupils assist, form a part of the work of the college, though necessarily where so much of the time of the professors is taken up in tuition, it cannot be prosecuted on any extensive plan. A botanic garden in which are representatives of the natural orders of plants, trees and shrubs, affords the students an instruction of great practical value.

The college course for the diploma extends over two years and one session, though there is a special course of one year for "out-students." An attendance of about 80 students is usual.

A very large staff of professors and lecturers is engaged in teaching agriculture and its allied sciences.

The College of Agriculture, Downton.

This college affords instruction in all the branches of agriculture, and possesses a large mixed farm for practical tuition in general farming and dairying. The farm, consisting of some 600 acres, is worked by the college,. About 120 acres are in pasturage, supporting a dairy of 40 cows. A heavy stock of Hampshire Down sheep is kept—the flock numbering in July about 1,200. Two hundred acres are devoted to wheat growing. The dairy is fitted with the newest appliances and is managed on business principles. Other features of the farm are the breeding of pigs and poultry.

The laboratories comprise one for chemical work and one for natural history, and are well suited for their purpose. The museum contains a collection of all substances related to agriculture. There is here also a botanic garden and aboretum. The academic course is for two years, but students are advised to stay another year in order to perfect themselves in agricultural practice. A fair amount of experimental work is done here, but necessarily it cannot be undertaken on any large scale owing to its interference with the tuition and affairs of the students. The professors and lecturers number eight, and among them are some of the highest authorities on agricultural subjects in England.

To Professor Wrightson, the president and professor of agriculture, I owe many thanks for providing me with all information regarding the college.

LABORATORIES AND EXPERIMENTAL STATIONS IN GERMANY.

Not a little of the time I spent on the continent was devoted to the inspection of chemical apparatus manufactured by the larger houses in Berlin, Bonn, &c., &c. As the result of this I have been enabled to make such a selection of apparatus—it being ordered from six different firms—as would best fulfil our present requirements and at the same time come well within the appropriation for the purchase of the same.

Berlin.

The famous laboratory of the university here, presided over by Dr. Hofmann, of world-wide celebrity, was first visited. It was erected in 1866 on Georgeu Strasse, at a cost of £32,000. The laboratories are very large, two being 48 ft. by 31 ft., a third, for special work, 47 ft. by 24 ft., with combustion room attached. The

arrangements here are somewhat out of date and inconvenient, many improvements in laboratory fittings having been made since the date of its erection. Thus there are no passages proper, the rooms being used for such. This causes great inconvenience and annoyance to workers—especially to those engaged in the "balance room." Like the great majority of German buildings it is built on all sides of a central "hof" or qnadrangle, a plan which has been adopted recently in some large buildings in England as one that affords more light to the rooms than any other. The usual rooms for storage and for special operations are all found here, but as much better arrangements have already been described, I may now pass on.

The second chemical laboratory of the university, situated on Dorotheen Strasse, where Drs. Rammelsborg and Friedheim are professors, was also seen, as were also those of the Berg Akademie, Invaliden Strasse, and of the Landwirthschaftliche Hochschule, where Drs. Fernandez and Knorre respectively are professors. These laboratories are all well adapted to their purposes, and in point of furniture, appliances, apparatus, &c., leave little to be desired.

Special mention must be made of the laboratories of the Polytechnikum or Royal Technical High School, Charlottenburg, near Berlin.

Some idea of the magnificence of this building may be obtained on learning that its frontage is 670 feet, and the eastern and western wings 270 feet deep. The edifice is of stone, and four storeys high. It contains five hofs or internal open courts. The finishing of the interior is very handsome. Its erection and equipment cost over £400,000.

The chemical laboratory, together with the photo-chemical laboratory, constitutes another building, about 200 feet square, including two "hofs." The celebrated Professors Liebermann and Vogel have had their respective laboratories supplied with every appliance of modern invention for facility and convenience in prosecuting their researches and teaching their students. Everything here is of the best material, and bears the stamp of a high degree of finish. The beauty combined with the substantial nature, which both interior and exterior present, makes a visit to the polytechnikum a most pleasing and instructive one.

Halle.

The laboratory of the Chemisches Institut of which Professor Volhardt is president is old, and consequently does not present those features so characteristic of modern institutions. The Experimental Station here, however, is doing a most thorough and reliable work in original research in agriculture.

Leipsic.

The University of Leipsic, so justly celebrated, stands out as the most prominent institution of the city. Professor Stohmann, the professor of agricultural chemistry, most courteously showed me over his laboratories. He is engaged in a series of experiments on the heat of combustion of chemical substances, the result of which throw great light upon the value of feeding stuffs.

Möckern.

The Experimental Station at Möckern is devoted to experiments with animals, with the view of elucidating the relative worth of different cattle foods. Professor Kühn, assisted by six chemists, is engaged chiefly in what is known as "Respiration Experiments," for which a most elaborate and costly apparatus is provided. The foods are accurately analysed, as is also all the products after digestion. These researches require great care and skill, and time, but the results obtained are of universal importance to agriculturists. Kjeldahl's method for the estimation of nitrogen is solely used here. This process has become of general acceptance throughout Germany for the determination, both quick and accurate, of this element.

Göttingen.

The Experimental Station, under Professors Henneberg and Tollens, is part of the University system, though its buildings and grounds are distinct and separate. The laboratories, which are well suited to the work of a station, as well as those of the University proper, were inspected. Special forms of apparatus for extraction of fat by Soxhlet's method, the determination of nitrogen by Kjeldahl's process, and for estimation of fibre in plants, foods and agricultural products, were here seen, and so commended themselves to me that it is the intention to introduce them at our new laboratories. The relative value of potash, phosphoric acid and nitrogen as food for potatoes, wheat, rye, barley, Indian corn and grasses, is ascertained in the experimental plots. Other experiments conducted here are trials with subsoil, *i.e.*, growing plants in a soil devoid of humus. It is the practice here to leave on the outside of the plot a strip about two feet wide, the growth of which is not included in the experiment, thus avoiding any errors that might occur through the action of light, air, &c.

Among a host of different experiments on various lines, I noticed some in which a bearded wheat was being developed by selection and breeding. Such a wheat is required in Germany, where small birds in large quantities do great damage to the grain crop. It has been found that a heavily bearded wheat is proof to a large extent against the attacks of these marauders. The Wunderschön wheat, of which there are both summer and winter varieties, is a bearded wheat of great prolificness, and has been brought to its present marvellous state of perfection at this station.

A very convenient plan has been adopted here of laying tramways (upon which trucks are run) in the walks between the experimental plots. These tramways lead into the buildings where the produce of the plot is stored.

Stuttgart and Hohenheim.

The Polytechnikum at Stuttgart contains large chemical laboratories fitted up for teaching both qualitative and quantitative analysis. The usual lecture rooms and other rooms for special purposes are also found here.

Not many miles from Stuttgart is Hohenheim, where is a large Agricultural College and an Experimental Station. These are distinct and separate buildings. The college was a schloss or castle occupied by Duke Charles in 1768, and since devoted to its present purpose. A large number of students is in attendance. A well-tilled farm surrounds the college, upon which the students receive instruction in practical agriculture.

The experimental station, at some little distance from the college buildings, consists chiefly of chemical laboratories, under the control of Professors Wolff, Behrend and Riess. There is here a very large acreage under experiment—the plots being numerous and large. I noticed that trials with wheat, oats, barley, grasses and all kinds of root crops were being made. A label on each plot indicated the fertilizer and the amount of such, used. At a glance could be seen the effect of the omission in one case of potash—in another, of phosphoric acid, and so on. In another series was evident the result of soil exhaustion by continuously growing the same crop year after year. A day was spent here in taking notes on these instructive experiments.

Darmstadt.

There is a very well arranged and handsome laboratory at the experimental station here—now three years old. It may be looked upon as a model for chemical research in agriculture. It is well appointed, with plenty of light, and the apparatus and fittings are of the most approved kind. The special character of the work is ascertaining the value of different fertilizers as plant food, which is conducted by Professor Paul Wagner, assisted by a staff of expert chemists. The experiments are carried out for the most part in zinc pots of different sizes and of special construction.

The ground behind the station—some half acre—is laid out in plots, between which run tramways similar to those at Göttingen. Part of the lot is covered by a glass house, into which the tramways run. The experiment pots can thus be easily and quickly placed under shelter when such is required. As to the great value of a scientific investigation, in which the experimentalist has full control over all the circumstances, Prof. Wagner speaks as follows:—"We must obtain information about the whole process of the nutrition of plants and clearness as to the influence of every single factor on the action of manure, and clearness can only be gained through experiments which have been carried out on scientific principles, with full control over all influencing circumstances and with the employment of scientific expedients. Practical field experiments cannot do this, they can only, in conjunction with exact and critical investigation, help to enrich the science of exact knowledge." Again: "The farmer cannot examine into the correctness, or the reverse, of the experimental results, the investigator must do this himself; but the farmers ought to try, by extended observation, by judgment based on intimate knowledge, and, if necessary, by well devised, carefully executed and logically interpreted field experiments, in what way scientific investigation, on the conclusions or advice derived from this, are to be turned to good account under the special conditions of soil or of cultivation on his farm."

As a result of such detailed and scientifically conducted experiments I may refer to the recognition of the fact, which is now thoroughly established beyond doubt, that the leguminosæ can and do take their chief supply of nitrogen from the air. For many years this was disputed, and it was only by such means as I have alluded to that Professors Hellriegel, Wolff and Wagner have been able to prove incontestably that such is the case. This fact is of paramount importance to agriculture. It divides farm crops into "nitrogen increasers" (clover, peas, vetches, lupines, &c.,) and "nitrogen consumers" (cereals, grasses, roots, &c.,) the latter depending on the soil for their nitrogen, while the former increase the nitrogen already contained in the soil. We now see plainly how it is that a crop of clover benefits the succeeding crop of wheat—a plant that absorbs all its nitrogen from the soil in the form of nitrogenous salts. E. Bréal (Compt. rend. 107) has shown that the absorption of nitrogen by some leguminosæ is very great—the total nitrogen in the case of lucerne amounting to twenty-five times as great as that in the seed.

Bonn.

The experiment station at Bonn is entirely devoted to chemical research and analyses. Its director, Dr. A. Stutzer, conducted me over the laboratories, in which were all the necessary fittings and apparatus for carrying on the work of scientific investigations in agriculture. Some new forms of apparatus for the analysis of foodstuffs were seen here, which appeared to answer their purpose admirably.

The laboratories of the University here are commodious, and were erected on the same plan as those at Berlin, with slight modifications. As I have already indicated the nature of the Berlin laboratories, it will be unnecessary for me to describe those at Bonn.

Aachen (Aix-la-Chapelle).

Before bringing to a close this brief account of chemical laboratories in Germany, some mention must be made of the very fine laboratories in this city.

The plan upon which this handsome edifice is constructed is particularly good. The subsidiary laboratories and rooms are grouped about the central lecture theatre, the quantitative laboratory connecting directly with the balance room, with laboratories for gas analysis, organic analysis, &c., being to the right, and the qualitative laboratories to the left. The rooms are lighted from the roof as well from the sides, and additional light obtained from two open courts.

The structure presents a handsome appearance, being faced with stone, and was of costly erection.

The lecture rooms and laboratories under the direction of Prof. Landolt have been fitted up in the most complete manner; the tables being supplied with water, gas, exhaust, blast, steam and electricity. The ventilation and heating arrangements are especially good. The warm air is forced in by a fan and the foul air exhausted by a similar contrivance. The temperature of each room is made known to the engineer, who controls the appliances.

Ensilage Experiments.

Some time was spent in examining into the various methods now in use for the making of ensilage, the value of which as a fodder is now recognized. During the wet seasons, when it is impossible to obtain a properly sun-cured crop, it is now quite feasible to preserve it in such a condition as to be excellent food for cattle. The experiments carried out at the experimental farm of the Royal Agricultural Society, show that for feeding purposes, ensilage, properly made, equals in value the ordinary cured crop. During the next season we purpose inaugurating experiments in ensilage making and feeding at the Central Experimental Farm, the result of which will, no doubt, be of great value to Canadian farmers.

All of which is respectfully submitted,

FRANK T. SHUTT,

Chemist, Dominion Experimental Farms.

REPORT OF THE ENTOMOLOGIST AND BOTANIST.

(JAMES FLETCHER, F.R.S.C., F.L.S.)

To the Director of the
Dominion Experimental Farms,
Ottawa.

SIR,—I have the honour to submit herewith a report upon the more important insects and plants which have come officially under my notice during the year 1888. Those species of insects which have been unduly abundant and injurious since I last reported to you are characteristically Farm Insects. The injuries to fruit trees have all been by well known species. Tent Caterpillars have been reported as more than usually abundant in Nova Scotia, the Eastern Townships of Quebec, and in British Columbia. No new remedies have been discovered for a more successful mode of keeping these pests in check than those now in use.

The Pear-blight Beetle (*X. dispar*, Fab.) locally known as the "Pin-borer," and the "Shot-borer," is apparently extending its ravages beyond the Annapolis Valley in Nova Scotia, as I have received specimens and a report of damage done in the orchard of Mr. C. C. Gregory, Antigonish, N.S. Spraying apple trees with Paris green for the Codling Moth, is in all instances reported of favourably, where it has been tried. The Plum Curculio and the Black Knot are reported to be increasing owing to the neglect of growers to use the well known remedies.

Of insects injurious to forest and shade trees there have been no new attacks worthy of special mention. In accordance with your instructions I am making a particular study of the insects injurious to pine timber. There are some points not as yet cleared up, and the results of some experiments undertaken during the last summer cannot yet be seen. In view of the above I deem it advisable to postpone for a short time, the presentation of a report upon Timber-borers.

In June last I had an opportunity, through the kindness of Mr. Mossom Boyd, of Bobcaygeon, to visit some timber limits which had been burnt by forest fires, or cut over, in other months of the year than any I had before been able to examine. In this way I was able to clear up some interesting points of which there was previously some doubt.

In the Botanical Department preparations have been made for laying out the roads and beginning the work in the Arboretum and Botanic Garden as soon as spring opens. Large numbers of plants from northern climates have been grown from seed, and are now ready to be located in their proper places in the garden.

Large and valuable collections of seeds and plants have been received from the following:—

Mr. C. Gibb, Abbotsford, P.Q., chiefly Russian species.

Dr. G. M. Dawson, Ottawa, a collection of seeds of rare alpine plants from the Rocky Mountains, and also some living plants of *Pinus ponderosa* and *Pseudotsuga Douglassii*.

Miss Alice Williams, Victoria, B.C., a collection of seeds of wild flowers of Vancouver Island.

Major Walker, Calgary, a collection of seeds of native grasses.

Rev. W. A. Burman, Griswold, Man., a collection of native grasses, and various other plants as well as insects.

From the Arnold Arboretum, Boston, a collection of seeds of 123 species of plants suitable for a northern climate.

From Mr. R. W. Starr, Port Williams Station, N.S., seed of the Beach Pea, (*Lathyrus maritimus*) which he suggests may be useful for growing on sandy shores to keep the sand from blowing about.

From Prof. J. Macoun, roots of rare native plants for cultivation.

From Mr. N. H. Cowdry, collection of native plants and insects from the North-West Territories.

From the Imperial College of Agriculture, Tokio, Japan, seed of several species of forest trees.

From the Royal Botanic Gardens, Kew, England, a large collection of seeds of trees, shrubs and plants, natives of Europe and Asia.

More than 50,000 young forest trees were planted out in the spring, the greater part of which did well. One consignment which was delayed was badly injured thereby. On the western and northern boundaries of the farm there were planted by your instructions mixed clumps of forest trees, and most of the avenues and hedges were set out.

Upon the experimental grass patches, many of the best English pasture grasses as well as several of our native north-western grasses, were planted out for study. These were for the most part grown in the conservatory during the winter, and then pricked out in the spring, and thus a considerable saving of time was made. Careful notes have been taken of all these species; but it is too soon to make any report upon them until they have passed a winter in this climate.

In preparing the present report I have endeavoured as much as possible to make it useful to the agriculturist. All unnecessary technicalities have been eliminated and only such information has been included as I deemed would be useful. The terms by which the different stages of insects are known, are familiar to most people, but it may not be amiss to repeat that insects pass through four stages, the egg, the larva, the pupa or chrysalis, and the imago or perfect insect. The larva of a two-winged fly is called a maggot, of a four-winged fly or a beetle, a grub, of a moth or butterfly, a caterpillar. The larvae of the other groups have no distinctive names.

I have the honour to be, Sir, your obedient servant,

JAMES FLETCHER,

Entomologist and Botanist to Dom. Exp. Farms.

OTTAWA, 1889

CEREALS.

WHEAT.

The Wheat Midge, "The Weevil," "The Fly," "The Red Maggot" (*Diplosis tritici*, Kirby.)

Attack.—When the wheat is in the milk, small orange-red maggots may be found at the base of the scales of chaff lying against the forming grain, from which they suck the moisture and prevent it from filling out properly.

Although in some districts the Wheat Midge is reported as having been less troublesome than usual, the amount of annual loss attributable to its ravages is still very large. In Nova Scotia this is particularly the case, and enquiries concerning its habits are frequently received. In response to an application from the Farmers' Institute of Colchester, N.S., a short account was prepared of the habits of this pest—as far as known—and the best steps to adopt to reduce its ravages. This account was read at their annual meeting, and was afterwards published in the *Colchester Sun*, a newspaper which makes a specialty of agricultural topics.

The Wheat Midge is most widely known in Canada under the inaccurate designation of "Weevil" a term which must be discouraged because it belongs to another class of insects altogether. The Weevils are hard-shelled beetles, while the Wheat Midge in its larval state is a legless maggot, and in its perfect state a delicate gnat-like creature with gauzy wings.

I am assured that in some parts of Nova Scotia the cultivation of wheat has been abandoned, owing to the attacks of this minute foe. The life history of the

Wheat Midge as at present understood is as follows: During the month of June, just when the wheat is in blossom, tiny yellow Midges with black eyes and yellow bodies may be seen flying over the fields, particularly on dull days or towards evening. Large numbers also of the same Midges may be seen in houses as soon as the lamps are lighted. These are the Wheat Midge, and the parents of the Red Maggot of the Wheat.

The body of the female is prolonged into a long slender tube, which can be extended or drawn in at pleasure. With this tube, which is called the ovipositor, she pushes her minute eggs down between the chaff of the green wheat-ear. In about a week these eggs hatch into small transparent yellowish maggots, which at once attack the forming grain. Gnawing through the outer skin of the kernel of wheat they extract its juices and prevent it from filling out properly. As these larvæ grow older they gradually become darker in colour, until they acquire the tint which has given them the name by which they are best known in England "the Red Maggot of the Wheat." Grain injured by the Midge has a characteristic shrivelled appearance, known amongst millers as "fly struck." There are sometimes four or five maggots to each grain in an ear. As soon as the maggots are full grown they either work their way up between the scales of chaff and fall to the ground, or remain in the ears until after the crop is carried. Those which fall to the ground, and these are by far the most numerous, penetrate about an inch beneath the surface where they spin a small cocoon of exceeding thinness, which fits so closely to their bodies that it is sometimes thought to be only the skin hardened, in the same manner as takes place in many other flies when they pass through their pupal or quiet state. It was generally supposed until lately that the perfect flies from these pupæ did not appear until June in the following spring. This, however, is not always the case, for during last summer, on a warm damp evening in August, and again in the beginning of September large numbers flew into my study and were killed at the lamp. Prof. Webster, of Purdue University, Indiana, and a special agent of the United States Department of Agriculture, tells me that he, on one occasion, bred considerable numbers of perfect Midges in July, from heads of wheat which had been badly attacked by the Red Maggot during the previous month, and that off and on during the rest of the summer until November, he caught the perfect insects at large. In the Report of the Entomologist of the United States Department of Agriculture for 1884 the same observer records as follows:—"From the 4th to 15th September I not only found larvæ in considerable abundance under the sheaths of volunteer wheat, but adults, too, in the same situation, and also on the outside of the plants and hovering about the upper leaves. From a quantity of this wheat placed in a breeding cage, on September 7 appeared three or four adults." Not only then did these maggots of June produce perfect flies that same summer, but there was a second brood which had time to lay eggs in the young fall wheat. That these insects have a double life-history—living both in the ears and later in the season in the shoots of the young wheat plant,—is an important discovery made by Professor Webster and gives us another means of checking their ravages.

He writes, "Cecidomyid larvæ were found in volunteer wheat and I could only breed *D. tritici* from them. Larvæ found in other young wheat were also Cecidomyid and not distinguishable from those of *D. tritici*, but I did not rear the adults from them. They were under the sheath of the young plant, but I think near or just above the surface of the ground." It is a most important point to find out exactly what is the life history of this pest, because that is the only means by which we can hope to obtain a complete remedy. The condition and locality where it passes the winter are of course valuable items of information; we have seen that some of the maggots of the first brood leave the grain before it is cut, and it is probable that most of them pass the winter in the state of larvæ beneath the surface of the soil and that the emergence of the perfect flies in large numbers the same year is an exceptional thing due to unusual climatic conditions. Besides those which winter in the ground, others remain in the ears of wheat and are harvested with it. By far the larger proportion leave the grain before it is cut, and it is probable that all would follow this course

if the crop were left standing long enongh. I am led to this conclusion by finding that of those which are left in the harvested wheat, although many prodnce the perfect flies, a considerable number are dried np and do not come to maturity. This points to the advantage of cutting the crop as soon as it can be done withont injury to the grain, so as to remove as many as possible of the insects from the fields. When the wheat is threshed the red encased larvæ are separated from the grain and fall down beneath the machine amongst the rubbish and dust, frequently in such numbers as to give a perceptible colour to the refuse. This shonld of course all be carefully swept np and burnt. If swept aside and left lying in a heap till spring, it will merely form a hotbed of mischief from which injury will be sown in every direction. Not only will these small insects endure a long period without moistnre, but they can withstand the opposite condition of excessive moisture with impunity. Indeed, Dr. Fitch in one place speaks of them as amphibious. A moist warm season in June is always more productive of Midge injuries than a dry one, and their ravages are most severe in low lying fields.

Remedies.—1. Deep ploughing directly the crop is carried so as to bury the larvæ so deep that the flies cannot work their way ont through the soil.

2. The burning in bad years of all the chaff, dust and rnbbish known as "screenings," or "cavings" from beneath the threshing machine. If it is objected that this is too wasteful, it should be remembered that by the small loss thus sustained a mnch greater saving is made in the quantity of the crop the following year.

If not burnt it shonld at all events be used as litter for stables or as an absorbent of liquid mannre, when it will be carried to the manure pile, or it may be put under cattle in yards.

3. Clean farming, including the brushing of all grasses along the edges of fields.

4. The cultivation of such varieties of wheat as are found to be least attacked.

The Army Worm (*Leucania unipuncta*, Haw).

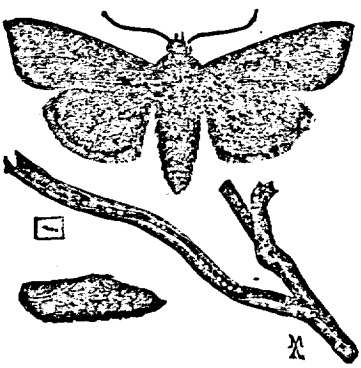

Fig. 1.

Attack. A brown striped caterpillar, eating the leaves and stripping the stems of grasses and many other low plants. When attacking cereals frequently cutting off the heads. When full grown over one inch and a-half in length, and when occurring in large numbers migrating in bodies from one food patch to another. When full grown the caterpillars burrow into the ground and turn to light brown chrysalids, from which in about two or three weeks the moths emerge. These are of a soft satiny-brown colour sprinkled with minute black specks and with a small but distinct white spot in the middle of each upper wing. They are very active. When the wings are closed the moth measures about an inch in length,

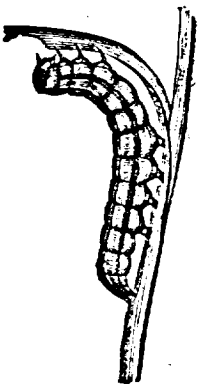

Fig. 2.

Of the many accounts which have been reported of injuries to grain crops by the "Army Worm," two only have proved to be the work of that species, one at Ottawa, the other at Lake Temiscaming. The term seems to be applied indiscriminately by farmers to any caterpillars which occur in large numbers. The Forest Tent Caterpillar, the Larch Saw Fly, the Clover Cutworm and various other Cutworms, all having been referred to during the past year, as "the Army Worm." The life history of the trne Army Worm in Canada is probably as follows: The eggs are laid in the autumn and hatch in ten or twelve days, after feeding for a short time the small Caterpillars become torpid and pass the winter beneath tufts of grass and other low herbage. In the following spring they complete their growth, and I think produce the moths in June. Caterpillars collected on 15th July upon wheat growing on the Experimental Farm

were then about half grown and increased in size very rapidly, pupating by the end of the month and producing moths in August. The eggs laid by the moths of this brood, I imagine, produced larvæ which were found hibernating in October. Although several caterpillars were collected from wheat at Ottawa, there was no serious attack, the caterpillars not being sufficiently numerous to "march," and the injury could hardly be perceived. Moreover a large proportion of those collected for observation were found to be parasitised by Tachina flies. In the fields too they were destroyed in large numbers by a small hymenopterous parasite, which Prof. Riley has decided is a new species (*Apanteles leucaniæ*, Riley M.S.S.) Small bundles of whitish silken cocoons could be seen in every direction, attached to the stalks of wheat, together with the emptied bodies of the dead larvæ from which the grubs had emerged before spinning their cocoons. There were sometimes as many as 17 of the parasites from one caterpillar.

The other occurrence of the army worm referred to, was of a much more serious nature. Mr. A. Laperrière, J.P., writing from Entremonts, Lake Temiscaming, on 6th August says: "You will find in a small box which I am sending you to-day, some caterpillars, which are by the millions in the grain of my neighbour, Mr. Alfred Miron. These caterpillars began by devouring the leaves of the grain, then they climbed up the stalk to the head and cut it off at the base. They also attack Indian corn and Timothy. More than half the crop is destroyed already, and before the rest is ripe it will also probably be lost. Made experiments with Dalmatian Insect Powder, and it killed the caterpillars at once; but of course this is much too costly for general application." The caterpillars sent by Mr. Laperrière arrived in good order and produced moths in September.

Upon the receipt of these larvæ, a short account of the habits and the usual remedies was despatched to Mr. Laperrière, but before they were received the insects had finished their work and disappeared. None of the caterpillars sent from Lake Temiscaming were parasitised; but from the large numbers present and the frequent experience of the past, I considered myself justified in encouraging the farmers in this new settlement with the hope that they would not receive another visitation next year. Professor Lintner in his first report, at page 147, writes as follows when speaking of another grass-feeding species which had suddenly appeared in vast numbers: "We may venture to record our belief that they will not continue hereafter. Indeed, many years may pass before we shall see it again in injurious numbers. Had it been as first supposed, a visit from the army-worm, we could have predicted that it would not recur the following year, for the immense hosts of that species are always attended by their parasitic foes, which so effectually destroy them that it seems impossible that two 'army-worm years' can follow in the same locality."

Remedies.—When the caterpillars appear only in moderate numbers, they have an abundant food supply and do not then acquire the habit of "marching" which is merely moving from one place where all the food has been devoured, to a fresh pasture. When, however, their appearance is excessive they must of necessity move on to some other place or starve. They may be prevented from marching from one field to the other by ploughing a deep furrow across their path. This should have the edge nearest to the field to be protected, perpendicular or slightly overhanging. Along the trench so formed, pits must be dug about twelve feet apart. When the caterpillars come to the trench they are unable to climb up the opposite side and after a few trials, walk along till they fall into the pits, when they may be destroyed by covering them with earth and tramping it down. If these pits are not dug, when the caterpillars occur in large numbers, the trench will soon be filled and they will walk over on the bodies of their fellows. In case any of the worms succeed in crossing the ditch, a narrow strip of the plants on the opposite side of the trench should be dusted or sprinkled with a strong mixture of Paris Green diluted either with 25 times its weight of flour, ashes, or land plaster, or mixed with water as strong as 1 ounce to a pailful of water. The plants so poisoned must of course be sacrificed as soon as the caterpillars disappear, and should be mown down and burnt.

A preventive remedy much relied upon, is the burning of all stubble and old grass in autumn and spring, in localities where the moths have been observed. The young caterpillars pass the winter beneath such refuse and many will thus be destroyed together with many other injurious insects. The moths of the early brood also lay their eggs by preference upon the old dead stems, and if these are removed they will seek some other place to lay. Systematic draining of low lands is very beneficial, the natural habitat of the species being thus rendered unsuitable for the young larvæ.

The Wheat-stem Maggot "Wheat Bulb-worm" (*Meromyza Americana*. Fitch.)

Attack.—Some time before the wheat should be ripe, the ear and top portion of the stem turn white. Upon examination the stem will be found to be severed just above the top joint by a slender transparent green maggot ¼ of an inch in length. When full-fed it works up to the upper portion of the sheath and turns to a flattened pupa from which the fly emerges in July.

In autumn the same green maggots may be found low down in the base of the stems of fall wheat just above the root.

The perfect insect appears in the latter part of May and June, and is a pretty little greenish-yellow fly, one-fifth of an inch in length, with shining green eyes and three dark stripes extending right down the back. The hind thighs are thickened, and when the fly is at rest the fore part of the body is much raised.

In addition to the above two regular broods, Professor Webster has detected a supplementary brood in volunteer wheat.

The attacks of the summer brood of the Wheat-stem Maggot were not so manifest in the wheat fields last season as in the three previous years; but upon the experimental wheat plots here, where some fall wheat had been sown in the spring but had not headed out, great injury was done. Strong plants with from 50 to 75 stems being entirely destroyed. This destruction was mainly due to the attacks of *Meromyza*, but the plants were also found to contain many of the larvæ and puparia of the Hessian Fly. These larvæ are easily distinguishable. The larvæ of the latter being shorter and whiter with a dark green central stripe and not having the black horny mouth parts of the Wheat-stem Maggot, which also attacks the centre of the stem tearing the tissues and causing them to decay, whilst the Hessian Fly larvæ lie outside the stem beneath the sheath of the leaf. As noticed by Professor Webster plants attacked by the Hessian Fly do not turn yellow in the autumn, but assume a much deeper shade of green, whilst the leaves of shoots attacked by *Meromyza* turn yellow and die before winter.

My attention has been drawn by Prof. Webster to a very full and correct account of this insect by Prof. Forbes in the thirteenth report of the State Entomologist of Illinois, a copy of which I have only lately been able to procure.

Remedies. Natural—I observed with much pleasure in July last that a large number of the pupæ were the hosts of a parasite belonging to the Hymenopterous genus *Cœlinius*. A specimen of this beneficial insect was sent to Prof. C. V. Riley and submitted to Mr. L. O. Howard, who writes as follows: "This may be a new species if subsequent rearing of a series of individuals shows the points in which it varies from *C. meromyzæ*, Forbes, to be constant. From the single specimen submitted it would be rash to describe a new species, as the differences are entirely colorational. It differs from typical *C. meromyzæ* in having the head and prothorax dark honey-yellow (instead of black) and in having the parapsidal sutures of the meso-notum also bordered with dark honey-yellow. At present it may be considered a variety of *C. meromyzæ*, although rearing of additional specimens may prove the variation to be so constant as to deserve a specific name."

I have also bred the other species of the same genus, *C. meromyzæ*, Forbes, from specimens of infested volunteer wheat sent to me by Prof. Webster from Indiana.

Artificial—1. For the summer brood the affected heads may easily be collected by hand as they are very conspicuous in the fields. If it is thought that they contain parasites, instead of burning them they may be enclosed in any suitable receptacle and covered with fine gauze until the flies emerge. If parasites are present they are easily recognized by having four wings and slender horns or feelers in front of their heads.

2. For the brood which follows the summer brood and which has been detected in volunteer wheat and also probably occurs in grasses, a strip of wheat might be sown very late in spring so as to be ready for the July brood to lay their eggs upon, and this strip might be ploughed in during August.

3. Sowing late. Prof. Forbes writes (loc. cit.) p. 27: "The discovery of an autumnal brood puts us in a position to suggest more effective measures. For reasons detailed under the head of 'life history' (where dates of appearance are given) it is very likely that delay in sowing until after the first frosts of autumn will wholly prevent injury by this insect; and certainly the general substitution of spring for winter wheat, for even a single season, would greatly diminish in numbers, or perhaps, very nearly obliterate both this species and the Hessian fly."

The *Cœlinius* mentioned above was quite plentiful in the summer brood and I am inclined to think that the sudden diminution in the numbers of this pest must be due to its attacks. This favourable appearance of things is not only at Ottawa. Mr. D. James, of Thornhill, Ont., who was one of the first to assist me in the investigation of this insect, writes: "I am glad to say that the Wheat-stem Maggot is not nearly so bad this year as last. In fact there were so few 'silver tops' that it settled all uneasiness as to its spread. I can't account for its disappearing, it may be only temporary. I would be inclined to attribute the apparent declension to two things: 1st, the very small acreage of fall wheat (and, consequently, very little stubble) grown in this county in 1887; 2nd, to the unusually dry fall of 1887, the farmers sowing very little fall wheat and the wheat on the stubble not sprouting, *i. e.*, what is called volunteer wheat not giving the brood any opportunity of being hatched."

The Grain Aphis—(*Siphonophora avenæ*, Fab.)

Attack.—Green, yellowish, or blackish plant lice attacking various kinds of grain on the leaves and roots in the early spring and late in the autumn. As soon as the grain heads out the plant lice crawl up and cluster around the ears, where they suck the juices of the stem, preventing the grain from filling. An occurrence of this insect in injurious numbers took place in July at Entremonts, Lake Temiscaming. Mr. A. Laperrière writes: "I send you a spike of bearded wheat taken from one of my fields. You will observe upon examining it that it is swarming with plant lice on the grains. All the crop of this spring's sowing is infested by it. Is it possible to get a remedy for this troublesome pest which attacks the standing crop?"

The specimen ear of wheat forwarded had certainly been severely attacked, no less than 39 dead aphides being attached to it. Every one of these, however, had been destroyed by parasites, probably a species of *Aphidius* from the appearance of the punctured skins. I have no doubt, therefore, that the attack in that locality was brought to an end by the agency of these useful little parasites.

Plant lice are remarkable for their fecundity and the rapidity with which they come to maturity. In the Annual Report of the Entomological Society of Ontario, for 1878, Prof. Saunders writes as follows:—"People are often puzzled at finding their trees or plants swarming with plant lice, where a week or two before there was scarcely one to be found. As a general rule an aphis, during the summer season, reaches maturity in ten or twelve days from birth, after which it produces every day two young ones, which, contrary to the general rule with insects, are born alive. This rate of increase is maintained for a considerable period, from fifteen to twenty days or more; the young begin to produce in like manner in from eight to ten days, and so on through the third, fourth, and sometimes up to the twentieth generation in one season. Some idea may be formed of the numbers which in a short time this rate

of increase would produce, from a calculation of Curtis, a celebrated English entomologist, who has computed that from one egg only, there would be produced in seven generations, taking 30 as the average of each brood, the enormous number of 729,000,000, so that were they all permitted to live, everything on the face of the earth would in a short time be covered with them. Indeed sometimes the possible rate of increase is even greater than this. Dr. Fitch, the State Entomologist of New York, has ascertained by actual experiment that in the case of the grain aphis, the wingless females become mothers at three days old, and thereafter produce four little ones every day, so that even in the short space of twenty days, the progeny of one specimen, if all were preserved from destruction, would number upwards of two millions."

It might naturally be supposed that insects with such prodigious powers of increase do sometimes a great deal of harm. This is the case, but if we can keep them in check for a time, as a general thing, nature soon comes to our aid. These insects form the food of several predaceous kinds, and whenever the plant lice increase largely, their enemies are attracted. The small parasitic Ichneumon flies belonging to the genus *Aphidius* are particularly useful in reducing their numbers. The *Coccinellidæ* or Lady-birds devour vast numbers both when in the larval state and as perfect beetles. The Syrphus flies and other Diptera also help; so that as much surprise is sometimes called forth by the sudden disappearance of hosts of plant lice as is evoked by their sudden increase.

Remedies.—It is quite evident that no application can be made to the wheat plant by which these insects can be destroyed when the wheat is in ear.

Immediately a crop which was infested has been carried, the land should be cultivated and all grasses should be cut down from the edges of the fields. After an attack no grass or grain crops should be grown on that land for the next year.

As the Grain Aphis attacks cereals in the autumn, winter and early spring, fields should be examined at these seasons, to see if they are present. If detected, top dressings of guano, salt, or gas-lime are recommended.

Rolling or feeding off with sheep are also said to be useful.

Weeds in Grain.

Millers complain that there is a much greater proportion than there ought to be of "dirt" in the shape of weed seeds in wheat sent them by farmers. Of samples sent to me for identification, by far the largest proportion of this seed was found to be of the *Polygonum convolvulus*, or Black Bind-weed, sometimes called "Wild Buckwheat." This is a naturalised weed from Europe, and has now spread over the whole of Canada. Although only an annual, it seems to be extremely hard to eradicate, and is very troublesome. Great care should be taken to have all seed grain thoroughly cleaned. There is much foul seed which may be separated from seed grain with an ordinary fine sieve, if farmers will only take the necessary trouble.

Perennial Sow-thistle (*Sonchus arvensis*, L.)

Communications have been received from three different localities enclosing specimens of this plant for name. Mr. W. L. Herriman, of Lindsay, writes on 23rd June: "I wish you would tell me the name of the enclosed plant, and how it may be exterminated from cultivated fields. It is very persistent, the field where this grew was ploughed five times, so the man told me. It grows close and kills out everything else." On 23rd August, Mr. Hiram Doxsee, of Hoard's Station, sends a specimen, he says: "Enclosed please find a plant that has been for some three years spreading on low bottom land on my farm here. I find it difficult to exterminate." Mr. John Willock writes from Fenelon Falls on September 8th: "Enclosed you will find a weed about which we would like to know particulars, so far it is confined to about two rods square, the ground was in wheat the year before last, when we first noticed it. There was no wheat growing amongst it.

the leaves lay so flat to the ground. Last year it was turnip ground, and well attended to, but this spring was put in barley, and the weed sprang up as briskly as ever." This is also an introduced species which has been brought to America in seed grain. It is decidedly spreading. In Canada, Professor Macoun records it as "abundant along road sides and in fields from Newfoundland throughout the Maritime Provinces and Quebec, at Ottawa, London and Hamilton." The only remedy we can suggest for this pertinacious weed is constant vigilance and summer fallowing.

OATS.

The oat crop in Ontario was not reported to have been injured by insects; but smut and rust were mentioned by some correspondents. In some parts of Quebec late oats were injured by the wet weather, and locusts were also troublesome in the same crop. Mr. S. Mireault, writing from St. Jacques, County of Montcalm, and enclosing specimens of *Melanoplus femur-rubrum*, *M. bivittatus* and *Dissosteira Carolina*, says as follows: "As insects, and especially the grasshoppers, are doing much damage in this locality as well as in many others in the Province of Quebec, and as they threaten to destroy our crop of oats by their incessant depredations, I have thought it wise to obtain some exact and precise information concerning them, and with this end, send you some specimens of the injurious kinds. Grasshoppers appeared early this year. They were observed in considerable numbers in the beginning of June. At that time they were small, but since then they have increased much in size as well as in numbers. Hay has suffered little from these insects; but they have invaded our oat fields and destroyed them in an alarming manner. And they even threaten complete devastation. At this moment I believe that half the crop has been sacrificed to the voracity of these insects, and the only thing which can save the other half will be a concourse of providential circumstances which we pray for. This is how they behave: They attack the oat when it is in flower and cut the stem which supports the grain, and destroy even the whole panicle. We have observed in certain localities that all the spikes or panicles had succumbed to the voracity of these insects. We have remarked that these insects are of different colours and I send you specimens of each."

This kind of attack upon the panicles of oats has been noticed several times before and is done chiefly by *M. femur-rubrum* in this locality. The amount of the crop so wasted is sometimes very great. (*Vide* page 63.)

BEANS.

The European Bean Weevil (*Bruchus granarius*, L.)

Attack.—Small slate-coloured beetles found in hollow chambers beneath the skin of seed beans. Sometimes as many as three in one bean. Seed so injured will generally germinate; but produces only a sickly plant, and if known to be infested should not be used.

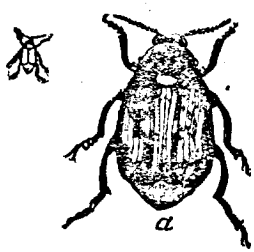

Fig. 3.

Some infested seed of the large Windsor Broad Bean was sent to me for examination. This seed was imported from England and was found to contain living specimens of the European Bean Weevil. Many of the beans had two beetles in them; but a few contained three. The ease with which these insects may be introduced into a country renders it essential that care should be taken not to sow infested seed.

The eggs are said to be laid by the parent beetle on the bean-pods while they are young and soft. The grubs feed inside the seed, sometimes destroying the greater part of the contents, but seldom injuring the germ. The grub is full grown by the time the beans are ripe and turns to a pupa inside the seed. Before it makes this change, however, it gnaws away the substance of the bean up to the skin and only leaves a thin film over its hole.

Miss Ormerod has observed that "the pupa is contained in a cell, a coating made apparently of small bits of bean agglutinated together. When the bean is dry this case or cocoon is very slightly observable, but when damped it parts from the wall of the gallery and you may quite readily pick out your beetle with this case clinging like a bag round it and only open at the mouth end." The perfect insect (Fig. 3) emerges in the spring soon after the beans are sown. It is a small black or dark brown beetle covered all over with a very short appressed grey pubescence and also has the wing covers ornamented with patches and dashes of white. The abdomen exceeds the wing-cases in length and bears upon its upper surface, just beyond their tips, two small black spots. The first pair of legs and three or four of the basal joints of the antennæ are reddish, the others black. Upon the hinder part of the thorax is a small fulvous patch.

The beetle resembles the well known Pea Weevil in shape, but is rather smaller, being only one-eighth of an inch in length. It is darker in colour and, like it, is a very active little creature.

From the habits of these insects, of remaining inside the seed until they are perfect, they are very liable to be carried from one country to another. This is illustrated by the fact that no less than eight species were collected amongst foreign produce sent to the Philadelphia Exhibition in 1876.

Remedies.—In the sample of Broad Beans referred to above, soaking them for twenty-four hours in water was found to drown every specimen of the weevils. When, therefore, a sample of seed is found to be infested, this simple expedient at the time of sowing the seed will be found efficacious. When the supply of seed on hand will permit it, it is better to keep the beans over until the following year in some close vessel. The beetles will emerge the first spring and die without injuring the beans further. A similar plan is that practiced with the Pea Weevil, of keeping the seed peas shut up in a close vessel in a warm room during the winter, when the weevils will emerge and die long before the seed is wanted for sowing. The remarkable freedom of peas in Canada from the attacks of the Pea Weevil, during the last few years, is attributed by some to the care taken by seed merchants to poison all weevils contained in seed peas, by subjecting them for some time, in large closed receptacles, to the poisonous fumes of bisulphide of carbon.

PEAS.

The pea crop throughout the districts where peas are most grown has been good and little troubled by insects, the most serious attack was by the Clover Cutworm, but this was complained of over a limited area only. The dry weather caused in some localities the condition mentioned at some length in my last year's report. Mr. F. Birdsall wrote on 25th July that many of the fields in the vicinity of Birdsalls, Ont., were badly affected. The top of the vines was green but the root dead. Numbers of the vines had only a single pod upon them and this seldom contained more than one pea.

The Pea Weevil (*Bruchus pisi*, L.).

Throughout the greater part of Canada the pea crop still remains exempt from the attacks of this once dreaded insect. Mr. T. B. Townshend writing from Aldershot, Ont., says: "The old enemy which used to be so fatal to the pea crop, the Pea Bug, or Pea Weevil, has not troubled us for some time, in fact has quite disappeared." It has not been entirely absent, however. In the Ontario Bureau of Industries return 24, we find a note that "the crop has been very free from bugs, excepting in the County of Essex, and in portions of Kent and Lambton." The ravages formerly committed by this insect have, however, put our pea-growers and dealers upon their guard, and if the seed is subjected to the bisulphide of carbon treatment or kept over in closed vessels until another season, there is no reason why this insect should again develop into a "first class pest." Should there be any doubt as to whether seed peas contain weevils or not, before sowing the whole lot should be

thrown into water when the injured seed will float, but the sound peas will sink to the bottom. All those that float should be burnt at once, or if in large quantities may be fed to pigs.

The Clover Cut-worm. The Cabbage Mamestra (*Mamestra trifolii*, Esp.).

During the month of August I received many enquiries concerning some green caterpillars which suddenly appeared in the counties around Hamilton, Ont. Specimens were sent to me from several localities and the following description was taken: They were thick green caterpillars with black or grey marks, very variable in the depth of the colour of the markings, some specimens appearing almost green while others were quite dark above. Length, two inches. General appearance—a dark green noctuid caterpillar with a very narrow dorsal stripe, a broken sub-dorsal stripe of yellow, edged above by velvety black blotches (the black line not quite as continuous as the yellow), a broad pink infrastigmatal band, narrowly edged with white above and below. Above the upper white, a black line which spreads out into a black blotch around each spiracle. The whole body mottled with white on a smooth green surface, giving a somewhat glaucous shade to the green. The narrow dorsal stripe consists of an aggregation of these mottlings, and the dorsal space has them shadowed with black, giving that area a darker appearance than the rest of the body. Legs and pro-legs concolorous with the body. Head, small, green bearing on the upper part of the face and on the cheeks clouds of white mottlings. Some of these caterpillars were simply pale green with fuscous markings, others were green, with clear brownish or black markings, some had the mottling all over the body so shaded with brown as to suggest the appearance of the Army-worm. Intermediately tinted specimens between all these colours occurred. The caterpillars sent to me were nearly all found to be parasitised either by a large yellow Ichneumon Fly called *Ophion purgatum*, or by a large Flesh-Fly which Prof. Riley has identified as a species of *Sarcophaga* near to *sarraceniæ*. When these caterpillars were first sent to me I took them for the Fall Army-worm (*Laphygma frugiperda*, Sm. and Abb.) a species which sometimes occurs much in the same way as this did in August. Of all the larvæ sent to me I only succeeded in getting three to the pupa and these will not emerge until next spring.* I am indebted to Prof. Riley for the identification of these caterpillars as the larvæ of *Mamestra trifolii*. Prof. Riley writes: "Your letter with notes on a noctuid larva is to hand. So far as I can judge from your description the larva which you have is that of *Mamestra trifolii*. It is certainly not that of *Laphygma frugiperda* nor of *Prodenia lineatella*. The coloration of *trifolii* is quite variable though the general pattern of the more prominent markings is substantially the same as in the larva which you describe. The general colour varies from a pale yellowish green to a rather dark greyish or brownish green. The larva of *lineatella* differs from the description which you give in several important details. * * * *M. trifolii* is probably single-brooded with you. Here in Washington and in Missouri it is double and sometimes treble brooded. In Germany it is single brooded."

This injurious insect has been treated of under the name of Cabbage Mamestra (*M. chenopodii*, Albin) and illustrated upon a coloured plate by Professor Riley in his annual report as State Entomologist for the United States for the year 1885, p. 123. From this account we find that the species is common all over Europe and in North America and the caterpillars were not noticed as specially injurious on this continent until 1876, when they attacked many kinds of garden vegetables, and were particularly severe on cabbages; they however feed upon a variety of plants, amongst which are mentioned by authors: celery, lettuce, cabbage, asparagus, spinach, parsley, clover, sow-thistle, goosefoot (or "lamb's quarter's," *Chenopodium album*, L.), &c. The name of this insect is derived from its attacks upon the clover and it is also known to be very destructive to peas, which, belong to the same natural order. As will be seen by the following extracts, nearly all the attacks began upon peas. In a letter kindly for-

* These specimens have emerged in my study, since the above was written and prove to be *M. trifolii*.

warded to me by the Editor of the *Toronto Weekly Mail*, Mr. John Puckridge, writing on 9th August for himself and several other farmers, says: "I herewith enclose specimen of a caterpillar which is now seriously damaging our field peas. They began by first cutting off the stalk some four inches above the ground several weeks back. The pea plant apparently died; but in a short time two or three stalks shot up and after a time grew until they blossomed and podded well. The dry weather came again when this pest made a second attack, eating the foliage and even barking the pea-pod now full-grown and near ripening. We think of pulling ours for fodder although they should yield 20 bushels or more per acre. Kindly inform us if this is the Army Worm and the best means to be adopted for their extermination. The caterpillars are of different shades of colour and sizes; but we suppose that this arises from the various periods of hatching."

Mr. F. B. Carlow, writing 7th August from Warkworth, says: "I send you a caterpillar which is totally destroying the turnip crop in our neighbourhood. They were in the pea fields first and as soon as the peas were harvested they went directly to the turnip field. I have tried to kill them by applying Paris green and hellebore to the leaves. Our neighbour, Mr. Douglas, has sifted ashes over his crop of turnips, but all these experiments failed. This morning I have started to pull up the turnips that are the worst with them and draw them out of the field. I am then going to plough around the turnip patch."

Mr. John Kay, writing from Paris on 15th August, says:—"I send you a Caterpillar that has made its appearance here within the last week—a perfect glutton. They are very fond of Mangold Wurtzel and they strip the leaves on short notice, leaving the bare stalks. I have advised dusting air-slacked lime on the root crops. To-night I learn that they have made their appearance on the turnips. As they are in thousands their ravages may affect all our root crops," and later, 25th August, he writes:—"One farmer says I mixed 4 lbs. Paris Green with 200 lbs. of finely ground Paris Plaster (Gypsum) and sprinkled over 2 acres of Mangold when the dew was on the leaves, but it did no good. Another farmer says that these Caterpillars came off the peas, having eaten all the leaves they then stripped his mangolds, which are now worthless. The Caterpillars bore into the ground and make a cocoon, of which I send you some specimens. I am informed that the pupa remains here only a short time when they appear as light-coloured moths."

Mr. S Hinman, writing from Dundonald on 24th August, says:—"Enclosed I send you a specimen of a green worm that has been doing a great injury to the pea-crop in this vicinity; it has destroyed hundreds of acres in this part."

Remedies—As these Caterpillars had the same habits as the true Army-worm, ploughing a furrow across their path was recommended, and where the crop would allow it sprinkling with Paris Green. Ploughing late in autumn, was also recommended, because this insect passing the winter as a chrysalis, by this treatment the chrysalids would be brought to the surface or disturbed, and would probably suffer from the frosts of winter. However, from the remarkable way in which the larvæ were infested by parasites I feel confident that next season there will not be a severe attack. When attending the meeting of the County of Wentworth Farmers' Institute, at Oaklands, near Hamilton, on 29th August, several farmers spoke to me of this pest, and some specimens bearing the eggs of Flesh Flies were handed me by Mr. T B. Townshend. Writing on the 10th September, with reference to the same matter, this gentleman says:—"When you were at Oaklands the pea fields were literally swarming with the pests, and I could readily have sent you a bushel of them. The specimens I handed you were, however, a fair sample. You pointed out to me a small protuberance on the head of one of them as the egg of a parasite, which would eventually destroy the caterpillar. I find on enquiry that as the insect advanced to maturity many of them were observed to have these little lumps or protuberances on the head, and we hope this natural enemy may have performed a work that will free us from future trouble with this caterpillar. The appearance of the insect so late in the season enabled us to reap the bulk of our pea crop without any damage, and I am glad to say it is a good crop.

The later fields were but a small percentage of the whole, and but few of them escaped; indeed one of my neighbours had two fields literally destroyed After eating the leaves they appeared to feed on the fleshy part of the pods, leaving only the inner membrane covering the grain and soon after the pod would dry up."

HAY AND CLOVER.

The hay crop in most districts has suffered severely from climatic influences. The excessive drought of last summer and the light rainfall of this spring had a marked effect upon the hay crops in Ontario and parts of Quebec, while in the Maritime Provinces and Lower Quebec the crop was even more seriously affected by excessive rains. Clover in Ontario is reported as winter-killed in some localities, but this is generally attributed to the drought of 1887, owing to which the plants went into hibernation in a weakened condition. This lack of sap and a consequent fatality was noticeable amongst all plants, and even many forest trees succumbed in rocky districts. The drought of the whole summer of 1887 was exceptional, there was a very light snowfall in the winter and almost no spring rains. By the 1st of July the want of moisture began to be apparent, but it was not until about 10th August that any rain came. At this time a fall of temperature took place over the whole of Ontario and occasional showers occurred.

HAY.

"Silver-top of hay,"—An unknown enemy.

An attack of considerable interest, because up to the present time the depredator has escaped actual discovery, has for many years been observed in hay. Various conjectures have been made as to the cause of the injury, but so far it must be acknowledged that this is not positively known—spring frosts, the maggots of some grass-eating flies, mites, plant bugs and during the last summer, with perhaps more reason, species of Thrips have all been accused. At first sight this injury is exactly similar to that of the summer brood of the Wheat-stem Maggot (*Meromyza Americana*). The top portion of the flowering stem turns white, before the time it should ripen, and dies without forming seed. Upon splitting the stem it will be found that the topmost section has been injured just above the top joint, but in a different manner to the stems of wheat, injured by *Meromyza*. Instead of the tissues being gnawed they are merely shrivelled and discoloured, as if the juice had been sucked out of them. This injury is only to the base of the top section of the stem and the enveloping sheath is uninjured. With a slight pull the culm parts at the injured spot and is easily drawn from the sheath. This attack is first apparent in the beginning of June, when the flowering stems of Kentucky Blue-grass (or June grass, *Poa pratensis*) turn white at the time of flowering. The injured stems are very noticeable at first, but soon become hidden by the other stems growing up and over-topping them. Later in the month Timothy (*Phleum pratense*) and Couch Grass (*Triticum repens*) are similarly attacked, and upon the Central Experimental Farm, *Poa serotina* and *Triticum caninum* showed the same injury to a limited extent. I failed to find any insect inside the stems, at the seat of injury, although examination was made early in the month. Various suspected species of Hemiptera or plant bugs were caged over growing plants of grass and although several of these punctured the leaves and stems for food, none made an injury similar to that described above. I did not myself find any species of *Thrips*, but Prof. Saunders informs me that he did in a casual investigation he made. Upon a previous occasion I had detected in small numbers, both hymenopterous and dipterous larvæ in injured stems, as well as mites, but this season at Ottawa, none of these were found and I am therefore under the impression that these are not the cause of this attack. In Prof. Forbes's thirteenth Illinois report at page 22, the following appears as a note to his article upon *Meromyza Americana:*

"An injury precisely similar to that done to wheat by the Wheat Bulb-worm is extremely common in Blue Grass and Timothy throughout the State, and may possibly be due to this species; but the escape of the insect is so prompt that I have rarely been able to find it in any stage after the injury becomes evident through the

whitening of the head of grass. Indeed a single pupa found beneath the sheath of a stem of Timothy which had been injured in this way is the only direct evidence I have of the character of the insect responsible for this mischief. This pupa was certainly dipterous and very similar to that of Meromyza, but differed in the proportions of the segments, and especially in the size and distinctness of the terminal ones. I am consequently doubtful if it was that of Meromyza, but think it more likely that it belongs to a species of Chlorops likewise very abundant earlier in the season. On the other hand the great abundance of the fly of Meromyza in May, in regions where very little winter wheat and not much rye are raised, makes it almost certain that the larvæ live in something else than these grains."

In my report for 1885 I quote some information given to me by Dr. Brodie of Toronto who succeeded in finding some larvæ which he felt sure were those of a species of *Chlorops*, and in 1887 he writes: "In addition to a dipterous larva which attacks the Timothy, we have found here a mite very common and very injurious."

Now, from the above observations and some others to be mentioned below, made by trained entomologists, it is perfectly certain that there are injuries to grasses by different insects, the effects of which are very similar in appearance and all of which would be classed under the head of "*Silver-top*"; but for each of which a different treatment might be necessary. In the same way Miss Ormerod tells me that there are attacks upon wheat in England, very similar to those we suffer from in the case of *Meromyza Americana*. During the past year the opinion has gained many adherents that one of these injuries, by which the panicle and top portion of flowering grasses is destroyed, is due to the attacks of a species of Thrips. These are minute, slender insects rarely exceeding two or three millimetres in length and are sometimes very active, leaping and taking flight with great agility. They have a habit of running about with the hinder portion of their bodies raised up when they are disturbed, in the same way as the *Staphylinidæ* or Rove beetles. Their structure is peculiar, so that naturalists have had difficulty in classifying them and they have been placed in various positions. In Prof. Comstock's new "Introduction to Entomology" the following description is given: "But the structure of the mouth and the character of the wing throw them out of any of the accepted orders. And now the majority of entomologists agree in assigning them the rank of a distinct order. As to the position of this order, it seems to me that it is the lowest living representative of one of the lines of development of winged insects, of which line the Hemiptera is the culmination.

"The body is long. The head is narrower than the thorax, without any distinct neck; the eyes are large, with conspicuous ocelli; there are also usually three simple eyes. The ventral side of the head is prolonged into a conical beak, which extends beneath the prosternum. The form of the mouth parts can only be made out by dissection and the use of the high powers of the microscope. The mandibles are long bristle-like, curved, and somewhat flattened at the base, and taper to a point; they are furnished with well-developed palpi; the labial palpi are distinct but less conspicuous; the labrum is furnished with a curious appendage at its tip; and the labium is deeply emarginate. The three thoracic segments are well developed. The wings are laid horizontally on the back when not in use; they are very narrow, but are fringed with long hairs, which diverging in flight, compensate for the smallness of the membrane. This fringing of the wings suggested the name *Thysanoptera* by which the order is designated in many entomological works. In some species the wings are wanting. The legs are well developed, but are furnished with very peculiar tarsi; these are two-jointed, and are bladder-like at the tip. This character suggested the name *Physopoda*. The abdomen is more or less spindle-form; it is terminated in some genera by a long slender segment; in others the females are furnished with a four-valved ovipositor, which lies in a groove on the ventral aspect of the abdomen. The larva resembles the perfect insect but has no wings and is sometimes red or a different colour from the imago. The pupa is more like the perfect insect with rudiments of wings and the antennæ are turned back on the head. It is much less active than either larva or imago."

There seems to be very little accurately known of the life-histories of these insects and there has been great difference of opinion as to their food and habits. Some observers claiming that they were carnivorous, whilst others maintained that they were herbivorous. In an excellent paper by Professor Osborn, of Iowa, read before the Entomological Club of the American Association for the Advancement of Science at the Cleveland meeting, and since published in *Insect Life*, No. 5, a résumé of our knowledge of these interesting insects is given, together with the opinions of some of the leading entomologists on their habits, and Professor Osborn's own careful investigations. From the study he has given the question, his conclusions are valuable as throwing light upon a question which must now be seriously considered by Canadian farmers, since the injury known as "silver top" is decidedly increasing, and may be due to the attacks of these insects. Professor Osborn's conclusions are as follows:—

"That the Thripidæ as a group are normally herbivorous, and their presence on cultivated plants is a source of danger.

"That they feed mainly on the exuded nectar or secretions of plants, when these are abundant, and on pollen, and at such times may do little or no damage. That they will upon occasion attack the tissues of the leaves or the essential parts of the blossoms and pierce them for their contents, and at such times may cause serious damage.

"That of the recorded species there are two, at least, which must be looked upon as carnivorous in certain stages at least."

Prof. Osborn also gives a list of 22 species which have been reported as injurious to vegetation, and Prof. Comstock has named one, from this habit, which there is every probability will prove to be the cause of one of the attacks upon our Canadian hay crop.

In June last affected stems of Timothy were sent to Prof. J. A. Lintner, State Entomologist of New York, for his opinion. His answer was as follows: "It is identical with what I have been investigating in our own vicinity—the whitening of the heads and the blackening, and shrivelling of the stalk just above the upper joint, the shrivelled stalk sometimes found on carefully removing the sheath, to be folded back upon itself for about one-twelfth of an inch. It is a *Thrips* attack, which is as exact as I can say at present, similar to that which has been for so long a time observed on June grass, and which I was not at first inclined to accept as Thrips attack, but of which there can now be no reasonable doubt. We do not know the Thrips of the June grass, nor is there any reason for accepting this one on the Timothy as the same. It may, however, prove to be identical, with its operations more recently extended to the Timothy."

Later Prof. Lintner writes on the same subject: "I cannot give you much additional information of the *Thrips*. The June grass species or an allied one did considerable injury to Timothy, in Albany County in June. It was probably the same that you had in Timothy, and is presumably the Grass-eating Thrips (*Limothrips poaphagus*) of Prof. Comstock, lately briefly described in his "Introduction to Entomology," 1888, p. 127. This description is as follows: "Another common species I have designated in my 'Notes on Entomology,' as the grass-eating Thrips, *Limothrips poaphagus*. The injury caused by this pest often attracts attention, although the insect itself is rarely observed. It infests Timothy and June grass, causing the head to turn yellow and die before maturity. These dead heads are very abundant every year. By pulling the head from its sheath, the stalk will be found to be shrunken in the tender part just above the joint, where the juice has been sucked from it; and in this place if the examination be made soon after the turning yellow of the head the insect can also be found. The adult female is light yellow in colour, measures from 1 m.m. to 1⅓ m.m. (0·04 inch to 0·05 inch) in length, and is remarkable in lacking the long spines on the veins of the wings."

In Europe these little insects are charged without hesitation with serious injury, to hay and grain crops. In Mr. C. Whitehead's second report to the English Government, 1886, he says: "Although very small indeed, this little creature does an

infinity of harm to wheat, oats and barley plants in some seasons and in some localities. Being so tiny its action upon cereals is frequently unnoticed, and the results are attributed to other than insect agencies or they are frequently called blight, or supposed to be due to an abnormal state of the plants.

"Upon close examination of affected plants, it will be found that the Thrips have taken up positions under the coverings or case or corolla, of the seed of corn* within the slits of the seeds, and are sucking the juices from them with their short, stout beaks. It has been supposed that they are attracted by the pollen, but it is certain that their chief attraction is the sweet fluid of developing seeds.

In 1886, Prof. Ch. Lindeman published a very complete article upon "Species of Thrips living on cereals in Middle Russia, which appeared in the Bulletin de la Société Impériale des Naturalistes de Moscou. In this the author states that his investigations have convinced him that only two, of five species he mentions, have an agricultural importance. These are

T. secalina. Of this the first generation appears in May and lasts till June, the larvæ living upon the ears of rye. The second generation appears at the end of June and lasts until the beginning of August, living upon the stems and ears of summer wheat and barley. The third generation appears at the beginning of August upon the stems, the same as the last.

The winged females lay no eggs in the autumn, but hibernate under stones, in hollow straws, &c. The eggs are large, $\frac{1}{4}$ mm. long, and are laid separately at some distance from each other. The larvæ remain on the same stem where they hatch from 5 to 15 together beneath the same leaf-sheath. Pupæ as well as the larvæ live only on the sap of cereals. A microscopical examination of the contents of the crop revealed no trace of cells or of vegetable tissue, only a thickish liquid with chlorophyll granules. Prof. Lindeman considers the species distinct from *T. cerealium*, which is the one referred to above by Mr. Whitehead

The damage by *T. secalina* is much less than that caused by *Palæothrips frumentaria*, Bd., the other species which he mentions. This causes great damage by puncturing the ovaries of rye, wheat, barley and timothy. The females lay eggs in May and June, in heaps sometimes as many as 27 together between the paleæ or on the rachis of rye. Larvæ appear at the end of May, and like the adults feed upon the ovaries, destroying from 80 to 90 per cent. of them on the ears attacked. Pupæ were first seen on 4th July. The second and last generation appeared on 10th July. The grains of rye were then ripe, so the insects migrated to the ears of summer wheat. The larvæ were observed by 17th July, and the adults by the end of August, when they went into hibernation.

Dr. Lindeman recommends as remedies for these grain eating species, fall ploughing, burning of the stubble and heavy rolling.

Remedies.—A fact which has been generally noticed amongst my correspondents, who have reported this attack, has been that it was most noticeable upon old and exhausted meadows. This naturally suggests breaking these up and laying them down to some other crop. An old timothy field upon the Experimental Farm was found to be badly attacked by what for the present I prefer still to speak of indefinitely as "Silver-top." When no cause for this injury could be discovered, it was ploughed up, and the result will be noticed during the coming year. This is the only remedy which can be suggested, until something more definite is discovered. The cause of the injury must be looked for immediately the heads of grasses begin to turn white, and the description given above should enable a careful observer to detect whether it is a Thrips or not.

* This word is used in England in the same way that we use "grain."

Locusts—" Grasshoppers" (*Acrididæ.*).

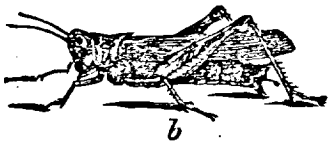

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Fig. 4.—*Melanoplus femur-rubrum*, Burm.

One of the remarkable occurrences of injurious insects during the past season was the appearance of vast numbers of locusts of several species. This is frequently the case in dry seasons, not only these conditions check the growth of vegetation, but also are very favourable to the development of insects. They are usually spoken of as "grasshoppers," but all the short-horned species are generally designated "Locusts" by Entomologists. In the eastern part of Ontario they were very abundant, and during the month of August attacked every green plant that came in their path, even going into the woods and attacking the forest trees. Upon the Experimental Farm they were extremely troublesome. In Western Ontario they were reported as attacking clover and timothy. In Manitoba and the North-West Territories there was no excessive superabundance complained of; but in British Columbia, I am informed by Rev. G. W. Taylor, the Provincial Entomologist, that they occurred in large numbers and were very injurious. He writes "possibly the names of our Victorian species may be of interest to you. The specimens were identified for me by Mr. Lawrence Bruner, which is a guarantee of the correctness of the determinations.

1. *Circotettix undulatus*, Thos.
2. *Arphia tenebrosa*, Scud.
3. *Melanoplus scriptus*, Walk.

These three, particularly the last two, are to be found until late into November, the last named is one of our most abundant species, and is much like your eastern *M. femur-rubrum.*

4. *Melanoplus bivittatus*, Say. Abundant.
5. *Trimerotropis vinculatus*, Scud. This is a rare species which I have only collected in one place.
5. *Camnula pellucida*, Scud. Abundant.
6. *Dissosteira Carolina*, L. Not injuriously abundant.
7. *Tettix granulatus*, Kirby. Occasionally taken.
8. *Gryllus neglectus*, Scud. Very abundant.
9. *Ceutophilus castaneus*, Thos. Not uncommon.
10. *Myrmecophila oregonensis*, Bruner.

This last, scientifically, is an extremely interesting little species, but has no economic importance."

In some parts of the Province of Quebec locusts appeared in large numbers and enquiries concerning them were frequent. Their numbers gave rise to the impression that they were the Rocky Mountain Locust. The occurrence of this last species in that Province is however extremely improbable, if not impossible, although during the last few years the Lesser Locust, *M. atlanis*, Riley, has been one of the most abundant species as far east as Ottawa. The specimens sent to me for identification from the Province of Quebec were, *M. femur-rubrum, M. bivittatus, and D. Carolina.*

In the neighbourhood of Ottawa, the hay fields were noticed to be swarming with young locusts in the beginning of June, and trouble was feared from their numbers. By the beginning of July the first specimens of the perfect winged locusts were taken, and from that time on, until the frosts of autumn, countless myriads committed serious depredations upon almost every green plant. Hay was cut in the beginning of July, and they then forsook the meadows and went to the fields of grain and other produce. The foliage of bushes, fruit trees, and even forest trees was devoured by them; nothing seemed to escape. Their numbers were so great that ordinary remedies were useless. In an effort to protect the experimental grass plots and a

large patch of tobacco, the mixture of bran, sugar and arsenic, as proposed by Prof. Riley, was used. It was readily eaten, and certainly killed large numbers, but the dead bodies were soon disposed of by the survivors, and when one was killed a thousand took its pace. Mechanical apparatus for catching and destroying the perfect locusts would have been the only way to deal with them. I am, however, strongly of the opinion, that, if the hay fields had been cut about the 20th June, instead of in the beginning of July, that the hay would have been just as good and enormous numbers of these locusts would have been destroyed. At that time they were in a condition when they require shade, and, moreover, have no wings with which to move from one field to another. In a close-growing crop, like hay which covers the ground thickly, there is very little active vegetation at the roots, and a great deal of moisture is kept from evaporating. As soon as the hay is cut, all that is left on the field, above the surface, is at once dried up by the action of the air and the sun, and the plant does not shoot up again for some weeks. In wet seasons, of course, this is a little sooner than in dry ones. The latter part of last June and the month of July were excessively hot and dry in this section, and what grass was left upon the fields after the hay was cut, could not possibly have supported the large numbers of locusts which afterwards devastated our crops. By leaving the hay standing until the 1st July, they had reached the final stage in which they can fly, and they were thus enabled to migrate from field to field, which they could not possibly have done in their earlier stages by hopping. It must be remembered that their wings do not grow gradually until they reach their full size, but appear suddenly after the last pupal moult in the same way as those of plant-bugs or butterflies. Amongst the Orthoptera the successive stages of development from the egg to the imago are somewhat different from what we see in other orders of insects. Locusts pass through seven stages. The egg, two larval stages, three pupal stages and the perfect form. In the larval stages there is no appearance of wings; after the second moult, however, small wing pads appear, which increase gradually during the two succeeding moults, but when the pupal life is completed, and just before the insect moults the last time and becomes a perfect locust, the wing pads, even in the large species, are only about a quarter of an inch long. When the last moult takes place, however, and this only takes a few moments when the time comes, from these short wing-pads are unfolded copious gauzy wings, over an inch in length. In a few hours these harden, and are ready to transport their bearer from place to place upon its mission of destruction.

CLOVER.

In the November bulletin of the Ontario Bureau of Industries Mr. Blue writes as follows: "The winter and spring were trying on fields already thinned by drought and the second dry summer left the crop in a very unsatisfactory condition, so far as any prospect of seed was concerned. The Midge was almost everywhere, and while a few correspondents in the Lake Erie and Lake Ontario Counties speak of a fair quantity of seed, the majority of returns describe the crop as a complete failure. Where any seed was obtained it was generally where fields were pastured until the middle of June."

The Clover-Seed Midge (*Cecidomyia leguminicola*, Lintner).

Attack.—Small footless, orange Maggots which eat out the contents of the clover pods and thus destroy the seed.

It is somewhat disappointing to find that the Clover-seed Midge instead of being reduced to the place of a second class pest by the concerted action of the growers of clover seed, has actually made headway during the past summer. This is the more remarkable because its life history is so well understood, and although it is well known by all that to secure a crop of clover-seed, the crop must be cut or fed off before the Maggots are full grown, yet farmers do not adopt this simple method. There are two broods of this midge in the season, corresponding with the two crops of clover-seed. The eggs are laid in the forming flower heads of the clover; when they hatch the maggots eat their way into the seed-pod and destroy the seed. When full grown, which here is about the end of June, they leave the heads of clover and

penetrate a short distance into the ground. Here after a time they change to pupæ and the perfect flies emerge in August, just at the time the clover is heading out again, and therefore just in the condition to serve their progeny as food. Now it is manifest that if the first brood can be destroyed in any district by the systematic and concerted action of all the growers, the second crop of clover-seed must be to a large measure exempt from the attacks of the Midge. It has been proved conclusively that if clover be either cut or fed off before the middle of June the young larvæ of the Midges are destroyed.

Mr. T. Farrow, of Bluevale, Ont., who has tried many experiments, in observing this insect for a succession of years, has written as follows:—"I am the only one in this section who has any clover-seed. I have 30 acres. Twenty acres I pastured until the middle of June. The other ten acres I left for crop. The hay on this was cut about the first week in July and then left for a crop of seed. The summer, as you know, turned out very dry, in consequence of which there was not as much growth as there would have been had the season been damper. However, the seed on the pastured 20 acres was very good and fine. No Midge at all."

Again Mr. Robert Wilkie writing from Blenheim, Ont., on the 4th January, 1889, says: "Very little seed has been threshed here as yet. I have heard of only two lots, one was pastured until early in June, when the stock was turned off and the crop allowed to go to seed. Thirty acres produced 50 bushels of seed; but another piece of ten or twelve acres which was cut for hay the first time produced about the same quantity of seed."

Now these are only two of a great many letters which might be cited to prove that by the adoption of this simple and inexpensive method one of our most remunerative crops may be saved. It is true that occasionally, even without taking this precaution, good crops of seed may be raised but they cannot be relied on.

FIELD CROPS AND VEGETABLES.

ROOTS.

Root crops in most districts are reported as good, and no new attacks of importance by injurious insects have been complained of. In some places potatoes were injuriously affected by rains in September and October, but as a general thing there was very little Potato Rot, and root crops were saved in good order.

TURNIPS.

Turnips were affected by the drought in June and July and the Turnip Flea. Beetle in many places destroyed the young plants so that they had to be sown again. After the middle of June dry weather set in and the plants could not get well started. Towards the middle of June a phenomenal appearance of Cut-worms occurred and it was only with the greatest difficulty that enough plants could be saved for a crop. These Cut-worms were chiefly of three species, *Agrotis subgothica*, *Hadena arctica* and *Agrotis volubilis*. Their attacks were most severe here on the farm in a sandy field, and turnips, mangold wurtzel, cabbage and cereals were most attacked. Paris green and finely ground apatite, 1 to 50 and later 1 to 25, were sown along the rows, but with no appreciable effect upon the Cut-worms.

Striped Flea-beetle, "Turnip Fly" (*Phyllotreta vittata*, Fab.).

Attack.—Small active shining black beetles, with yellow markings on the wing-covers, which eat the seed-leaves of turnips and all other cruciferous plants directly they appear above the ground. When disturbed they hop from the leaves to some distance. As is always the case in dry seasons many complaints have come in of the depredations of flea-beetles upon the turnips. These are not, probably, all by the Striped Flea-Beetle (*P. vittata,*) but as this is the commonest species, and the most successful treatment will apply for all, the description given above will serve to identify the attack.

Dr. J. T. Steeves, Superintendent of the Provincial Lunatic Asylum, St. John, N.B., writes in July last: "I enclose with this specimens of flies, millions of which have invaded our turnip field this summer and destroyed nearly all our young

turnips, and also the mangolds and beets. We have sown early and late, in the same field three times; all were eaten up excepting our garden patch, a large patch which was sown very early, these were not touched. From these we obtained several barrels of plants, which we transplanted, and these a huge grub devoured.

"Is there any remedy that we can use against these enemies, they are very numerous and hop off like fleas when disturbed. Of course we shall lose our crop this year; but what can be done to prevent disaster next year? I have advised our farmer to prepare his drills this autumn and have them all ready to receive the seed as soon as the frost is fairly out of the ground in the spring, and sow early. Most, if not all, the farmers in Lancaster parish, situated on the west side of the St. John River, near its mouth, have suffered from the same foe."

In the Ottawa district the species which attacked the turnips was *P. vittata*, the same as was sent by Dr. Steeves, but I am under the impression it must have been some other insect which destroyed the mangolds and beets. The grub mentioned by him was undoubtedly one of the many species of Cut-worms. These are very partial to mangolds and may have been the culprits.

In the far west the same or a similar beetle occurred followed also by a Cut-worm. Mr. T. H. Fullerton, writing from Calgary, N. W. T., says: "The farmers in this vicinity have been greatly annoyed by flies this year on field turnips as well as on all garden stuff. What the fly left, a sort of grub took, eating the plant off close to the ground. I have some turnips four times sown and would be glad to hear of any remedy you may know of for another year." The life history of these Flea Beetles seems to be as follows:—The perfect insects pass the winter beneath rubbish or clods of earth in the fields. In the early spring they come forth and feed upon some of the many cruciferous plants which then have foliage, as various biennial weeds. The eggs are laid soon after and as stated by Dr. Thomas (Illinois, Rep. VI, p. 159) the larva feeds upon the roots of cruciferous plants and when full-fed makes a small earthen cocoon near its feeding place. From the time the egg is laid until the perfect beetle emerges, it takes about a month, and there are probably three or four broods in the season, for perfect beetles were taken upon cruciferæ in the seed beds at the farm right through the summer. The European Turnip Flea-Beetle (*P. nemorum*, Chev., is stated by Mr. C. Whitehead (Rep. on In. Inj. to Roots and other crops, 1887) to lay its eggs beneath the leaf, and he says that the young larvæ mine the leaves, when full-fed dropping to the ground and pupating in the earth close to the turnip plants. It is further stated that the beetles "arrive in a rapid succession of generations throughout the summer, if it is hot and dry and if other circumstances are favourable, when it is believed that there are as many as six generations."

Remedies.—In England agricultural methods of prevention are relied upon almost entirely. The land is ploughed and manured in the autumn so as to produce a good seed-bed. In the spring it is merely cultivated; this destroys weeds but does not open up the land, which would allow too much moisture to evaporate and would also make shelters for the insects after they had been attracted to the fields. Beneath the wing-covers of the beetles are folded-up ample gauzy wings with which they can fly long distances, and they are doubtless attracted to their food by the sense of smell. Mr. Whitehead advises that "rolling down the land immediately after the drill should be adopted, as it tends to keep in the moisture and to level the earth in the drills, so that the seed may come away as rapidly as possible." He also advises that "plenty of seed of the preceding year's harvest should be used, carefully examined as to its germinating powers, and as to its freedom from other and worthless seeds. From three to four pounds per acre may be put in. The importance of having seed of full germinating* power cannot be too strongly insisted upon."

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*I draw particular notice to this statement of Mr. Whitehead's with regard to the value of seed-testing. Mr. Whitehead is an extensive and successful farmer, who has been all his life a practical farmer. Canadian farmers who can send seed of all kinds to the Experimental Farm to be tested, free of all charge, even postage, have no excuse whatever for sowing or even buying bad seed. The returns as to the germinating quality of seeds can generally be sent back in about a week.

As the beetles pass the winter in the perfect state, early sowing in a district where they have been abundant the previous season is not always successful, although some of the Nova Scotian farmers have great faith in it.

In the Ottawa district the most successful crops have usually been grown from seed sown from 15th to 20th June. Judicious management in the time of sowing so as to get the young plant into the rough leaf, in between the broods of the beetle is one of the best methods of prevention. The great injury to the young plants is done by the beetles attacking the seed-leaves, which are stores of nourishment laid up in the seed for the use of the young plant. What an important office they fill can be easily seen by cutting them away from any young seedling. As soon as the rough leaves or true leaves are formed, in all ordinary seasons, the plants will grow more quickly than the beetles can destroy them. For this reason, as soon as the turnips appear above the ground some quick-acting fertilizer such as superphosphate should be applied so as to push on the young plants past the state when they can be destroyed by the beetles. A most satisfactory result followed the mixing of 1 lb. of Paris green with 50 of plaster and sowing it along the rows. Dusting with lime or dust when the dew is on the leaves is largely practised; but if Paris green is added in the above proportion all the beetles are killed which attack the crop. The time of appearance of the different broods will vary in different localities, and this can only be learned by observation in each locality.

The Turnip Aphis (*A. brassicæ*, L.) abundant upon Swede turnips last autumn, was only reported as injurious once; this was in Victoria, British Columbia, where, however, it confined itself to the Swedes, and did not touch other varieties.

POTATOES.

Fig. 5.

Potatoes in the west are reported to have suffered severely from the attacks of a Flea-beetle, but no specimens have been sent in. *Crepidodera cucumeris*. Har. (Fig. 5) a small black flea-beetle with yellowish antennæ and legs, frequently attacks potatoes in the way described, *i.e.*, by eating small holes in the foliage. This same beetle has been sent to me by Mr. E. D. Arnaud, of Annapolis, N.S., who found it in numbers upon his young tomatoes as soon as they were set out. He had tried a weak solution of carbolic acid, but without much effect. The Colorado Potato Beetle was very destructive in many districts. A correspondent writing from the Eastern Townships of Quebec in the beginning of June, says: "I never anywhere saw the potato beetles so thick. The beetles are upon every plant and the eggs are abundant on the other side of the leaves. Unless something is done there will be a total destruction of the potato crop." Upon receipt of this letter I at once wrote a letter for the St. John's *News* urging upon agriculturists the importance of destroying the first brood and recommending the application of Paris green in the proportion of a teaspoonful to a pail of water. There should be no trouble with this pest, the liquid Paris green mixture meeting all requirements of the most exacting practical farmer. The time required for applying it is short, the cost is small, the results are certain, and there is no injury to the plant. The potato beetle has been mentioned in reports from all the eastern Provinces of Canada and from Manitoba. One correspondent, writing from Lake Temiscaming, says: "The Colorado potato beetle has played great havoc with my potatoes; out of nine bags of seed sowed last spring I shall not have five bags of crop; this is too bad, but not expecting them to turn up here I had no Paris green by me. I have it now, though, and shall be ready for them next spring." Specimens of the grey blister beetle (*Epicauta cinerea*, Forst) have been sent for identification on several occasions, and Messrs. Thomson & Fraser, florists, of Winnipeg, sent me specimens of the black blister beetle (*E. Pennsylvanica*, De G.) as the perpetrators of "considerable damage amongst potatoes."

"Black-worms," Thousand-legged worms—(*Julidæ*).

A small species of Julus has been sent in twice during the season as injuring potatoes. This is the same species as in my 1885 report I indentified as *J. cæruleo-*

cinctus, Wood. It is a rather small species, scarcely an inch in length, and banded alternately with dark brown and bluish rings. It was stated that it had injured the surface of growing potatoes in August by eating out shallow furrows on the surface of the tubers, and Mr. R. Brodie, of St. Henry of Montreal, writes that he has had several different plants attacked by it. He writes: "Another thing which is getting to be a serious matter with us is the injury done by the 'black worm' mentioned in your 1885 Report. Our rotten manure heaps are full of them; they begin with our early potato sets in spring after they are planted, and the corn in the hills. We have to put shingles under the melons or they will eat into them when they are barely ripe. They also attack tomatoes and windfalls under our apple trees. I hope we will soon get a remedy for this troublesome pest. Some talk of using salt, but I am afraid the quantity of salt it would take to kill them would destroy the growth of plants also."

In June I received specimens of the same Julus from Principal A. H. Mackay, of the Pictou Academy, N.S. He writes: "I send you to-day a species of Julus found eating the seed corn of the young growing plants. They are very abundant in this particular corn patch in a garden here. I do not know whether they do much damage or are likely to do so; perhaps they only destroy the old exhausted grain of corn."

From what is known of the habits of these creatures I fear there is no doubt that they must be considered as injurious. After detailing several attacks, Miss E. A. Ormerod in her report for the year 1885, says: "From reports sent in during the last three years it appears that millipedes live on most of our common root crops, such as mangolds, potatoes, carrots, onions, &c., likewise on young wheat and on various crops, on which they feed as the case may be—at the roots, as of peas; or at what they can reach, as celery; or on ground-fruit as strawberries. The fact of their feeding on wheat was observed more than forty years ago in the case of *Julus Londiniensis*, and without entering at too great length on details, everything confirms the fact that they are general feeders, consuming living and decayed vegetable and animal substances."

Mr. Whitehead, in his report upon hop insects (1885), says: "It is commonly held that these thousand-legs are merely attendants upon decay and do not themselves create it; but the formation of their jaws adapted for gnawing and biting proves clearly that they are active sources of injury to plants."

These creatures are not insects but belong to the myriapods. They have no wings, and although so well provided with legs cannot walk fast nor for long distances. When therefore their habits are better understood a remedy should be forthcoming. It is quite exceptional their occurring in large numbers. It is stated in Nova Scotia that they are always abundant where sawdust has been used as a vehicle for liquid manure; this then should be discarded as much as possible. They are nearly always found in damp places which would point to the advantage of draining low lands. Frequent cultivating during the summer would also be beneficial.

Miss Ormerod found that salt and water killed *Julidæ* in a short time, and she therefore advises the treatment of land or manure heaps with salt, nitrate of soda, caustic lime or gas lime. Traps are also suggested, made by placing slices of mangolds, carrots or vegetable marrow upon the ground, an expedient which is tried with good results in Germany.

The large species of *Julus*, two inches and a-half in length by nearly a quarter of an inch in width which is sometimes found under rotten logs is named *Julus Canadensis*. It has never so far been found injuring vegetation.

CABBAGE.

Cabbage insects during the past season, with the exception of the work of cutworms in the spring, have not been so troublesome as usual.

The Anthomyian root maggots were decidedly less destructive in every locality reported from, not only in cabbages but also in onion beds. Where the earth was

kept well hoed up to the collar much better crops of cabbage were grown than where planted in the ordinary way. The most serious pest during the past year in Eastern Canada has been

"The Cabbage Worm." The Imported White Cabbage Butterfly (*Pieris Rapæ*, L.)

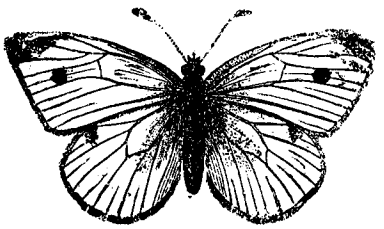


Fig. 6.

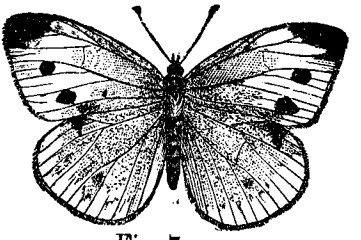


Fig. 7.

Attack.—Velvety green caterpillars, about an inch in length, with a broken yellow line along each side and an unbroken one down the middle of the back. At first eating the outside leaves, but eventually boring right into the heart of the cabbage. These, after three or four weeks produce the white butterflies so common in gardens. Fig. 6 male, fig. 7 female.

Renewed experiments with pyrethrum insect powder mixed with four times its weight of common flour, have proved to be most successful, and I consider this to be undoubtedly the best remedy for this insect. Cabbages treated three times were perfectly free from worms The applications were made by puffing a small quantity of the powder into the heads in the middle of July and at the beginning and end of August. Mr. R. B. Whyte, of Ottawa, writes: "Last spring, on your recommendation, I tried the effects of insect powder as a remedy for the ravages of the cabbage-worm. For several years previously I had great difficulty in growing cabbage, and always lost a large part of the crop. A few days after the first appearance of the worm I applied the powder by means of a small bellows, such as druggists sell for 15 cents. I walked along the rows compressing the bellows once and sometimes twice about 8 inches above each plant. One ounce of powder, costing less than 10 cents, entirely cleared 150 plants. On examining the plants three days afterwards, not a single living worm could be found. Three or four weeks afterwards I noticed that another brood was beginning to hatch out, so I applied the powder again, with the same results."

When attending a meeting of the Frontenac Farmers' Institute, held last June in Kingston, the statement was made that gardeners were giving up growing cabbages owing to the trouble they experienced with this insect. I strongly advised them to try the pyrethrum remedy, and some of those present said that they would do so. In a late letter from Mr. Alexander Ritchie, the Secretary of the Institute, the following encouraging words appear: "We have more cabbage this year than we ever had before, and scores of others say the same, all due to your remedy for the cabbage-worm."

A satisfactory discovery I have made during the past season is that the small parasite which is so useful in the United States, *Pteromalus puparum*, is present in many parts of Canada and at Ottawa in very large numbers. Mr. W. H. Harrington took it at Sydney, Cape Breton, Professor A. H. Mackay sent it to me from Pictou, Nova Scotia, and I found it in very large numbers in the conservatory of the Experimental Farm at Ottawa, infesting chrysalids of *P. Rapæ* which had fed upon mignonette. I was unable to detect the females in the act of stinging the larvæ; but frequently found them perched upon the newly formed pupæ, and I now have about 40 infested pupæ for distribution to localities where as yet the parasite has not been observed.

Club-root of the Cabbage (*Plasmodiophora brassicæ*, Wor.)

A disease of cabbages which is very little understood by farmers is Club-root. I have received three communications concerning it. It is usually supposed to be the

work of insects, but this is not the case. It is a distortion of the tissues of the cabbage root owing to the presence of a parasitic fungus. In Mr. Worthington G. Smith's "Diseases of Field and Garden Crops," (1884) is given an elaborate account of this pest. In this he says: "until the last six or seven years no one knew the cause of Club root; but in 1876, after three years constant attention, Mr. Woronin, a Russian botanist, as completely explained the nature of the Club-root in turnips and cabbages as the Rev. M. J. Berkeley expounded the murrain of potatoes in 1846."

"The observations made by Mr. Woronin, which have several times been confirmed by others as well as ourselves, seem to place the fact beyond all doubt that clubbing is caused by a fungus (p. 94). The family to which this fungus belongs is known by the name of slime-fungi (*Myxomycetes*) which are most remarkable from the fact that they do not form cells, tissues, nor mycelium, during the time of active growth; but the protoplasm remains during that time free and collected into small amœba-like masses. When mature, however, small pieces are separated from the mass, a cell wall is formed and the small pieces become spores for the re-production of the plant." Fungi, it must be remembered, even the microscopic species, are plants. Spores of fungi are analogous to seeds in higher vegetables. I received from Rev. Mère Marie St. Augustin, of Sillery, P.Q., some roots of young cabbage badly infested with this fungus—the roots and the galls of the fungus were also attacked by the Cabbage Root-maggot, and these had naturally been accredited with all the injury. In the letter which accompanied the specimen is the following: "I send you in a small box a specimen which is commonly called 'potato of the cabbage' without doubt on account of the resemblance in the form of this excresence on the root of the cabbage to the tuber of a potato. It appears to be due to the presence of small white larvæ which are nourished on the juice of the plant stopping its growth and killing it. We shall be much obliged if you can suggest some means of destroying the injurious insect. If it is too late this season to stop its ravages, we shall be pleased to know its name and any remedy for its attack."

Mr. R. Brodie, of St. Henry of Montreal, who is considered one of the best growers of cabbage on the Island of Montreal wrote to me in 1887: "On some of our land we cannot grow cabbage or cauliflower two years in succession on account of the worm (?) which causes Club-root. I am doubtful if it really is, as supposed, a worm which causes this big root. I have cut the root away with my knife piece by piece and could never find one. Mr. Peter Henderson, in one of his books says it is the want of lime in the soil that partly causes the Club-root. Four years ago I used a quantity of hardwood ashes on a four-acre field of cabbage, but I had to leave twelve drills without ashes as I ran short of them; these twelve rows were almost a total failure, being Club-rooted, while the others were a splendid crop averaging ten pounds per head. I find there are far more fertilising qualities in ashes than in lime and it is a wonder to me that farmers do not use more of them when they are so cheap."

Again Mr. Brodie writes this year:—

"You ask me if my treatment to prevent Club root in cabbage was again successful. In our 9 acres of cabbage and cauliflower I do not think that we found one that was Club-rooted. We gave the land a heavy coat of ashes that we had gathered round the country. I suppose they would be mixed hard and soft wood ashes. These we mixed well with the soil. We had a man following the plough with a cart-load of ashes. In scattering them he stood in the cart and held a coal-shovel full of ashes over the side shaking them off as evenly as he could into the furrows as the horse moved on. The land was heavily manured the previous year. After the plants had started to grow I applied to each plant a small handful of a complete fertilizer I procured from the Standard Fertilizing Company, Smith's Falls. This gave them a vigorous growth. We very seldom plant cabbage two years in succession on the same soil, but one of the best gardeners in this neighbourhood, who pays a high rent for a small piece of land, has planted cabbage I am sure 20 years in succession. He uses large quantities of quick-lime, and also gas-lime from the gas-works, otherwise he could not grow them at all, for the nature of his soil is more

subject to club-root than mine. I use the ashes as much for their fertilizing qualities as for their prevention of club-root, but quick lime has hardly any fertilizing qualities that I am aware of."

This experience of Mr. Brodie's is very valuable, because it can be tried by everyone.

Mr. Worthington Smith recommends such an alternation of crops for two or three years, that the spores of the fungus may be exhausted before a cruciferous crop is again cultivated on the same land. He says:—"Beyond all other things it is necessary that old club-root should not be allowed to remain on the ground where turnips or cabbages are to be grown. All the diseased material should be gathered into a heap and, if possible, burnt. No sane healthy person would remain in a place tainted with contagia of dead and diseased animals, and it is equally unsafe to place sound plants, tubers, or seeds amongst dead or diseased vegetable refuse. In one case, as in the other, certain individuals may, perchance, escape; but the general result is the healthy organisms are at length destroyed by the dead or diseased ones."

Cut-worms.

Of all the injuries committed year after year upon field and garden crops, there are none concerning which more enquiries are made, than of the various caterpillars known as Cut-worms. During the past season, however, possibly owing to the exceptional climatic conditions during the autumn of 1887 and the spring of 1888, various species of these caterpillars appeared in overwhelming numbers, in all directions. During the month of June letters and specimens poured in. There was no province in the Dominion from which complaints of their depredations were not received. From British Columbia I received the variegated Cut-worm (*Agrotis saucia*), and some chrysalids which turned to *Ag. obeliscoides*, Guen. From Manitoba, the W-marked Cut-worm (*Ag. clandestina*, Har.) and *Ag. declarata*, Mor. From New Brunswick, the Gothic Dart moth (*Ag. subgothica*, Haw.) From Nova Scotia came the last named and the Lance Rustic (*Agrotis ypsilon*, Ratt.), and from Cape Breton, the caterpillars of a moth, which has been kindly identified by Prof. Riley as *Ag. turris*, Grote. In addition to these, various letters described their ravages without sending specimens.

Rev. J. B. Hemmeon, of Wolfville, N.S., says: "The Cut-worm is very prevalent this year, destroying acres of cucumbers and other things planted for pickling factories."

Prof. J. Burwash, of Mt. Allison University, Sackville, N.B., sent specimens of two species of larvæ which, he writes: "Have been doing considerable damage in this neighbourhood and generally throughout the county of Westmoreland, N B. They work under the ground at a short distance from the surface, and bite off the plants at the beginning of the stem. They prefer beets, mangolds, or carrots; but have also cut down peas, corn and onions. The beets have, in some place, been completely destroyed by them."

Dr. R. A. H. McKean, writing from Cow Bay, Cape Breton, N.S, says: "I send you a few specimens of a grub* which has been, for years, playing a great deal of mischief in our gardens in this county, and which is likely to ruin not only our gardens, but grain fields as well. When my peas, beans and mangolds were well up I noticed the peas cut off near the ground; examination showed the work to have been done by a grub similar to the specimen forwarded. One or two were found round some of the stocks, but in a day or two they increased in number, extending their operations to the beans, beets, squash, spinach, &c., and now I find a small piece of southern corn, put in as an experiment, also receiving attention. As it looks at present, gardens will be stripped of everything green and succulent. In the country districts, I hear that oat fields are suffering in the same way, and will have to be resowed. I tried a strong decoction of tobacco round my peas and beans; but I cannot say that the grubs objected to 'the weed.' Others have experimented with hellebore, but to no purpose. The fertilizer I used was a mixture of horse and cow

*These produced the moth *Agrotis turris*, Grote.

manure in some places, and well-rotted compost of the above with black bog-mud in others; but I could see no difference in the number of grubs or their activity. In one instance kelp has been tried; but with, if anything, more grubs in that garden than in others."

Mr. C. W. C. Bate also says: "My father writes me from Killarney, Manitoba, that his kitchen garden is being ruined by the attacks of what he takes to be the Cut-worm."

These are samples of a large number of similar letters, and in this district the same state of affairs occurred as is described above. In May and June the fields simply swarmed with these injurious caterpillars, and great injury was done to field crops. When Cut-worms only appear in their ordinary numbers, there are certain remedies by which their ravages can be kept within bounds; but when they suddenly occur in the countless myriads, as our fields were overrun by last spring, all ordinary methods of meeting their attacks prove entirely inadequate. Cut-worms are the caterpillars of dull-colored active moths belonging for the most part to three genera, namely, *Agrotis*, *Hadena* and *Mamestra*. Now, these three genera alone contain more than 340 described species. Of course the different species vary somewhat in their habits, but taken as a class they are very similar, and in the present state of our knowledge, it will be more convenient to treat them as a class, at any rate in a report like this, which is prepared particularly with the hope of helping farmers to overcome their insect foes. As Cut-worms are the caterpillars of so many different species of moths, the inaccuracy of speaking of them as *the* Cut-worm is apparent. Moreover, many other insects are sent in and reported upon as Cut-worms which do not belong to this class at all. Of these the White Grubs, the larval state of the June Beetles (*Lachnosterna*) are most often referred to. There is some reason in this, from their occasional habit of biting off plants in the manner of the true Cut-worms, which are the caterpillars of the moths referred to above, and may be described in a general way as smooth, almost naked, greasy-looking caterpillars of some dull shade of colour similar to the ground in which they hide during the day. The head is smooth and shining, and sometimes of a different colour from the rest of the body. On the top of the segment next to the head, is a smooth chitinous plate known as the thoracic shield. There are generally about six series of bristle-bearing tubercles along each side of the body, and when disturbed the caterpillars curl up into a ring.

Their habits are almost always nocturnal, lying hid by day just beneath the surface of the soil; they come out at night to feed. When, however, they develop in large numbers they frequently change their habits and feed by day, owing probably to the reduced food supply consequent upon their ravages. The habits of most Cut-worms are probably as follows:—The egg is laid in the spring, summer or autumn, and the insects may pass the winter either in the perfect moth state, as a young half-grown caterpillar or as a chrysalis. Those which hibernate as moths lay the spring eggs and moths are produced again before winter sets in. The eggs which are laid in the summer or autumn hatch soon after and the caterpillars either become full fed the same season and pass the winter underground in the chrysalis state or after feeding for a short time become torpid and pass the winter as half-grown caterpillars. In this condition they may be found late in the autumn under stones, logs or heaps of dead vegetation, in the roots of grasses, or in cells beneath the surface of the ground. The ravages of the young caterpillars which hatch in the summer and autumn, are seldom noticed then, on account of the abundant vegetation at those seasons. In the spring, however, not only are the caterpillars much larger and capable of more mischief but the land is cleared of all weeds and vegetation, other than the crop which is to be grown, and when the Cut-worms, revived by the warmth of the sun and the opening of spring, come from their winter retreats, there is nothing for them to eat but the farmer's early crops. They are particularly troublesome in gardens, cutting off young cabbages, tomatoes and other plants as

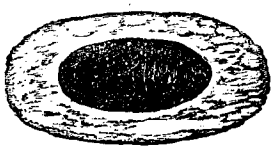


Fig. 8.

soon as pricked out. When the caterpillars are full-fed they burrow into the ground to a depth of a few inches and turn to brown chrysalids inside a smooth cell or a light cocoon (Fig. 8). From these after a few weeks the perfect moths emerge. They are very active at night, and when disturbed have the same habit as their caterpillars of dropping to the ground and remaining perfectly still as if dead. From their dull colour they are then difficult to find. When at rest their wings lie horizontally over their backs and the upper ones entirely cover the lower pair. The upper wings are generally crossed with one or more waved lines and always bear two characteristic marks, one about half way down the wing, orbicular in shape, the other, nearer the tip, reniform or kidney-shaped.

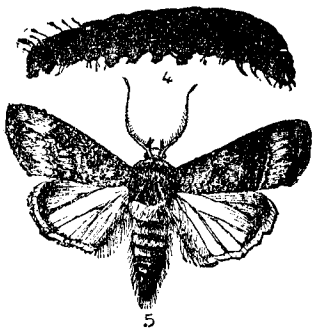


Fig. 9.

Fig. 9 shows a common and very injurious species, the Lance Rustic Moth (*Agrotis Ypsilon*) and its caterpillar, the Greasy Cut-worm.

From their nocturnal habits Cut-worms frequently do a great deal of harm to vegetation without being recognized as the cause. It is important in the view of discovering useful remedies to ascertain as soon as possible the habits of all these caterpillars.

Those of which the preparatory stages are known may be divided into three classes: 1. Climbing Cut-worms, or those which climb trees and destroy the buds. 2. Surface Cut-worms, or those which live on the surface of the ground and cut off herbaceous plants just beneath the level of the soil. 3. Those which combine both of these habits.

Of the first class we cannot have a better example than the Common Climbing Cut-worm (*Agrotis scandens*, Riley). This species was abundant last spring, but as a rule is rather a rare species here, although I have specimens from several localities in Western Canada. The caterpillar attacks the apple, and is sometimes very injurious, eating out the buds just as they are expanding. "It is of a light yellowish gray colour variegated with dull green, with a dark line down the back, and fainter lines along the sides; the spiracles or breathing pores are black. When full grown it is nearly an inch and a-half long." (Saunders, W. Insects Inj. to Fruits, p. 108.)

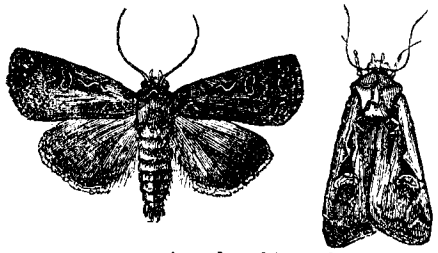


Fig. 10—*A. subgothica* showing wings expanded and folded.

Of the second class or Cut-worms proper, there are many species, perhaps the best known of which is the Dingy Cut-worm, the caterpillar of the Gothic Dart Moth (*Agrotis subgothica*, Haw.) There are, however, several species almost identical in general appearance and habits. Frequently observers collect several specimens, supposing them all to belong to the same species; but when the moths appear they find that they have been dealing with four or five different kinds. This was my own experience during the past season. From cages supposed only to contain one species I obtained specimens of *Agrotis campestris*, *A. Ypsilon*, *A. volubilis* and *A. subgothica*. I unluckily omitted to take exact descriptions of the larvæ and their colorational differences; but their habits were all similar and the same remedies would apply for all. The Dingy Cut-worm is found over a very large area. From the Atlantic to the Pacific in Canada and it also occurs in Europe. The colours are very variable but may be described as follows: Head grey, shiny and speckled. Thoracic shield on first segment bearing three white stripes. General colour of the body grey with a wide brownish stripe down the back and three indistinct stripes along the sides. The bristle-bearing tubercles black and conspicuous. When full grown it is about an inch in length.

Of the third class which both destroy low vegetation and climb up trees and bushes and destroy the buds, no better example can be cited than the Variegated Cut-worm,

the caterpillar of the Un-Armed Rustic Moth (*Agrotis saucia*, Treit.) This was a very abundant species last spring. Mr. E. Hutcherson, writing from Ladner's Landing, British Columbia, sent in June last specimens of this species, in both the larval and pupal stages. It is a large and most voracious species. Dr. Thomas in the Seventh Illinois Report says: "This is widely distributed and it is probable that we have no other species that is more voracious or is a more general feeder. While some kinds of Cut-worms are not found much out of certain situations, this may be sought in any place during its season, with a good prospect of finding it. There seems to be no cultivated crop that are free from its attacks, and when these are not at hand it feeds readily upon weeds that are found in the fields and by the roadsides."

I have taken this species also in Victoria, B. C., where it was most troublesome, attacking all kinds of vegetables in market gardens.

Mr. Hutcherson writes: "I send you several grubs which are doing great destruction here at the present time. As you will see they are ground grubs burrowing in the ground in the day time and working at night. I am eager to know the best remedy for destroying them as well as their history. Would gas-lime destroy them? If so how should I employ it and what danger would there be to vegetation?" And again later he writes: "I send you to-day a packet containing grubs in the chrysalis stage as I expect those sent before would reach you in such damaged condition as to be useless. I might say the ground is full of them, scarcely a square foot without a grub in it. They have damaged my grafts and one year old trees pretty badly by eating off the tips."

The caterpillar is large, nearly two inches in length when walking, of a light slate colour mottled or marbled with irregular pinkish, grey, and deep black elongated marks which make two broken and indistinct lines along the sides. Beneath the breathing pores a pale stripe. Head, grey, mottled. The moth is a large species of very variable appearance, expanding one inch and three-quarters, usually of a pale brown colour with a few indistinct black marks on the upper wings, the lower wings whitish in the centre and brown outside.

Another species with the same habit as the above, of occasionally climbing up trees and bushes is called the Yellow-headed Cut-worm, the caterpillar of the Amputating Brocade Moth (*Hadena arctica*, Bois.) Fig. 11.

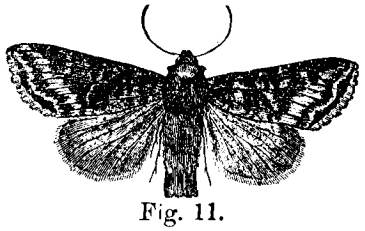


Fig. 11.

This was remarkably abundant in the perfect state during the months of July and August flying into rooms at night by hundreds. The larva was not recognized amongst the injurious Cut-worms collected. It is described as "of a smoky or livid brown colour, with a yellow or chestnut coloured head, and a horny shield of the same colour on the first and last segments of the body. It grows to a larger size than most of the other Cut-worms, and is peculiarly destructive, because it severs the plant about an inch below the surface of the ground, thus destroying it irremediably. They also attack the corn till a later period than some others." (G. J. Bowles in An. Rep. Ent. Soc., Ont, 1887, p. 39.) The moth is a very beautiful creature expanding nearly two inches. The general colour is rich reddish brown, mottled with clear grey. In the centre of each of the upper wings is a bright red V-shaped space containing the ordinary round and kidney-shaped marks of the family. Exterior to this red space are two irregular bands, the first grey and a terminal dusky band. These are divided by a white line shaded with brown within. The thorax and the body are ornamented with reddish tufts.

Remedies—There are many remedies which may be tried for Cut-worms, some of which will usually answer the required purposes. When, however, as stated above, the caterpillars appear in enormous numbers and materially reduce their own food supply, no remedies except killing them will prevent them from attacking plants. There are a great many beneficial insects which help to keep these pests in check. Various Hymenopterous four-winged flies attack them as well as the parasitic Tachina flies and true Bugs. In addition to these, however, there are some large ground

beetles known by the name of *Calosoma*. These should be known by sight by every gardener and farmer; they are amongst his best friends; but being usually found amongst the injured plants where they are hunting for the injurious Cut-worms their mission is misunderstood and they are frequently destroyed. Fig. 12 shows the Fiery Ground Beetle (*Calosoma calidum*, Fab.) a common and very useful species, the grub of which has been styled the "Cut-worm Lion."

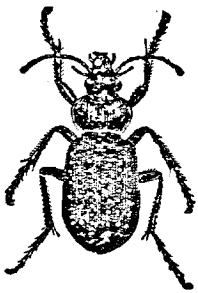


Fig. 12.

Artificial remedies will, of course, vary with the habits of the caterpillars to be guarded against.

For the Climbing Cut-worms the best remedy is to place round the stem of the tree or bush to be protected a strip of tin six inches wide; the lower edge can be pressed into the ground and the tubular shape is easily preserved by securing it above with a piece of twine. This will effectually keep all Cut-worms from the tree, for these heavy-bodied caterpillars are unable to crawl over the smooth surface. A similar expedient is to tie a band of cotton batting round the stem. The caterpillars being unable to crawl over this yielding material.

For Surface Cut-worms the most efficient remedies are the following:—

1. Keeping down all weeds in the late summer and autumn months, so as to deprive those species which hatch in the autumn of their food supply and winter shelter.

2. Late ploughing in autumn or winter so as to disturb them after they have gone into winter quarters. The value of this treatment lies chiefly in breaking the cell they have made as a protection from the cold of winter, at a time of the year when they will be unable to make another.

3. Burning off all stubble and rubbish as late as possible in the spring when many of the caterpillars and the eggs of some species will be destroyed.

4. Placing some substance with an obnoxious odour around young plants when first set out, as fresh gas lime, sand or sawdust saturated with coal oil or carbolic acid.

5. Traps.—Prof. Riley has found that they may be destroyed in large numbers by setting poisoned traps between the rows of the crop to be protected. These are made as follows, having procured a supply of some succulent plant as grass, clover, or "lamb's quarters," (*Chenopodium album*, L.), tie them in loose bundles and sprinkle them heavily, or dip them in Paris Green and water. These are placed between the rows. Tying the plants in bundles has the effect of keeping the traps green and fresh for a longer time. "Lamb's quarters" is a favourite plant with many kinds of Cut-worms and it will be noticed that where this weed grows, it is much more attractive than most plants grown as crops. This plant springs up everywhere in cultivated land. I believe that if strips of it were left at intervals in the fields, they would draw off the attack from the crops. A noticeable feature with this weed is the ease with which it can be destroyed. From the habit Cut-worms have of cutting off the stem of an attacked plant and remaining close to its root in the day time, and from the fact that when this plant is injured it fades quickly and turns to a whitish tint, the presence of Cut-worms in these rows can be detected at a glance, after a couple of hours of sunshine. The caterpillars should then of course be dug out and destroyed. After the season for the Cut-worms has passed by, these strips can be run over with the cultivator and will be of no further trouble.

6. Wrapping.—Young tomatoes and cabbages may generally be protected in a large measure from the attacks of Cut-worms, by simply wrapping a piece of paper around the stems at the time of planting, care being taken that it reaches above the ground for about an inch. This remedy usually answers well; but last spring not even paper saturated with a mixture of coal oil and linseed oil kept the hungry myriads from the young tomatoes and cabbages. The same remedy is sometimes used in a modified form by making a cornucopia of paper and after putting some earth in it, put in the plant and sink it in the ground and fill up, leaving two inches above the ground. In short the plant is planted in the cone of paper. By the time the roots have reached the paper it is decayed and forms no barrier to root growth.

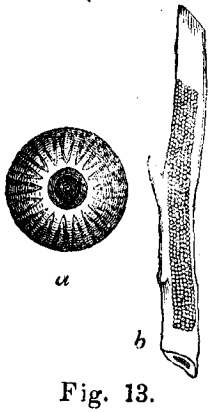
A similar expedient is to place tomato tins, with the tops and bottoms cut out, over young plants, the caterpillars being unable to crawl over the smooth tin.

7. Ditching.—It must be remembered that Cut-worms are essentially vagrants. They never stay long in any one place, but crawl long distances at night from place to place. In years of very bad attack, it usually happens that certain fields are free from attack, whilst most of the others are badly infested. To prevent Cut-worms from leaving a certain field or to keep them out of another, ploughing a deep furrow has been found useful in confining their ravages.

All the above named remedies have been tried and found useful, but in years of great abundance they fail to protect the crop entirely. This fact is illustrated by our Ottawa experience of last season and by the following letter from Mr. G. A. Knight, of Mount Tolmie, Victoria, B. C. As I have received many enquiries as to the value of gas-lime, I insert the letter in full:—

"With regard to Cut-worms I am afraid gas-lime is a failure. In January I put it on very thick—1,500 lbs. on ⅓ of an acre. I was afraid I had it too thick; but I ploughed it in, and in March I ploughed the land again. I then saw that the land was thick with the larvæ of a *Tipula*, and even where the lime was dumped they were there as well by the thousand. In some places I also saw earth-worms, but no signs of Cut-worms I sowed part with beet-root, carrots, and peas. Everything went splendidly until all the seeds were up about one or two inches high. The peas were sown sometime after the other seeds, so they all came up about the same time. I may say that before this we had had a lot of cold, nasty weather and things made scarcely any growth. All at once it cleared up and the sun came out hot for a week, and then as if by magic, the Cut-worms made their appearance. They were very small at first, but soon grew to be half an inch and one inch long. I had a lively time with them. In some places they cleared off everything. I sowed carrots three times, but the last lot did not come up until the middle of July, which is too late for them to do anything as it is too hot and dry then. My onions were all taken of the first sowing, and they served my nursery stock very badly. They would cut the plum and apple buds clean out. I mixed Paris Green with lime and put it on so thick that I killed the foliage and bark; but no dead Cut-worms could I find. I tried saltpetre and ashes, but that was no good. As for the traps you speak of they were no good with me either. What is to become of the cabbage plants when there are no leaves or clover for traps, and other things that are sown in March and are up and taken before there is anything to make traps with? The traps, too, soon wilt with the sun and wind, and Cut-worms, here at any rate, will not eat that stuff when they can get a carrot or an onion an inch high.

"I cannot altogether condemn the gas-lime, although I have no faith in it, because it did not kill the *Tipulas* nor the weeds. Chickweed came up by the millions before anything else, and I put no manure on the land. The Cut-worms might have come from the land on both sides, but I believe not, because they were so small At any rate it is a splendid fertiliser, whatever plants were left by the grubs grew very rank and strong."



a *b*

Fig. 13.

Specimens of Cut-worms sent to me by Mr. Knight, produced *Agrotis saucia* and *A. obeliscoides*. With regard to the first of these it was discovered by Prof. Riley, that the eggs (Fig. 13) were laid upon the twigs of trees, and he thinks it probable that the moth hibernates in the perfect state, so that while Mr. Knight may have destroyed many larvæ by the use of the gas-lime, those which attacked his crop might have been produced in the spring from eggs laid upon trees growing in his garden, after the gas-lime had lost its effect. A light sprinkling of fresh gas-lime amongst cabbages and onions has the effect of keeping off the flies which are the progenitors of the Root Maggots, and it seems probable that Cut-worms might have been kept from attacking these beds had they been treated with one or two light sprinklings in the spring.

Empusa (*Entomophthora*) *virescens*, Thaxter. A beneficial parasitic fungus.

In 1884, fields and gardens were over-run by vast hordes of a black velvety Cut-worm, with white lateral stripes and a red head. These turned out to be the larvæ of *Agrotis fennica*, Tausch. About the 22nd May, it was noticed that many of these larvæ were attacked by a fungous disease with such virulence, that but a small proportion could become pupæ. In certain fields they were to be seen in large numbers on stones, fences, stems of grasses and other plants up which they had crawled, and to which they were fixed by the fungus. This seemed in nearly all cases to emerge from the body just below the head, in the shape of a small tuft of white downy matter. After a short time the bodies dried up. Specimens of this fungus were sent to Mr. Roland Thaxter, Cambridge, Mass., who has just published a monograph of the Entomophthoreæ of the United States. "These are minute fungi possessed of an individuality of their own that renders them susceptible of consideration apart from all other forms of plant life. This peculiarity consists in an obligatory parasitism upon insects, which, although in some instances it exists without apparent injury to the insect host, is usually of such a nature as to cause its death; often resulting, especially amongst noxious insects, in widespread mortality."

A well known instance of these fungi is the *Empusa muscæ*, Cohn, which causes the death of house flies in the autumn, when they may be found attached to walls or windows by their tongues and surrounded by a white cloud of the spores of the fungus which had destroyed them.

Although so abundant at Ottawa in 1884, and notwithstanding that close search was made constantly since that time, no further specimens could be found until this spring, when a few specimens were discovered upon stems of grass in a hay field in June. When the specimens were sent to Mr. Thaxter he recognized them as belonging to an undescribed species and in the monograph referred to he describes it as follows:—

Empusa (*Entomophthora*) *virescens*, Nov. Sp.

Conidia, ovoid to oblong, of irregular shape; with bluntly rounded base and apex, the former often hardly papillate and not well distinguished from the apex; colour greenish yellow in dried material; containing numerous small, irregular, often rod-like fat bodies; measurements, 10 by 20 m.—16 by 36 m., average 14 by 30 m. *Conidiophores* digitate, arising indirectly from spherical hyphal bodies which germinate in all directions, giving rise to very numerous hyphæ which subsequently become conidiophores, *Cystidia* not observed. Secondary conidia like the primary. Resting spores unknown. Host attached to substratum by rhizoids.

Hosts. Lepidoptera: Larvæ of *Agrotis fennica*.

Habitat, Ottawa, Ontario.

REPORT OF THE HORTICULTURIST.

(W. W. HILBORN.)

Prof. WM. SAUNDERS,
Director of the Dominion Experimental Farms,
Ottawa.

SIR,—I have the honour to submit herewith a report on the progress made in the horticultural department of the Central Experimental Farm, Ottawa, during the past year. I have also added a list of the varieties of fruit trees planted on the farm.

As stated in my last report 216 apple trees, out of a collection of 903, were transplanted from the nursery rows in the autumn of 1887, to an orchard, with the view of testing the relative merits of fall and spring planting. Most of these were standard sorts such as are in general cultivation in Ontario, with a few Russian varieties. The summer and autumn were both unusually dry and unfavourable for newly planted trees and the lack of moisture in the soil at the time of planting was very unusual. The winter was severe, the thermometer having gone as low as 40 below zero.

When the snow disappeared in the spring it was found that nearly all these autumn planted trees were more or less injured, many of them killed down to the snow line. The fact that such varieties as Duchess of Oldenburg, Tetofsky and Fameuse, of which there are healthy bearing trees growing unharmed within a short distance of the farm suffered equally with the tender sorts, showed clearly that these failures were due to the unfavourable season for planting rather than to lack of hardiness in some of the sorts tested.

In the autumn of 1887, 200 apple trees were procured of the following varieties: 100 Wealthy, 50 Duchess, and 50 Tetofsky. These were got with the intention of planting them in the spring for top grafting with new varieties as soon as they should become established These trees were obtained from Fonthill where the soil had been more moist, they arrived in good condition, were "healed in" for the winter and in the spring were found in excellent order alive to the tops of the branches.

The trees left in the nursery rows did not suffer to nearly the same extent as those in orchard. Many of the larger trees were injured, but most of the smaller ones, among which were nearly all the Russian sorts, came through the winter in very fair order. These smaller trees, however, had the advantage of being more protected with snow than the larger ones.

The orchard of standard apples was replanted and enlarged, and it now contains 390 trees, most of which have made a fair growth. The trees have been banked up with earth in the same manner as last year to a height of 12 to 15 inches and good results are hoped for. It contains the following varieties:

APPLES.

American Pippin.	Nonpareil.
Baldwin.	Nodhead.
Blenheim Orange.	Orange Winter.
Bombarger.	Peck's Pleasant.
Belle de Boskoop.	Pewaukee.

Brewington.
Beauty of the World.
Bottle Greening.
Chenango Strawberry.
Canada Baldwin.
Cooper's Market.
Cranberry Pippin.
Duchess of Oldenburg.
Duke of Connaught.
Early Strawberry.
Fameuse.
Fall Pippin.
Fallawater.
Fall Jennetting.
Fanny.
Grimes Golden.
Gravenstein.
Hurlbut.
Haas.
King of Tomkins.
Keswick Codlin.
Lady.
Lord Suffield.
Lawyer.
Lady Henniker.
Maiden's Blush.
Mann.
McMahon's White.
McIntosh Red.
Magog Red Streak.
Northern Spy.
Pomme Grise.
Peach of Montreal.
Plums Cider.
Primate.
Richard's Graft.
Red Astrachan.
Roxbury Russet.
Ribston Pippin.
R. I. Greening.
Red Beitigheimer.
Red Utters.
Shannon.
Sweet Bough.
Sutton Beauty.
Salome.
St. Lawrence.
Snyder.
Saxton.
Stump.
Scott's Winter.
Swayzie Pomme Grise.
Spitzenburg.
Tetofsky.
Talman Sweet.
Wagener.
Walbridge.
Warner's King.
Wealthy.
Winesap.
Winter St. Lawrence.
Yellow Bellefleur.

The following collection of Russian Apples was procured from various sources, most of them in the spring of 1887; they were grown one year in nursery row, and then planted out in orchard twenty feet apart each way.

RUSSIAN APPLES.

No.	Adopted American Name.	Russian Name.
15	Avenarius.	Suesapfel von Avenarius.
60	Red Pine.	Ananasapfel rother.
122	Revel Borsdorf.	Borsdorfer Revaler.
153	Transparent Naliv.	Skvosnoi naliv.
157	White Naliv.	Bielui naliv.
161	Longfield.	Langerfeldskoe.
169	Green Sweet.	Zelenka sladkaya.
170	Revel.	Revelskoe.
181	Champagne Pipka.	Pipka champanskaya.
183	Burlovka.	Burlovka.
184	Arabka.	Arabkoe.
185	Anisovka.	Anisovka.
187	Green Glass.	Steklianka zelenka.
188	Yellow Arcad.	Arkad jeltui.
190	Tiesenhausen.	Tiesenhausenskoe.
200	Rosy Repka.	Riepka vosavaya.
202	Hare Pipka.	Saitchia pipka.
230	Titovka.	Titovka.

No.	Adopted American Name.	Russian Name.
236	Antonovka.	Antonovka.
240	Lejanka.	Lejanka.
242	Broadcheek.	Schirokolitchiko.
245	Borovinka.	Borovinka.
252	Aport.	Aport.
261	Repka Aport.	Rieptchatui aport.
262	Charlamoff.	Charlamovskoe.
264	Scented.	Duchovoe.
265	Gorke Pipka.	Pipka Gorkaya.
267	Pear.	Gruschevka.
268	Zakoritnoe.	Zakoritnoe.
274	Rosy.	Rosovoe.
277	Vargul.	Vargul.
282	Voronesh Reinette.	Renet Voroneshskui.
284	Kremer's Glass.	Steklianka Kremera.
290	Ukraine.	Ukrainskoe.
304	Switzer.	Suislepper.
313	Muscatel.	Muscatapfel (Livlander Rgl.)
315	Herren.	Herrenapfel.
316	Red Reinette.	Reinette rothe.
317	White Pigeon.	Golubinoe (bieloe not Rgl.)
322	Cinnamon.	Koritchnevoe.
324	German Calville.	Niemetskui kalvil.
(327)	Yellow Arcad (188)	Joltui arkad.
332	Early Prolific.	Plodovitka rannaya.
334	Yellow Transparent.	Skvosnoe jeltui.
337	Serinkia.	Sierianka.
338	Revel Pear.	Gruschevka Revelskaya.
342	Thaler.	Charlottenthaler gelber.
344	Sultan.	Sultanapfel.
352	Resonant.	Svonkoe.
361	Pointed Pipka.	Pipka ostrokonetchnaya.
362	Lead.	Svintsovka.
367	Red Streak.	Polosatoe.
368	Sugar Miron.	Miron sacharnui.
371	German Skrute.	Skrute Niemetskui.
375	Cinnamon Pine.	Koritchnevoe ananasnoe.
378	Hibernal.	Osimui.
382	Green Butskaya.	Butskaya zelenka.
387	Good Peasant.	Dobrui krestianin.
393	Imperial Citron.	Tsitronnoe Tsarskoe.
398	Enormous.	Krupneena.
406	Sweet Pipka.	Pipka sacharnaya.
407	Blackwood.	Tchernoe derevo.
413	Cross.	Skrijapel.
428	Fonaric.	Fonarik Nalivnui.
441	Rattle.	Gremuschka.
442	Yellow Calville.	Kalvil jeltui.
447	Keiv Reinette.	Renet Kievskui.
453	Beautiful Arcad.	Arkad krasivui.
469	Grandmother.	Babuschkino.
470	Lapouchoe.	Lapouchoe.
471	Prolific Anis.	Anisovaya plodovitka.
472	Ostrokoff.	Ostrokosvkays steklianka.
477	Christmas.	Roshdestvenskoe.

No.	Adopted American Name.	Russian Name.
478	Thin Twig.	Tonkovietka polosataya.
502	Rambour Reinette.	Russkui ramburovui renet.
580	Winter Livland.	Livlandischer winter.
597	Sandy Glass.	Pesotchnoe steklianovoe.
599	Romenskoe.	Romenskoe, also Romnenskoe.
600	Long.	Dlinnoe.
874	Sweet Borovinka.	Borovinka sladkaya
978	Golden White.	Biel zolotovskaya.
984	Kursk Anis.	Anis Kurskui.
985	Red Anis.	Anis krasnui.
987	Yellow Anis.	Anis jeltui.
988	Pine Apple.	Ananasnoe.
	Imported by Iowa Agricultural College from Moscow.	
7 M.	Osimoe.	Osimoe.
12 M.	Vargulek.	Vargulek.
14 M.	Anisim.	Anisimovka.
17 M.	Kruder.	Kruder oder blauer.
29 M.	Melonen.	Melonen oder nonnen.
30 M.	Ledenets.	Ledenets.
32 M.	Anis.	Anis.
37 M.	White Borodovka.	Biel borodovskoe.
51 M.	Avenarius.	Pipka sladkaya.
53 M.	Blackwood.	Tchernoe derevo.
54 M.	Great Mogul.	Vilikui Mogul.
68 M.	Broad Green.	Nalivnoe zelenui schirokui.
84 M.	Bergadorf.	Bergadorvskoe.
97 M.	Marble.	Mramornoe.
107 M.	Serinkia.	Lehmapfel (Sieriauka).
112 M.	Champagne.	Champanskoe.
122 M.	Beresina.	Berezinskoe.
144 M.	Marmalade.	Marmeladnoe.
	Bogdanoff's Glass.	Steklianka Bogdanoff.
	Alfriston.	Alfriston.
	Red Jungfern.	Rother jungfern.
		Langer gruner gulderling.
	Nitchner's Strawberry.	Nitchner's erdbeerapfel.
	Stettiner's Kantapfel.	
	Cinnamon Streaked.	Koitchnevoe polosatoe.
	Jeltin biel.	
	Riga Naliv.	
	Nonnen.	
	Schwarze Gans.	
	Himlian.	
	Melana.	
	Malus Toringo.	
	Zaffed Prookan.	
	Red Serinkia.	Rother Serinkia.
	Danziger Kantapfel.	
	Russian Transparent.	
	Romenskoe.	
	Possart.	Possart's Nalivia.
	Strawberry Streaked.	Erdbeer Streifling.
	Simbirsk.	
	Rotta.	
	Rheinischer Bohnapfel.	
	Stettin.	

Citronat.
Foundling, of U. S.
Red Aport.
Red Sweedish.
Crimea.
Winter Citronen Apfel.

This orchard contains in addition to the 184 sorts of Russian apples given above, 16 varieties of crab apples, while adjoining orchards contain 68 sorts of pears, 67 of plums, 70 of cherries, 5 of apricots and two of peaches. Many of these are from Russia and other parts of northern Europe and are believed to be among the hardiest varieties obtainable.

These combined form a total of 362 named varieties to which must be added a number of seedlings, making 1,020 trees in all.

They have been planted 20 feet apart each way, well cultivated during the summer and earth drawn up around the base of them for protection through the winter. They consist of the following varieties:—

CRAB APPLES.

Bowman.
Dartmouth.
General Grant.
Hyslop.
Hesper Rose.
Lady Elgin.
Marengo.
Martha.
Orion.
Oblong.
Orange.
Quaker Beauty.
Red Siberian.
Transcendant.
Van Wyck.
Whitney.

PEARS.

Angouleme.
Beurre Hardy.
Beurre de Anjou.
Beurre Clairgeat
Beurre Easter.
Bartlett.
Clapps Favourite.
Countess Clara.
Cure Carnoy.
Coeman's Butter.
Doyenne d'Eté.
Doyenne Boussock.
Duchesse de Bordeaux.
Easter Belle.
Flemish Beauty.
Frederick Clapp.
Goodale.
Howell.
Indian Queen.
Josephine de Malines.
Napoleon's Butter.
Kieffer.
Lawrence.
Louise Bonne de Jersey.
Lucy Greive.
Margaret.
Mt. Vernon.
Mille Blanche Saunter.
Osband's Summer.
Peffer No. 2.
Peffer No. 3.
President.
President Drouard.
Ritson.
Sheldon.
Seckel.
Summer Belle.
Tyson.
Theresa.
Vicar of Winkfield
Zoe.

	Adopted American name.	Russian or foreign name
122	Autumn Bergamot.	Bergamot osennui.
345	Long-stem.	Dolgokvostka morosovskaya.
358	Juicy Gliva.	Gliva otschen sotchnaya.
361	Victorina.	Victorina mnogoplodnaya.
392	Kurskaya.	Gliva Kurskaya.
395	Red Bergamot.	Bergamot krasnui.

	Adopted American name.	Russian or foreign name.
396	Flat Bergamot.	Bergamot ploskui.
418	Early Bergamot.	Bergamot, rannaya.
439	Double Beurre.	Maslitchnaya dvoinaya.
508	Seedless.	Bessemianka.
513	Thin Twig.	Tonkovietka.
516	Lemon.	Limonnaya.
520	Sapieganka.	Bergamot Sapieganka.
4 M.	Dula.	Dula.
9 M.	Winter.	Osimaya.
12 M.	Saccharine.	Sacharnaya.
13 M.	Strawberry.	Semlianitchnaya.
15 M.	Czar.	Tsarskaya.
107 Vor.	Bear.	Medviedevka.
109 Vor.	Scented.	Duchovaya.
Orel, No. 16	Waxen.	Voskovaya.
	Large Sugar.	Zucherbirne grosse.
	Green Wine.	Weinbirne, grune.
	Junfer.	Junferbirne.
	Pound.	Pfundbirne.
	White Livland.	Butterbine weisse Livlandesche.
	Vinograd.	Vinogradnui.

AMERICAN AND FOREIGN PLUMS.

Admiral.	Newman.
Adirondack.	Orel, No. 21.
Beauty of Naples	Ogden.
Botan.	Orange.
Briton.	Prince Englebert.
Belmore.	Prune of Agen.
Bradshaw.	Pond's Seedling.
Bryanston's Gage.	Quackenboss.
Communa.	Reine Claude.
Coe's Golden Drop.	Rollingston.
De Soto.	Red Egg.
Early Red.	Red Winter.
Forest Rose.	Robinson.
Gueii.	Richland.
Golden Cluster.	Shropshire Damson.
General Hand.	Speer.
German Prune.	Sweet Water.
Grand Duke.	Smith's Orleans.
Glass Seedling.	St. Lawrence.
Hungary.	Wolf.
Imperial Gage.	White Winter.
Kenyon (No. 1).	White Otschakoff.
Kansas Dwarf.	White Nicolas.
Luscomb's Nonsuch.	Washington.
Lombard.	Weaver.
Langford.	Wangenheim.
Masters.	Yellow Egg.
Moreman.	Yellow Aubert, No. 115 Vor.
Maquoketa.	Yellow Gage.
Mariana.	5. Russian.
Moldavka, No. 44 Vor.	13. do
Niagara.	85. do
Nota Bene.	102. Voronesh.

CHERRIES.

Amarelle Hative.
do Aboyet.
Abreende Bergaura.
Abbesse d'Oignies.
Amarelle à Bouquet
Belle Magnifique.
Brown's Best.
Bender, Mo.
Brussels.
Carnation.
Cerise d'Ostheim
Common red.
Dyehouse.
Double Natte.
Doppelte glaskirsche.
Early Richmond.
Empress Eugenie.
French.
Frühes Amarelle.
Formige Hess Weichel.
Frauendorf.
Gros Gobet.
Grotto de Nova.
Grotto Moul.
Griotte de Buttner.
Groner South Kirk.
Glaskuk Kinorm.
Githam (Ostheim).
Griotte Precose.
Griotte du Nord.
Kirschen Amarelle.
Louise.
Lutovka.
Leib.
Montmorency Large.
Montmorency.
do Agne.
do Ordinaire.
do Longue queue.
Minn. Ostheim.
Ostheim.
Olivet.
Royal Duke.
Reine Hortense.
Red Morello.
Schatten Amarelle.
Spate Amarelle
Steklianka (Glaskirsche).
Susse Fruhe Weichsel.
Sithanri Weichel.
Vistula.
Voronesh, 27.
Vladimir.
Windsor.
Wragg.
Wiers, No. 2.
do 12.
do 13.
do 18.
23 Orel.
24 do
25 do
26 do
27 do
207 Russian.
18 Riga.
62 M.
62 Russian.
206 Russian.

SMALL FRUITS.

The plantations of small fruits contain all of the leading varieties in general cultivation and most of the new sorts catalogued in America. No pains will be spared in testing all new kinds worthy of trial as early as they can be obtained. This portion of the experimental work has already become of great interest and will be of much value to all who grow these fruits either for home use or market. It is impracticable for a private individual to test all varieties as they are introduced, but such work can be successfully done at a public institution such as this, where careful records are kept of the relative merits of the different sorts and reliable information given to those interested.

SEEDLINGS.

Many new seedling small fruits have been brought together from various localities throughout Canada and the United States. Among the former may be mentioned a large collection of strawberries, raspberries, currants, gooseberries and grapes originated by Prof. Wm. Saunders at London and brought here for trial, among which are some very promising sorts which will be propagated and sent to the other experimental farms for further testing.

A number of the strawberries are very productive, of fine quality and size, with strong healthy foliage. A new plantation has been made from these, which will give a better opportunity to study their characteristics both with one and two year old plants. The raspberry seedlings number about 380, most of these have fruited, some being remarkably productive and of good quality.

Some seedlings of Davison's Thornless appear to be quite an improvement on their parent, particularly so in vigour and productiveness. A number of seedlings from other varieties have many valuable points.

Some hybrids between Gregg and Cuthbert were especially promising, they were of the Shaffer type; some were thought to be of better quality and equal to that valuable variety in every other respect. The weather being unusually dry at the time of ripening, all the raspberries were injured to such an extent that it was difficult to make comparisons of these new seedlings with named varieties which would be accurate and just, hence the experience of another season will be required to fully determine their respective merits.

Among the 140 black currant seedlings are several well worthy of an extended trial. One with very long racemes was shown at a meeting of the Ontario Fruit Growers Association, held at Picton, Ont., in July and was thought well of by those best qualified to judge. These currants were also affected by the drought to such an extent as to render comparisons difficult until more experience is obtained.

GRAPES.

In the spring of 1887 a vineyard was planted, containing 127 varieties of grapes. last spring 31 more were added, making a total of 158 sorts. The greater portion of these have made satisfactory progress. A large number of new and rare varieties are contained in this collection which will make it of great interest and very instructive to grape-growers generally. This locality is noted for the fine quality of grapes grown. During favourable seasons the crop is large and ripens well.

CURRANTS.

It was found necessary to remove the currant plantation last spring to another part of the farm, hence, no fruit of any consequence was produced during the past summer. There are in this collection 20 varieties, planted in rows six feet apart, and four feet apart in the rows.

They made a good growth during the summer and will be in condition to give a partial crop next season.

GOOSEBERRIES.

The plantations of this fruit contain 36 named varieties, and about 50 unnamed seedlings. These have been planted the same distance apart as the currants, and most of them have made fair growth.

RASPBERRIES.

The raspberry plants came through the winter in good condition and promised an abundant yield early in the season, but just before they began to ripen the weather turned hot and a dry scorching wind which prevailed for some time had the effect of drying up the fruit to such an extent that the crop was a partial failure.

A new plantation was put out in June, by transplanting from the older plants young shoots as soon as they had reached a height of twelve to fifteen inches, these subsequently made a good stocky growth.

Where such plants are near at hand this method will be found advantageous and if carefully done the plants will make a stronger growth by autumn than shoots of the previous year's growth put out in early spring.

This collection is made up of 43 named varieties and a large number of unnamed seedlings.

BLACKBERRIES.

Of the 26 varieties planted, Snyder appears to stand best, with Stones hardy next. Agawam and Taylor's Prolific not far in the rear; more time will be required, however, before any definite information can be given regarding the hardiness of these fruits for this locality.

STRAWBERRIES.

The plantation of 90 varieties referred to in my last report contained most of the standard and many new sorts. They came through the winter in good shape, blossomed freely and set a large quantity of fruit. The fruit began to ripen the latter part of June, the first being gathered on the 25th. The weather turned very hot and dry before the crop was half matured, not only was the fruit injured but in many places the plants were injured by the scorching winds that prevailed for some time; on this account the crop was materially lessened. There were 2,049 quart boxes of fruit gathered which were sold at good prices.

A new plantation has been made in which are planted 115 named varieties and many seedlings. These have been put in rows three and a-half feet apart and about one foot apart in the rows in the same manner as the old plantation. The land for this plot had been well manured. They were carefully cultivated during the summer and made a strong healthy growth. When cold weather set in a light covering of straw was given to protect them through the winter.

SEEDS.

The seeds of many varieties of fruits were gathered during the season of 1887 from choice specimens, and from these a large number of seedlings have been grown. A similar course has been pursued during the past year and it is hoped that some valuable new varieties may be thus produced.

Some attention was given to artificially crossing and hybridizing small fruits with partial success. The dry weather affected this work considerably, still a number of crosses were obtained. The seeds will be sown in season and the results reported on hereafter.

Respectfully submitted,

W. W. HILBORN,

Horticulturist, Central Experimental Farm.

REPORT OF THE POULTRY MANAGER.

(A. G. GILBERT.)

To Professor WILLIAM SAUNDERS,
Director Experimental Farms.

SIR,—I have great pleasure in submitting the first report of the Poultry Department of the Central Experimental Farm. Although the operations thus far have been on a comparatively limited scale yet some results have been ascertained which, it is hoped, will be of interest and benefit to the farming community and especially to those desirous of obtaining eggs and poultry for market or home use.

In the early part of the month of May last it was deemed advisable, in order to have a number of fowls ready for the occupation of the poultry building about to be erected on the Farm, to procure eggs of the most useful varieties and hatch them by means of sitting hens, a number of which had been secured. Accordingly 30 sittings representing 388 eggs, were purchased from the leading breeders of Canada, Great Britain and the United States. Eggs from the latter country were obtained for the purpose of securing different strains for breeding purposes in the forthcoming spring. The following table will show the number of eggs purchased and the results therefrom :—

Eggs Purchased and Chickens Hatched.

No of Sittings.	No. of Eggs Set.	Description of Eggs.	No. of Chickens Hatched.	Date when Chickens were Hatched.
				1888.
1	13	Buff Cochins	9	May 18
2	26	Andalusians	18	do 18
1	13	Black Breasted Red Game	8	do 30
2	26	Plymouth Rocks	15	do 9
2	26	Wyandottes	8	do 29
2	26	White Leghorns	19	June 7
1	13	Silver Pencilled Hamburghs	5	May 25
2	26	Bearded Golden Polands	8	do 25
2	26	Houdans	15	do 25
1	13	Black Hamburghs	7	do 25
1	13	Langshams	1	do 28
1	13	Black Minorcas	9	June 5
		From England.		
1	12	Indian Games	7	July 4
1	12	Red Caps	5	do 4
		From United States.		
1	13	Dirigos	5	June 2
2	26	Black Minorcas	12	do 27
1	13	White Leghorns	6	do 16
1	13	Houdans	3	do 16
2	26	Colored Dorkings	8	do 16
1	13	Buff Cochins	4	do 16
1	13	Black Java	8	do 16
1	13	Langshams	4	do 27
		Hatched in incubator	25	May 31
30	388		209	
		DUCKS.		
1	12	Pekin	4	June 13
1	11	do	3	do 20
2	33		7	

It will be seen from the above that 209 chickens were hatched, which was satisfactory, when the very unfavourable season and the long distance the greater number of the eggs travelled, are taken into consideration. It is worthy of notice that from twelve Indian game eggs, shipped by Messrs. Abbott Bros., of Norwich, England, seven chickens were hatched, and from twelve Red Cap eggs, shipped by the same firm, five chickens were the result. The eggs were sent from Norwich, England, to the agent of the firm in Toronto, and were by him re-shipped to Ottawa, so making a long journey by ocean steamer and railway, yet yielding a return of 50 per cent. thus proving that fertile eggs, properly packed, can be shipped a long distance and hatch well. In this case the eggs were packed in cut straw.

EGGS FROM CANADIAN BREEDERS HATCH BEST.

It will also be seen that the eggs supplied by Canadian breeders hatched better than those from the United States. The eggs furnished by our home breeders were wrapped in paper and packed in bran, while the eggs from the United States breeders were tightly packed in sawdust, a method strongly condemned by Canadian poultrymen, who assert that the turpentine contained in pine sawdust lessens the fertility of the eggs. There is room for interesting experiment here.

NEW BREEDS IMPORTED—INDIAN GAMES.

The Indian Game eggs were the first of the kind imported into Canada. It was thought best to give them a trial, as the Indian Game had earned a great reputation in Cornwall and Devonshire, England, as a market fowl, the male birds attaining to a weight of 9, 10, and 11 pounds. The cockerels are also highly spoken of for crossing purposes with the Plymouth Rock and Dorking. It was the 4th of July before the eggs were hatched, and that month being unusually chilly and raw, four of the chickens succumbed, notwithstanding the greatest of care, leaving three which never made much headway and died on the approach of wintry weather. These chickens were slow to feather, displayed no hardiness, and were content to brood when four months old. I would suggest another trial of this breed, the chickens to be hatched at an early period, so as to have ample opportunity to mature before the fall months.

RED CAPS.

The Red Caps, another late arrival from England, were also tried but with unsatisfactory results. Up to the age of two months the chickens grew rapidly and appeared hardy, but did not stand the cold and extremely wet weather of October, although well housed. As with the Indian Games, I would recommend another trial of early hatched chickens. A Black Spanish and Red Cap cross is recommended as producing a hardy fowl and great layer.

THE STANDARD VARIETIES.

The chickens of the other breeds made rapid progress, the Plymouth Rocks showing the earliest and greatest development, followed by the Wyandottes, Buff Cochins and Houdans in the order named. Two methods of feeding the chickens were adopted. Part were fed with bread and milk from time of leaving nest up to ten days, and after that with crushed corn, wheat and other grain. Another part were fed with hard boiled eggs and bread crumbs in the early stages and soft feed afterwards, with a liberal supply of grain to all in the evening. The two methods seemed to have equally good results. All the chickens were frequently and liberally fed and had one of the best grass runs it was possible for them to get access to anywhere. Shade and insects were abundant.

THE FOLLOWING RECORD

of the weights of four of the leading varieties will instance the progress made.

On the 5th of July a Plymouth Rock cockerel, hatched on the 9th of the preceding month of May, weighed 1 lb. 15 ozs.; a Wyandotte cockerel hatched on the

8th of the same month (May) weighed 1 lb. 5 ozs.; a Buff Cochin hatched on the 18th of same month (May), 1 lb. 1 oz.

On the 30th of July, twenty-five days later, the same chickens weighed as follows:—

	Lbs.	Oz.
Plymouth Rock	3	08½
Wyandotte	2	04½
Buff Cochin	2	00
Houdan (hatched 25th May)	1	14½

On September 4th the Plymouth Rock weighed 5 lbs. 13 ozs., and the Wyandotte 3 lbs. 13 ozs.

On the 12th of November the weights of the same chickens were as follows:—

	Lbs.	Oz.
Plymouth Rock	7	05
Wyandotte	5	12
Buff Cochin	5	02
Houdan (hatched 25th May)	5	00

At date of writing (January 20th, 1889) the same chickens weighed in breeding condition:—

	Lbs.	Oz.
Plymouth Rock	9	05
Wyandotte	7	00
Buff Cochin	7	12
Houdan	6	02

INCUBATOR TRIAL.

On the 10th of May last a Bessey Incubator of 100 egg capacity was put into operation with a small number of eggs for a first attempt. Twenty-eight chickens were the result. Three died soon after being hatched. The remaining twenty-five were transferred at the proper time to the brooder and made rapid headway.

CROSSES.

Among the chicken so hatched were five male birds of a cross between a Brahma cockerel and Plymouth Rock hens. This cross was made with the view of ascertaining what sort of market fowl it would produce, and was successful. A cockerel of this cross (hatched on the 31st of May) weighed 6 lbs. 2 oz. on the 17th of October following, showing a gain of nearly 1½ lbs. per month.

Another trial was made of a cross between a Brahma cockerel and Black Minorca hens and resulted in the production of several very fine, large, dark pullets, which ought to make an excellent fowl for the farmer, embracing as they should the egg laying properties of the Minorca with the hardiness and size of the Brahma. The pullets will lay in a few days.

NEW POULTRY HOUSE COMPLETED.

By the middle of November the new poultry house was completed and the chickens were removed into it. Briefly sketched the building is 100 feet long, running north and south, with a middle compartment 20x20 feet, from which extend on either side two wings 40 feet each in length, each wing containing five pens 8x14 feet and capable of accommodating 20 or 25 fowls if required. There are four windows on the east (coldest) side of each wing and one window in each of the 10 pens to the west. The pens are separated by wooden partitions 2½ feet in height, and wire netting of 2½ inch mesh from this to the ceiling, giving the interior a light and cheerful appearance. Entrance to the pens is had from a roomy passage way four feet in width and through neat wire doors which swing inwards or outwards. The pens are furnished with platforms and roosts (which fold away in day time and are let into place again at dusk), nests of neat design, dust bath, box for oyster shells, gravel

&c. A slide operated from the passage way opens the way to the runs in the rear of the building. Two large ventilators in each wing are also controlled from the passage way. Above the wings are roomy lofts containing straw and chaff, which are let down to the pens beneath for the poultry to scratch in. A medium size base burner coal stove placed in the centre compartment heats the building as well as the water for soft feed, &c. The central room is also used as an office and for keeping feed. The upper room of the compartment is utilized for storage purposes and a portion is set apart for an hospital for sick fowls. A good dry cellar contains vegetables, gravel and other necessaries for the chickens, as well as coal for the stove. The building is substantially constructed, is fitted with double windows and storm doors, and answers the purpose admirably.

POULTRY LIST.

There are at present in the building birds of the different sorts as per following list:—

Left Wing.

Pen 1.—Black Minorca pullets, 10; White Leghorn do, 9	19
2.—Houdan pullets	11
3.—Black Hamburgh pullets, 6; Black-breasted Red Game do, 3; Silver Pencilled Hamburgh do, 2; Wyandotte do, 2: Golden B. Polands do, 3; Dorking do, 3; Andalusian do, 2	21
4—White Leghorn hens, 10; Plymouth Rock pullets, 6; Dirigo do, 1; Black Java do, 2; 1 mixed hen	20
5.—Buff Cochin pullets, 6; Brahma do, 2; Langsham do, 2; Brahma-Minorca pullets, 5	15

Right Wing.

Pen 1.—White Leghorn cockerels, 8; Andalusian do, 8; Black Minorca do, 7; Brown Leghorn do, 2; B. B. R. Game, 1	26
2.—Wyandotte cockerels, 4; Buff Cochin do, 5; Houdan do, 5; Silver P. Hamburgh do, 3; Black Java do, 2; Black Hamburgh do, 1; Dorking do 1; Dirigo do, 2	23
3.—Brahma hens, 7; Dirigo do, 6; Black Minorca do, 1; Black Russian do, 3; Plymouth Rock do, 6	23
4.—Plymouth Rock cockerels, 5; Brahma-Plymouth Rock cross, 4; 1 Single Comb Wyandotte	10
	168
1 Dirigo cock; 1 Black Minorca do	2
Pen 5.—Wild Geese	5
	175
In hospital	5
	180

WET AND COLD WEATHER.

The fall was marked by continuous rain, the month of October was unusually cold and both combined proved fatal to many of the tender varieties, which pending the completion of the new house, were rather crowded in limited house room. Next to the Indian Games and Red Caps, the Black-breasted Red Game, Bearded Golden Poland, and Dorking cockerels proved the most susceptible to the fall weather.

DIRIGOS.

Among the varieties enumerated the Dirigos are yet new to Canada breeders. This comparative stranger, which owes its origin to the enterprise of Mr. Sumner Beale, New Hampshire, U. S., is the result of crossing a Canada Game Cock and White Plymouth Rock pullet (a sport) the progeny again crossed with a Light Brahma cock. The Dirigos make a large fowl, are hardy and excellent layers. In the new American Standard of Excellence they are classed as the Dirigo Strain of White Plymouth Rocks.

WILD GEESE.

The Wild Geese which occupy No. 5 pen have exhibited their characteristic hardiness in all seasons. They have been lively and have grown well in confinement. It remains to be seen whether they will breed in captivity mated to one of their own species, and with common geese, or others.

THE BEGINNING OF WINTER LAYING.

On the 12th of December the first egg in the new building was layed by a Wyandotte pullet hatched on the 29th May. The first hen to lay was a Dirigo on the 17th of December. The Wyandotte pullet, which first layed on the 12th December, layed again on the 15th and was followed on the 16th by the first egg from the second Wyandotte pullet hatched on the same date as the first layer. Other pullets layed first eggs in the following order:—

Houdan, hatched 25th May, first egg 23rd December, 1888.
Silver P. Hamburgh, hatched 25th May, first egg 24th December.

Black Minorca	do	5th June	do	26th	do
White Leghorn	do	7th do	do	30th	do
Black Hamburg	do	25th May	do	2nd January.	
Andalusian	do	18th do	do	4th	do
Plymouth Rock	do	9th June	do	6th	do
Buff Cochin	do	18th May	do	16th	do

NUMBER OF EGGS LAYED FROM 12TH DECEMBER TO 20TH JANUARY.

The following table will show the number of eggs layed by the different breeds from the time of laying first egg in December, 1888, to 20th January, 1889:—

Date.	Pullets.									Date.	Hens.				
	2 Wyandottes.	11 Houdans.	2 Silver Pen. Hamburghs.	10 Black Minorcas.	9 White Leghorns.	6 Black Hamburghs.	2 Andalusians.	6 Plymouth Rocks.	6 Buff Cochins.		6 Dirigos.	5 Brahmas.	3 Black Russians.	1 Black Minorca.	7 White Leghorns.
1888.										1888.					
Dec. 12	1	.....	.....	.....	.....	.....	.....	.....	.....	Dec. 17	1	.....	.....	.....	.....
do 15	1	.....	.....	.....	.....	.....	.....	.....	.....	do 19	1	.....	.....	.....	.....
do 16	2	.....	.....	.....	.....	.....	.....	.....	.....	do 20	1	.....	.....	.....	.....
do 18	2	.....	.....	.....	.....	.....	.....	.....	.....	do 22	1	.....	.....	.....	.....
do 19	2	.....	.....	.....	.....	.....	.....	.....	.....	do 23	3	.....	.....	.....	.....
do 20	2	.....	.....	.....	.....	.....	.....	.....	.....	do 24	1	.....	.....	.....	.....
do 22	2	.....	.....	.....	.....	.....	.....	.....	.....	do 25	2	.....	1	.....	.....
do 23	2	.....	.....	.....	.....	.....	.....	.....	.....	do 26	2	.....	.....	.....	.....
do 24	2	.....	1	.....	.....	.....	.....	.....	.....	do 27	1	.....	1	.....	.....
do 25	2	1	.....	.....	.....	.....	.....	.....	.....	do 28	2	.....	.....	.....	.....
do 26	1	3	1	1	.....	.....	.....	.....	.....	do 29	2	1	1	1	.....
do 27	1	.....	.....	1	.....	.....	.....	.....	.....	do 30	1	.....	.....	.....	1
do 28	2	4	1	.....	.....	.....	.....	.....	.....	do 31	2	1	1	.....	.....
do 29	2	3	1	.....	1	.....	.....	.....	.....						
do 30	2	1	.....	.....	.....	1	.....	.....	.....						
do 31	2	4	1	1	2	1	.....	.....	.....						
1889.										1889.					
Jan. 1	2	3	1	.....	2	.....	.....	.....	.....	Jan. 1	3	2	1	.....	2
do 2	1	3	1	1	2	1	.....	.....	.....	do 2	1	1	1	1	.....
do 3	2	2	1	1	1	1	.....	.....	.....	do 3	.....	.....	.....	.....	3
do 4	1	2	....	1	4	2	1	.....	.....	do 4	2	2	2	.....	.....
do 5	1	4	.....	1	6	2	.....	.....	.....	do 5	3	1	.....	.....	.....
do 6		2	.....	1	1	1	.....	1	.....	do 6	2	1	2	1	.....
do 7		3	.....	4	5	3	.....	.....	.....	do 7	2	.....	1	.....	2
do 8		2	1	2	4	.....	.....	1	.....	do 8	3	1	.....	1	1
do 9		2	1	2	4	2	.....	1	.....	do 9	4	1	1	.....	2
do 10		.....	.....	1	3	1	.....	2	.....	do 10	.....	2	.....	.....	.....
do 11		2	1	2	5	2	.....	.....	.....	do 11	2	.....	.....	.....	.....
do 12		2	.....	.....	2	2	1	.....	.....	do 12	3	2	.....	.....	.....
do 13	1	2	.....	1	4	3	1	1	.....	do 13	.....	.....	2	.....	.....
do 14	1	1	.....	1	2	2	1	1	.....	do 14	1	2	.....	.....	.....
do 15	.....	.....	.....	2	3	3	1	.....	.....	do 15	3	2	.....	.....	.....
do 16	2	3	.....	1	1	2	1	1	1	do 16	.....	1	.....	3	.....
do 17	1	.....	.....	3	3	1	.....	2	1	do 17	4	1	1	.....	.....
do 18	2	1	1	2	2	3	.....	1	.....	do 18	2	.....	.....	.....	.....
do 19	1	1	.....	.....	6	.....	.....	1	1	do 19	2	1	2	.....	.....
do 20	1	1	1	1	3	2	1	2	.....	do 20	.....	.....	.....	.....	2
Totals	44	53	13	30	66	35	7	14	3	Totals	57	22	17	7	13

Broody for 7 days.

METHOD OF FEEDING.

The conditions as to temperature, feed, &c., were the same with the exception of the Brahma hens, which were given more oats than the others. The morning feed was varied, but always warm and known as "soft." It was composed of two parts shorts, one part cornmeal, and one part boiled wheat. The hot water the wheat was boiled in was used for mixing the feed. To the mixture was added, almost every morning, a small quantity of Cayenne pepper and bonemeal. Twice or three times a week meat scraps were substituted for the bonemeal and boiled wheat. At other times small potatoes and scraps of cabbage formed the greater part of the morning meal. On this variety the layers were fed barely enough to satisfy and never enough to gorge. Soon after, when the water was given for drink, a few handsful of small wheat or ground meat were thrown into the chaff, always on the floor for the fowls to scratch in, every effort to keep them in activity being of paramount importance. The noon meal was light and scattered in the chaff. The last feed of grain, also thrown on the floor, was liberally given, and the layers sent to roost with a full crop to carry them over the long night fast. A cabbage suspended from the centre of the pen was also used as an incentive to exercise. Oyster shells (ground) and gravel were also supplied.

The temperature varied from 30 to 45 and 50. On reaching the two latter figures the morning feed was greatly reduced and more dry grain given. At the lower figure the chill was taken off the water given to the layers.

MALE BIRDS SEPARATE.

The male birds, in all cases, have been, and are kept from the laying stock, for the reason that an impregnated egg is not so good in flavour, nor will it keep as well, as one from hens with which no male bird has been allowed to associate. The cocks and cockerels are also kept away from the breeding stock, and will be so kept until the breeding pens are made up. Their feed is oats and wheat with green food, gravel, &c., &c.

SICKNESS.

Several cases of sickness have occurred, among them five or six cases of virulent roup. The birds were most likely affected before coming into the new building. The sick were at once separated from the others, and the roup cases with the exception of two, were quickly cured. The exceptions, two cockerels, were so bad that had a cure been possible, they would have been useless for breeding purposes. Under the circumstances the birds were killed and the remains burned. Experiments as to the best remedies for the diseases of poultry are being made, as opportunity permits. I will be most happy, on enquiry, to give those desirous of knowing what has been found the most effective treatment in the different cases met with so far.

IN HOSPITAL.

There are at present in hospital one Black Breasted Red Game pullet; one Bearded Golden Poland pullet; one Black Russian hen, and two Black Minorca cockerels. Their ailment is cold, sometimes called catarrh.

FALL EXHIBITION.

According to your instructions 125 chickens of the different varieties were placed on exhibition at the Canada Central Fall Show in the month of September last, a space for the purpose having been allotted in the poultry shed.

PRACTICAL VISITORS.

Since the occupation of the poultry house there have been numerous visitors, among them several farmers who expressed their intention of establishing poultry departments in connection with their farms. Two of their number had already 75

to 85 hens, and one is making preparation for the housing of 500 winter layers. All the information desired as to the best methods of care, feeding, &c., was given.

PROPOSED CROSSES.

Among the crosses proposed for experiment, some of which it is intended to undertake in the spring, are the following:—

Dirigo—White Leghorn.
Brahma—Black Russian.
Plymouth Rock—White Leghorn.
White Leghorn—Brahma.
Plymouth Rock—Dorking.
do Wyandotte,
Brahma—Black Minorca.
Black Minorco—Black Leghorn.
Brown Leghorn—Buff Cochin.
Wild Goose—Common Goose.

The results from some of these crosses will no doubt prove of value and interest to all those concerned.

I have the honour to be, Sir,

Your obedient servant,

A. G. GILBERT,

Manager Poultry Department.

CENTRAL EXPERIMENTAL FARM,
20th January, 1889.

EXPERIMENTAL FARM FOR THE MARITIME PROVINCES.

REPORT OF W. M. BLAIR, SUPERINTENDENT.

To Prof. WILLIAM SAUNDERS,
Director Experimental Farms,
Ottawa.

SIR,—I have the honour to submit herewith the following report of the operations on the Experimental Farm for the Maritime Provinces at Nappan, N.S., during the year 1888.

Acting under your direction I took possession of the Farm on 12th May, having previously purchased such horses, harness, waggons, carts, implements, &c., as were immediately necessary to carry on the work successfully.

The farm consisting in all of about 300 acres, is made up of the following lots of land, viz.:—

32	acres of	English marsh.
18	do	broadleaf.
6	do	upland, under cultivation.
10	do	do in hay.
104	do	do in pasture.
20	do	unbroken, in stumps and small second growth.
110	do	woodland.

On this land is found a great variety of soil, including stiff and lighter clay, clay loams mixed with more or less sand and gravel, sandy loam of varying quality associated with gravel, also small patches of black bog mud.

The sub-soil also is variable, a considerable portion of the upland consisting of mixtures of clay, sand and gravel, which hold the surface water, thereby delaying the cultivation of the land until late in the spring and also interfering with farm operations during summer and autumn when heavy rains occur, suggesting very forcibly the necessity of under-draining.

MARSH LANDS.

The marsh lands have been formed by the action of the tide-waters of the Bay of Fundy, which rush up with great force with every tide. These waters are heavily charged with a sticky mud, a portion of which is deposited each time the waters cover the flats. In process of time these flats become so high that only the highest tides—which occur at the change and full of the moon—cover them. They are then considered high enough to be reclaimed, which is done by building a heavy dyke around them on the borders of the rivers and creeks which empty into the ocean. These dykes are of different heights and formed by throwing the mud up on each side. The dykes on this farm have been built about five feet high and nine feet wide at the base, they should average in this case not less than six feet high and ten feet wide at the base.

These lands are very fertile and grow heavy crops, and some of them have been growing hay continuously for over 150 years without any fertilizer and still produce from one and a-half to two tons and a half per acre. In some places on the Experimental Farm the dyke was unsafe, and it was found necessary to rebuild 42 rods and repair some 65 more. It was also found necessary to open over two miles of surface drain and build a new aboideau to carry the water through the dykes.

Notwithstanding these precautions the unusually high tides of 5th December broke through in several places, carrying away in all 15 rods of dyke and flooding the entire marsh. The dykes of the adjoining marshes were also broken and the lands flooded. Fortunately, however, the soil was saturated with water from the recent heavy rains, also slightly frozen, and would not readily absorb the salt water; and the new drains lately opened enabled the water to run off quickly when the tides receded, thereby preventing much damage from the salt water, while the land will receive some benefit from the deposit of mud left on the surface from the always muddy tide waters. These tides overflowed the marsh for three days, and as soon as the water had sufficiently subsided the dykes were repaired in as substantial a manner as the weather would permit, and we trust they will be found sufficient to withstand the spring tides next year. The crop of hay cut during the past season from the marsh land, now being got in order, was from 60 to 70 tons.

UPLANDS.

About six acres of the upland were cultivated and in crop last year and ten acres in hay; 104 acres which had previously been cultivated and cropped have for many years been in pasture. These lands were divided into several fields by fences, which as far as practicable, have been removed and the rubbish from about them, together with some scattered stumps taken out, piled and burned. One or two useless buildings have also been taken down.

PLOUGHING.

Ploughing was begun on the 16th of May and continued as opportunity offered and the land and weather would permit until 16th November; during that time about 100 acres were turned over. Of this 40 acres were ploughed a second time after the crop of the season was removed. Five acres of the unbroken land were cleared by taking out the small second growth and stumps. These were piled and burned and the land ploughed.

MANURE.

Manure being greatly needed on this land 30 cords were purchased at Amherst and drawn up, a distance of seven miles. Besides this 700 loads of marsh mud, which is found to be an excellent fertilizer, were drawn from the adjoining unreclaimed flats which are accessible at low tides. A number of young cattle were purchased in the autumn for the double purpose of disposing profitably of the hay and straw produced on the farm and of making manure for next year's crop. These animals are making fair progress and when ready for the butcher in the spring will, it is hoped, realize good prices.

GRAIN.

Twenty-six acres of oats and three acres of barley were sown. Of the oats two acres were sown on the site afterwards selected for the new farm buildings and had to be cut out of season, as the land was needed for building purposes. The date of sowing these grains, viz., the "Black Prince Edward Island Oats," "Cream Egyptian Oats" and "Prince Edward Island Barley" ranged from 24th May to 7th June. From the 27 acres were threshed 830 bushels.

Two acres were sown in plots embracing four varieties of wheat, five of barley and ten of oats. The date of sowing, names of the different varieties and the time of ripening was as follows:—

WHEAT.

Sown.	Name.	Time of Ripening.
May 18.	Onega	101 days.
do	Ladoga, C.E.F	105 do
do	Ladoga (2nd importation)	108 do
do	Colonist or Saxonka	113 do

BARLEY.

Sown.	Name.	Time of Ripening.
May 18.	Poplar	98 days.
do	Petschora	99 do
do	Thanet	108 do
do	Chevalier	115 do
do	Beardless	113 do

OATS.

Sown.	Name.	Time of Ripening.
June 1.	Lincolnshire Poland White	86 days.
do	Victoria Prize	88 do
do	Flying Scotchman	91 do
do	Early Racehorse	92 do
do	Waterloo	95 do
do	Black Tartarian	96 do
do	Early Blossom	96 do
do	Onega	96 do
do	English Red	100 do
do	White Tartarian	100 do

The Cream Egyptian oats ripened in 100 days, while the Prince Edward Island Black took 113 days, both of these were sown on the 24th May. From the 24 acres there were threshed 765 bushels.

The season in the Maritime Provinces was most unfavourable for the ripening of grain, and it is quite probable that another year with more favourable weather all of these varieties would mature earlier. The samples of grain grown were very good, but accurate returns as to their relative yield cannot be given this season.

POTATOES.

A few plots of potatoes were planted, in all about one acre. One of the varieties viz., "Dorman's Seedling" which was grown from seed by Mr. Dorman in this county, gave 120 lbs. from 3 lbs. planted; another variety, the "Black Elephant," said to be a native of Montana, gave 3,600 lbs. from 120 lbs. of tubers.

In addition to these, other varieties were planted, which yielded in all 150 bushels.

FERTILISERS.

Not having any barnyard manure it was not thonght desirable to sow many turnips, but with the aid of some special fertilisers, about half an acre was grown, which yielded fully 400 bushels. Some fertilisers were also used on part of the buckwheat and on two acres of oats; a statement of the results is given below:—1 acre without fertiliser produced 23 bushels of oats, 1 acre with $4.00 worth of bone meal produced 28¼ bushels, a gain of 5¼ bushels, which at 40 cents per bushel= $2.10, or an apparent loss of $1.90 per acre; 1 acre with $7.32 worth of Bowker's Fertiliser produced 41½ bushels, a gain of 18½ bushels, which at 40 cents=$7.40, or a gain of 8 cents per acre. The effect of these fertilisers especially the bone dust will no doubt be seen on future crops. Twenty acres of buckwheat were sown for the purpose of enriching the land. Of this 13 acres gave a heavy crop, and when the seed was just beginning to form, the buckwheat was rolled with a heavy roller and turned under with a jointer-plough which covered it completely. The remaining 7 acres were sown later without any fertiliser, and the crop was not sufficiently advanced to plough under when the frost of 5th September cut it down.

FRUIT CULTURE.

About 2 acres were planted with fruit trees and vines, part of which were obtained in New Brunswick and part in Ontario.

On 24th and 25th May the large fruits were set out in nursery rows 4 feet apart, allowing two feet between each tree, these were well cultivated during the early part of the summer, and late in the fall they were banked up with 4 or 5 inches of earth firmly pressed down with the foot.

On 21st and 22nd May the grape vines and strawberries were planted. The former being set in rows 10 feet apart, with 10 feet between each vine; two rows of potatoes were planted between these rows of vines and frequently cultivated. Of the 70 vines, consisting of 20 varieties, the largest proportion grew well.

The strawberries were planted in rows 4 feet apart with 1 foot between the plants, and were well cultivated and kept clean. The vines were allowed to run and in some places completely covered the ground with strong healthy plants before the close of the season. As soon as the ground was frozen they were covered lightly with coarse horse manure. Of the 1,000 plants, of 10 varieties, nearly all grew. The Wilson and Captain Jack were the most healthy and vigorous growers.

On 22nd and 23rd May the gooseberries and currants were set out. These were placed in rows 6 feet apart with 4 feet between each bush, and were also kept well cultivated during the summer. Of the 325 bushes, consisting of 12 varieties, all but three or four made a healthy growth. The date of setting out the raspberries and blackberries ranged from the 21st to the 25th of May. These were planted in rows 6 feet apart, with 2 feet between the plants, and cultivated in the same manner as the other small fruits. Of the 450 plants, of 10 varieties, only about 25 per cent. grew. The collection of fruit trees and vines consisted of the following:—

		Varieties.
160	Apples	54
12	Crab Apples	4
46	Pear	21
5	Cherry	2
30	Plum	14
70	Grape	20
100	Gooseberry	4
150	Red Currant	6
75	Black Currant	2
75	Blackberry	3
375	Raspberry	7
1,000	Strawberries	10

Of the 253 trees referred to all with a single exception made a strong healthy growth.

FOREST TREES.

On the last day of May 2,800 young seedling forest trees, of 28 varieties, were set out. These were placed in rows 4 feet apart allowing from 9 to 18 inches of space between them, and received the same treatment as the fruit trees. A large proportion of these young trees grew.

Three varieties of rhubarb were also set out and made a rapid growth. The land on which the large and small fruits, forest trees and plots of grain were planted was under cultivation and had a dressing of manure last year.

DRAINING.

Much of the land on this farm requires draining to admit of early planting; a portion of this necessary work has been accomplished during the summer, and some five and a-half miles of tiles were laid on 24 acres of land. The land thus drained was afterwards well ploughed, and is now in good condition for spring planting.

BUILDINGS.

Building operations commenced on 15th August, but the work has been delayed by the almost continuous wet weather. The barn and horse stables are, however,

now partially completed, and will be ready for occupation next season. The barn is 111 feet long and 50 feet wide, with posts 18 feet long; this frame rests on a stone basement, the walls of which are 2 feet thick and 10 feet high in the clear. The stable which is attached to the barn is 65 feet long and 32 feet wide, with posts 15 feet long and rests on a substantial stone foundation. A cottage for the stableman is also in course of erection.

HORSES.

Our teams consist of 6 young horses, 4 and 5 years old, purchased in Prince Edward Island on the first of May last, and when landed here weighed respectively (i) 1430, (ii) 1350, (iii) 1300, (iv) 1320, (v) 1250, and (vi) 1130 lbs., and now weigh (i) 1635, (ii) 1385, (iii) 1325, (iv) 1425, (v) 1340, and (vi) 1250 lbs. In the interval these horses have been kept busy with heavy farm work, having ploughed 140 acres, cultivated, harrowed and drilled 58 acres of crop, besides cutting and drawing in 80 loads of hay and 27 acres of grain, drawing tiles from the station, carting manure and marsh mud, and doing all other farm work.

ATTENDANCE AT AGRICULTURAL EXHIBITIONS AND FARMERS' INSTITUTE MEETINGS.

Some of the products of this farm were shown at the Exhibition held in Truro on the 24th and 27th of September last, including 18 varieties of grain both in straw and in glass bottles. These, being new varieties in this district, were closely examined and favourably commented upon by the farmers. The Exhibition held at Charlottetown in Prince Edward Island, on 4th October, was also visited. The weather was very unfavourable; but the show of horses was remarkably fine; there were some good cattle, a large show of fine sheep, a few nice hogs, and a good exhibit of grain, fruit, butter and vegetables. The subject of reclaiming large tracts of salt marsh was engaging the attention of the farmers on the Island, and was dwelt on at some length by Lieut.-Gov. McDonald in his opening address at the Exhibition.

The Exhibition held in Sackville, N.B., on the 17th October was also attended. At this show there were some good horses and cattle, but on the whole, it was below the average on account of the unfavourable weather."

I attended the sessions of the Farmers' Institute of Colchester County, held in Truro, N.S. on the 28th and 29th of November, when addresses were made and papers read on the following subjects:—

"Road Making," by Prof. H. W. Smith, Truro.

"The Necessity for a More General Knowledge of Veterinary Science among Farmers," by Dr. Jakeman, V S, Halifax.

"Hints to Farmers," by Howard Trueman, Pointe de Bute, N.B.

"Dairying," by C. P. Blanchard, Truro, N.S.

"Winter Dairying," by P. C. Black, Windsor, N.S.

"Bee Keeping," by J. W. Black, Truro, N.S.

"The Wheat Midge or Weevil," by J. Fletcher, Entomologist and Botanist to the Dominion Experimental Farms.

"Experimental Farms," by W. M. Blair, Superintendent Experimental Farm, Nappan, N.S.

These subjects were all freely discussed and the meeting throughout was very interesting and instructive.

A meeting of the New Glasgow Farmers' Institute, held in New Glasgow, N.S., on the 4th January, was also attended. The following papers were read:—

"Horse Training," by J. A. Fraser, M.P.P., New Glasgow.

"The Standard-bred Trotting-horse," by Harry Townshend, New Glasgow.

"Thorough-bred Cattle," by A. C. Bell, New Glasgow.

"Grasses," by Prof. H. W. Smith, Truro.

"Ensilage," by Mr. McNaughton, Hopewell.

"Agricultural Education," by J. B. McKay, Pictou.

"Experimental Farm, Nappan," by W. M. Blair, Nappan.

I have the honour to be, Sir, your obedient servant,

NAPPAN, N.S., 31st December, 1888. W. M. BLAIR, *Superintendent.*

5*b*—7½

EXPERIMENTAL FARM FOR THE NORTH-WEST TERRITORIES.

REPORT OF A. MACKAY, SUPERINTENDENT.

INDIAN HEAD,
NORTH-WEST TERRITORIES,
DECEMBER 31, 1888.

Professor WILLIAM SAUNDERS,
Director Experimental Farms,
Ottawa.

SIR,—I have the honour to submit to you my report on the North-West Experimental Farm, the work done, and the improvements made on it, since it has been established.

This farm contains 682 acres, comprising the whole of section 19, and an angle made by the Canadian Pacific Railway of section 18 in Township 18, Range 12, West 2nd Meridian, and lies immediately east of the Indian Head town site, and less than half a mile from the Canadian Pacific Railway station. Indian Head is situated in Eastern Assiniboia, forty miles east of Regina, the capital of that province. The Canadian Pacific Railway forms the southern boundary of the Experimental Farm, from which a good view of the whole of it can be obtained. Along the east, west and north boundaries are public roads, from any of which the farm can be approached or seen equally well.

SOIL.

The soil varies from a sandy loam to a clay loam, with a porous clay subsoil. While the greater portion of the farm is a black clay loam, a considerable part is of a lighter nature and very suitable for testing fruit and forest trees.

STREAMS OR COULÉES.

Two streams or coulées pass through the farm in a north-easterly direction, in which there is running water in the spring and early summer, but which dry up later in the season. One of them is the outlet for Deep Lake, six miles south. The other is fed by flowing springs seven miles south-west. One enters the farm on the south and the other on the west, and after leaving it joins the Qu'Appelle river a few miles to the north.

These coulées, besides imparting beauty to the farm, are invaluable in supplying an abundance of water for stock, and affording desirable slopes for orchards, nurseries, &c., and should it ever be necessary to do so, almost the entire farm can be thoroughly drained into them.

In 1883 the Bell Farming Co. broke up nearly 600 acres out of the 682 acres now comprising the Experimental Farm, and since then that portion has been in crop each year, except a small area which in 1886 was fallowed.

The spring of 1888 was very backward, being at least two weeks later than any since 1882, and on account of there being a good deal of snow last winter, and it being retained by the stubble, work did not commence on the farm until the 24th of April, on which day ploughing was begun. A few days prior to this some Ladoga, Saxonka and Talavera wheats were sown on potato land, rented from Major Bell. This, with two acres, also rented, and afterwards sown with new varieties of barley and oats, were obtained in order that whatever grain might be grown, it would not be injured by a mixture of the volunteer crop, which would sure to have been the case

had any portion of the Experimental Farm been used for this purpose. Forty acres of oats for feed were sown on the Farm, which, though light in the straw, gave a yield of 50 bushels to the acre. Ontario gang ploughs were used, the grain being first sown on the stubble and then ploughed in. Two acres of peas were also sown on the stubble, and though the return was only small, good samples have been obtained which will be put in next spring under more favourable conditions.

SPRING WHEAT.

The different varieties of wheat sown were: Ladoga, Saxonka, Talavera, Scotch, Defiance Red, and Scotch Square Head. The Ladoga, Saxonka and Scotch wheats ripened and were not injured by frost. The Talavera being later in maturing was considerably hurt, while Defiance Red was so badly frozen as to be useless. The Scotch Square Head never headed out. The following are dates of seeding, harvest and yield:—

Ladoga—Sown, 20th April; harvest, 21st August; yield, 29 bushels per acre; weight, 62 lbs. to the bushel. This wheat ripened from a week to ten days earlier than Red Fife sown at the same time on adjoining lands.

Saxonka—Sown, 20th April; harvest, 27th August; yield, 30 bushels per acre; 62 lbs. to the bushel.

Talavera—Sown, 21st April; harvest, 10th September; yield, 15 bushels; weight, 57 lbs. to the bushel.

Scotch—Sown, 1st May; harvest, 27th August; yield, $28\frac{44}{60}$ per acre; weight, 62 lbs. to the bushel.

Defiance Red—Sown, 21st April; not cut.

Scotch Square Head—Sown, 1st May; did not head out.

BARLEY.

Six varieties of barley were sown, five of which were two rowed, Golden Melon, Peerless White, Thanet, Chevalier, Polar and Common Two Rowed. The Polar ripened very early, but was a poor sample. All the varieties were very heavy in the straw.

Golden Melon, two rowed, sown 1st May, harvest 22nd August, yield 34 bushels per acre, weight 54 lbs. to the bushel; Peerless, two rowed, sown 1st May, harvest 22nd August, yield $33\frac{12}{48}$ bushels per acre, weight 53 lbs. to the bushel; Chevalier, two rowed, sown 1st May, harvest 22nd August, yield 24 bushels per acre, weight 53 lbs. to the bushel; Thanet, two rowed, sown 1st May, harvest 22nd August, yield $56\frac{36}{48}$ bushels per acre, weight 54 lbs. to the bushel; Polar, six rowed, sown 1st May, harvest 7th August, yield 33 bushels per acre, weight 41 lbs. to the bushel; Common Two Rowed, sown 10th May, harvest 17th August, yield $36\frac{37}{48}$ bushels per acre, weight 52 lbs. to the bushel.

OATS.

Seven varieties of oats were tested—Tartarain, Early Blossom, Victoria Prize, Improved Waterloo, Lincolnshire Poland, Early Race Horse and Flying Scotchman. On account of horses and fowls injuring the oats, and having no buildings for the grain, the yields given are not accurate, but are the number of bushels per acre sowed. The oats were sown on beet land, ploughed and drilled in at the rate of two bushels per acre.

Tartarian, sown 1st May, harvest 24th August, yield $47\frac{20}{34}$ bushels per acre, weight 35 lbs. to the bushel; Early Blossom, sown 1st May, harvest 25th August, yield $55\frac{12}{34}$ bushels per acre, weight 40 lbs. to the bushel; Victoria Prize, sown 1st May, harvest 17th August, yield 49 bushels per acre, weight 42 lbs. to the bushel; Improved Waterloo, sown 1st May, harvest 17th August, yield 44 bushels per acre, weight 36 lbs. to the bushel; Lincolnshire Poland, sown 1st May, harvest 17th August, yield 35 bushels per acre, weight 41 lbs to the bushel; Early Race Horse, sown 1st May, harvested 17th August, yield 49 bushels per acre, weight $43\frac{1}{2}$ lbs. to

the bushel; Flying Scotchman, sown 1st May, harvest 17th August, yield 56 14/34 bushels per acre, weight 42 lbs. to the bushel.

PEAS.

Three varieties were sown on stubble land, but wild buckwheat coming up very rank smothered a great many of the vines and reduced the yield.

Blackeyes, sown 2nd May, harvest 30th August, yield 12 bushels per acre, weight 62½ lbs. to the bushel; Crown, sown 2nd May, harvest 22nd August, yield 16 bushels per acre, weight 65 lbs. to the bushel; Extra Early, sown 10th May, harvested 4th August, yield 18 28/60 bushels per acre, weight 61 lbs. to the bushel.

POTATOES AND FIELD ROOTS.

Twenty-three varieties of potatoes were obtained in Manitoba and the North-West and planted on stubble land, and though the yield was not large; sufficient good seed has been secured for next year. Other varieties will be added next spring. The following are the names of the different kinds grown:—Early Rose, Surprise, Beauty of Hebron, Morning Star, Lee's Extra Early, Lizzie's Pride, Brownell's Beauty, Carlo's Matchless, Dakota Red, Snow Flake, Genessee Seedling, Early Sunrise, Burbank's Seedling, Vick's Pride, Boston Market, Garnett Chili, Stonewall Beauty, Spray's Beauty, Burbees Empire State, Queen of the Valley, Early Conqueror, White Star and Empress Bell.

Several varieties of turnips and mangolds were sown early in June. Three methods of sowing were followed—broadcast, in raised drills and in rows on the flat, and in every case the roots on the flat did the best. A Turnip Flea-beetle was very numerous and did considerable injury to the young plants, especially to those first sown.

FRUIT AND FOREST TREES.

As it was deemed very important that something be done in fruit and forest tree culture without delay, some eight or ten acres of land was prepared as early and as well as possible, and during May and June 23,000 trees and plants were put out. The large fruits, as well as all the forest trees, were planted in nursery rows 3 feet apart so as to permit of cultivation with horse cultivators.

APPLES.

Two hundred trees of 60 varieties of apples were put out, in nursery rows, and received thorough cultivation. Every tree made a good growth though some were late in starting. Before winter set in the trees were wrapped with straw or tarred paper and earth heaped up around the base 10 inches high.

CRAB APPLES.

Of this fruit 12 trees of 4 varieties were planted; all did well and received the same treatment before the frost came as the apples did.

PLUMS.

Thirty trees of 8 varieties were planted; all lived, made a healthy growth during the season, and received the same attention at its close as the apples and crabs.

CHERRIES.

Thirty-four trees of 7 varieties of cherries were planted, and though they did not make as much growth as either the apples or plums, they made fair progress.

PEARS AND PEACHES.

In pears 20 trees of 7 varieties and 3 trees of peaches were put out. The pears made a very vigorous growth. Starting earlier than any other of the large fruit

trees they did extra well during the entire season. Like all the preceding classes, the pears and peaches were protected by straw or paper and the earth heaped up around the base before winter set in.

CURRANTS.

Of this fruit 178 bushes of 8 varieties were planted in rows 6 feet apart and 4 feet apart in the rows. With the exception of two bushes every one lived and did well. Before winter set in earth was heaped well up among the branches and around the stalks, more to protect the bushes from rabbits than from the winter.

GOOSEBERRIES.

Seventy-four bushes of 3 varieties of this fruit were planted the same as the currants. Four bushes never made a start; all the others made rapid growth.

RASPBERRIES.

In this fruit 411 plants of 6 varieties were set out in rows 6 feet apart. Ten per cent. died, or never made a start, the remainder made only fair progress, but were healthy looking when winter set in. Some of the plants were laid down and covered with manure or earth before the frost became too severe, others were only covered on the tips.

BLACKBERRIES.

Seventy-four plants of 3 varieties of blackberries were put out in the same manner as the raspberries and similarly treated. Nearly 20 per cent. failed to grow, the rest doing fairly well.

STRAWBERRIES.

The bed of this fruit consisted of 1,300 plants of 13 varieties. A severe frost occurred two days after they were put out, which killed two-thirds of the plants, some varieties having only a few plants left, while the "Wilson" had only one killed. During October nearly all the blanks were filled in from runners. After the ground became frozen the plants were lightly covered with manure and straw.

GRAPE-VINES.

Sixty-four vines of 18 varieties were planted in rows 6 feet apart and 6 and 10 feet apart in the rows. Some of the varieties made an early start and good growth, while others only began to grow late in the season—one vine alone failed to grow. Before winter set in the vines were covered with earth.

WILD OR NATIVE FRUITS.

In addition to the cultivated fruits a collection of native currants, gooseberries, raspberries, cranberries, strawberries, cherries, Saskatoon berries and grapes were obtained and planted. Every bush or plant put out did well.

FOREST TREES, SHRUBS, &c.

Twenty thousand of the following varieties were planted in nursery rows three feet apart, and during the season received thorough cultivation:—

Five varieties of elm, 6 of ash, 5 of maple, 6 of pine, 4 of spruce, 2 of locust, 2 of birch, 2 of alder, 2 of cedar, 2 of catalpa, and 1 variety each of butternut, walnut, hickory, oak, beech, basswood, larch, fir, juniper, wild cherry, hornbeam, Russian, mulberry, hackberry, hawthorn, cranberry, Kentucky coffee tree, sycamore, ailanthus and wahoo. Among the elms, ashes, locusts, soft maples, Norway spruce, larch, cherry, ailanthus, catalpas, Russian mulberry and cranberry hardly a blank occurred. Among the cedar, butternut, walnut, oak, beech, basswood and sycamore 20 per cent. were failures, while of all the other varieties put out from 20 to 40 per cent. died; the greatest failures being in Austrian pine and Douglas spruce, but most of

these were injured on the way up by delay in transit and being overheated. The black locust, butternut, walnut, catalpa and ailanthus were badly nipped by the first fall frost, while all the other kinds were none the worse even after repeated visitations.

TREE SEEDS.

During the latter part of May, seeds of native or ash-leaved maple, sugar maple, ash and basswood were sown in rows three feet apart. Between forty and forty-five thousand native maple came up and before their growth was checked had attained a height of from 10 to 20 inches. A large number of the ash also came up, but made slow progress. The sugar-maple and basswood failed to appear; possibly these may germinate next season. Four bushels of native maple seed were sown in October last. Before winter came several thousand maple trees, and a more or less number of all the varieties planted were taken up and placed in a cool cellar, to be set out again early next spring.

FALL WHEAT.

During the first week in August, three varieties of fall wheat were sown followed two weeks later by six more. The land having been fallowed and the weather very favourable, the grain came up in a few days, and before cold checked its growth it was covering the ground. In addition to the nine varieties which were drilled in, 165 other sorts were planted in rows, 50 grains of each variety set one foot apart. These were obtained too late to make much headway, and small birds, after they did come up, injured all the lots by eating off the green blades.

RYE.

Two varieties of fall rye were sown by drill early in August, and like the wheat covered the ground before the winter set in. Nineteen varieties were added by planting in rows 50 grains of each kind one foot apart.

GRASSES AND CLOVER.

The land being in an unfit condition, nothing was done towards testing forage plants until August, when some timothy and lucerne clover were sown by drill and 38 other varieties of grasses and clovers sown in small plots. None of these appeared above ground though a few varieties started to grow. Many additions of new, and especially all old and well-known grasses and clovers will be sown next spring. A collection of North-West grasses has also been gathered, the seed of which will be sown, and from which it is hoped good results will be obtained.

IMPROVEMENTS, &c.

During the summer a competent Dominion Land Surveyor, Mr. Wm. Thompson, of Qu'Appelle station, defined the limits of the farm, laid it out in fields, roads and plots, and prepared a plan of the whole section, including course of coulées, dams, building sites—number of acres in each field—number taken up by roads—coulées and water. Each field or plot being numbered on the plan, a record of all future operations can be conveniently kept.

FENCING.

On account of scarcity of men, and it being impossible to obtain suitable posts during the summer, nothing was done towards enclosing the farm, until frost put a stop to other work, when the regular staff was used, and something over one mile was put up. Sawn posts from British Columbia are being used, which, with 4 strands of wire, make a substantial and at the same time a creditable looking fence. The entire farm will be enclosed early next spring as nearly all the material is on hand to complete the work.

BUILDINGS.

There being no erections on the farm suitable for farming purposes, stabling and warehouse accommodations were obtained in Indian Head, which although the best that could be done, has been very inconvenient on account of the distance from the work. This will be remedied early next spring, when it is expected that all the buildings now under way will be completed. These comprise superiniendent's, horticulturists and foreman's dwellings, a large stone basement barn, and horse stable.

ROADS—GRADING AND DAMS.

The farm having been laid out in fields, those on that portion summer fallowed, have been made accessible by roads. Two avenues to the buildings have been graded and planted and the grounds around the superintendent's house, laid out, graded and the roads made. Two dams, one on each of the coulées were widened and made higher, and new sluice-ways made to carry off all surplus water, should sufficient snow fall this winter, or water flow in the spring, lakes of 12½ acres and 3 acres in extent will beautify the farm next year. Besides this a good well has been sunk which yields a bountiful supply of excellent water.

LAND READY FOR CROP.

Two hundred and fifteen acres were thoroughly worked during the past summer, the greater portion being twice ploughed and several times harrowed and cultivated, 20 acres were only ploughed once, but all weeds were kept down by harrowing, so as to test the relative merits of the different ways of cultivatior. Wild buckwheat, which had attained considerable hold of the ground, and the volunteer crop which grew very luxuriantly on the land fallowed, caused a large amount of extra work, but no doubt next year's crop will be all the better for the work done.

A space 100 feet in width, of the prepared land, along the western boundary of the farm, has been reserved for forest tree planting, and a strip around the entire farm for a like purpose.

TREE PLANTING.

In the beginning of October 700 fine ash-leaved maple trees were obtained in Brandon (Manitoba) and most of them planted along the western and part of the northern boundary and along the avenues leading to the buildings. The trees, which are from 5 to 6 years old, and have attained a height of 5 to 10 feet, were placed 20 feet apart on the boundaries, and 25 feet on the avenues.

EXHIBIT OF FARM PRODUCTS AT FAIRS.

During October many of the municipalities in the North-West held their annual fall exhibitions. It was thought advisable to exhibit the result of the first year's work on the farm, at as many of these as possible—accordingly, samples of wheat, barley, peas, oats in the straw, as well as the grain, native grasses, and the different varieties of potatoes and roots were prepared and were shown at Wolseley, Indian Head, Qu'Appelle station and Fort Qu'Appelle, where they received warm praise from farmers and others, while the press were unanimous in their approval. His Honour Lieutenant Governor Royal, on opening the North-West Assembly, referred to the exhibit as proof of the advantage the Experimental Farm will be to the North-West Territories.

On account of the harvest being backward, fairs held prior to those mentioned, could not be attended, but it is hoped that in the coming year many others will be reached.

I have the honour to be, Sir,

Your obedient servant,

ANGUS MACKAY,

Superintendent.

EXPERIMENTAL FARM FOR MANITOBA.

REPORT OF S. A. BEDFORD, SUPERINTENDENT.

To Professor Wm Saunders,
Director Experimental Farms,
Ottawa.

Sir,—I have the honour to submit herewith a report of the work accomplished on the Manitoba Experimental Farm during the past five months.

DESCRIPTION OF THE FARM.

The Manitoba Experimental Farm comprises portions of Sections 27 and 34, Township 10, Range 19, west 1st Meridian, 652 acres in all, about two-thirds of it is in the Assiniboine Valley, the remaining one-third is upland prairie, the greater portion of it is delightfully situated, the higher portions overlooking the Assiniboine Valley, one and a half miles from Brandon station and in full view of the Canadian Pacific Railway, it is in the centre of a thickly settled farming district, and is easy of access from all parts of the Province.

SOIL.

The soil is of a variable character, suitable for the purposes of an experimental farm, and consists of stiff clay and river sediment on the river flats, clay loam and rich sandy loam, from two to six feet deep on the higher portions of the valley, and light sandy and gravelly loam on the uplands.

WATER SUPPLY.

The Farm has an abundant supply of excellent water, the Assiniboine River, a navigable stream, forms a portion of its southern boundary, about the centre of the valley there is a lake of good water, three-quarters of a mile long and several feet deep, four spring creeks traverse the northern portions of the property, and several wells have been dug, which yield an abundance of good water at a depth of from 15 to 30 feet.

SHELTER.

On the borders of the lake and on the side hills and ravines of the northern portions of the Farm, there is a quantity of small timber and bushes which can be utilised for the protection of more tender shrubs and trees.

HAY LAND.

In the flats bordering on the Assiniboine River there is about 150 acres of excellent native hay meadow. In favourable seasons this will supply a large quantity of feed for stock and furnish land very suitable for carrying on a series of experiments with the view of determining the value of our native grasses for feeding purposes.

On my arrival here in the beginning of July last about 140 acres had been brought under cultivation, 100 of which was sown to grain. As no satisfactory arrangements could be made for the purchase of this crop, the owners were allowed to remove it. A large proportion of the cultivated land had been badly ploughed, and in the lower portions couch grass had taken a firm hold. On arrival the men and teams were at once started to plough the unsown portions, and before frost set in 110 acres were prepared for spring sowing. Owing, however, to my late arrival

and to the condition the land was in, there was not sufficient time to give portions of it that thorough cultivation it required, hence about thirty acres will be better left for summer fallow, to be thoroughly cultivated during the coming season.

FALL GRAIN.

As the season was far advanced when I reached the farm, only a limited area of land could be prepared for fall grain, about the first week of September fifty grains, each of 184 varieties of fall wheat and rye were sown one foot apart for comparative test, but owing to the extreme dryness of the season only a portion of these germinated and their growth was slow. When winter set in the plants were only about three inches high and not as strong as I could have wished, the autumn here being generally cool and dry, better results are likely to be obtained by sowing early in August.

GRASSES.

Owing to the increasing scarcity of natural hay in most parts of the Province the question of suitable fodder plants is becoming an important one and my attention has been repeatedly called to the desirability of introducing some variety of grass suited to our soil and climate, with that end in view 37 varieties of cultivated grasses were sown during the month of September, an acre of timothy seed was also sown on the river flats, the seeds of some twenty varieties of native grasses were also collected, these will be sown early in the spring and their suitability for cultivation noted.

SOWING SPRING WHEAT IN THE FALL.

During the past season many volunteer crops of grain in this district were found to have entirely escaped the frost, while fields of spring sown grain in close proximity were injured; for the purpose of throwing further light on this subject an acre of Red Fyfe spring wheat was sown on the 3rd of November just before the ground froze up.

FOREST TREE CULTURE.

Early in November $\frac{3}{4}$ of an acre of native ash, basswood and maple seeds were sown, and a number of other varieties will be sown in the spring, 650 native ash-leaved maples from 8 to 10 feet high have been procured and a portion of them planted, the balance will be set out next season.

SMALL FRUITS.

The demand for all kinds of fruit in this Province is very large and yearly increasing. Judging from the number and variety of native small fruits found growing on this farm, its soil and situation promises to be well adapted to this branch of horticulture.

Just before the ground froze up 425 currant bushes, embracing 5 varieties, were received from the Central Experimental Farm, these were healed in ready for spring planting. A number of cuttings from native fruit trees were also set out and the effect of cultivation on them will be noted.

CLEARING OF SCRUB.

On taking possession of the Farm about 70 acres of the hay land bordering on the river was badly over-grown with roses, willow and ash scrub from four to nine feet high; during the past summer and fall this has all been cleared off, making an excellent meadow, fire has been run over a portion of this meadow and its effect on next season's crop will be watched and reported on.

DRAINING.

In former years the water from two of the springs rising in the uplands was allowed to spread itself over the lower land preventing early seeding and in wet

seasons completely flooding portions of it; during the autumn 1,114 yards of open ditch has been dug conveying the water directly through the Farm and no further difficulty is expected from this source.

ROAD MAKING AND FENCING.

As the regular road allowances on both the north and south boundaries are impassable owing to the river and river banks, a public road, a chain wide and one mile long, has been laid out across the Farm from east to west; 507 yards of this road has been graded and well gravelled, the grade is 30 feet wide, leaving a sidewalk of 18 feet on each side which it is proposed to sow with permanent grasses. A row of native maple trees has also been planted on each side of this road giving it a finished appearance; during the coming season an effort will be made to complete this road and avenue, thus making a good approach to the Farm and greatly adding to its appearance.

FENCING.

A little over three miles of fencing has been erected, this is composed of round cedar posts from 5 to 10 inches in diameter placed 8 feet apart, 4 strands of barbless wire, and a 2 by 4 scantling mortised into the posts 4½ feet from the ground, this makes a substantial and at the same time an attractive fence.

A quantity of surface stone has been removed from the cultivated land, some of which has been used in repairing the temporary buildings, the balance will, no doubt, be found useful when the permanent buildings are erected.

TEMPORARY BUILDINGS.

When taken over by the Government there was a frame house 20 by 26 feet and a basement barn 26 by 36 on the property, both were in an unfinished condition and unfit for occupation; they have been thoroughly repaired and will serve a good purpose for a number of years to come; two temporary implement sheds 14 by 26 have also been built.

I have the honour to be, Sir,

Your obedient servant,

S. A. BEDFORD,

Superintendent Manitoba Experimental Farm.

BRANDON, MANITOBA, December 31, 1888.

CENTRAL EXPERIMENTAL FARM, DEPARTMENT OF AGRICULTURE, OTTAWA, CANADA.

BULLETIN No. 4.

March, 1889.

To the Honorable
The Minister of Agriculture:

SIR,—I have the honour to transmit herewith the fourth Bulletin from the Central Experimental Farm. This relates to the Ladoga wheat which was first imported under your instruction from Northern Russia in 1887, with the object of securing an early ripening variety of hard wheat, of such quality as would compare favourably with the best hard wheats now in cultivation in the North-West of Canada. The results submitted in the accompanying Bulletin indicate a gratifying measure of success obtained in this undertaking.

The first part prepared by myself treats of the earliness, fertility and quality of the wheat; the second part, which has been prepared at my request by Mr. Frank T. Shutt, Chemist of the Dominion Experimental Farms, relates to the chemical constituents and physical characters of wheat, and gives the results of the chemical analyses conducted by him of a number of samples of Ladoga, Red Fife and other varieties of wheat.

I have the honour to be, Sir,

Your obedient servant,

WM. SAUNDERS,

Director.

OTTAWA, 22nd March, 1889.

LADOGA WHEAT.

PART I.

By Wm. Saunders, F.R.S.C., F.L.S., F.C.S., Director of the Dominion Experimental Farms.

Importance of obtaining early ripening varieties.

The question of early ripening varieties of grain and especially of wheat, is one of the utmost importance to the future of Canada. The Provinces of Prince Edward Island and New Brunswick, the northern portions of Quebec and Ontario, and the great plains of the North-West, all have a short season, and the immense advantages which would accrue to the farmers in all these sections of our country from the introduction and dissemination of early ripening sorts of wheat, barley and oats, and the annual saving this would effect would be difficult to over-estimate. But the wheat problem is the subject of the present Bulletin, and it is to the needs of the

North-West settlers that we would at this time direct special attention. The soil of the great plains of Manitoba and the North-West Territories is stored with such an abundance of fertility that the capacity for production can scarcely be estimated provided that the difficulties associated with a short season can be partially or wholly overcome by the introduction of early ripening sorts. To meet the requirements in this case, not only must the variety of wheat be early in ripening, but it must also possess such superior qualities as will command for it a relatively high price in the markets of the world; otherwise the cost of transporting so bulky a product over long distances would leave but little profit to the grower. It is a singular fact that the northern countries of the world, where the difficulties surrounding agriculture are greatest, both in the way of production and access to markets, are the only countries producing wheat of the highest quality, and it is found to be a necessity by millers everywhere, who aim to produce first-class flour, to add to the softer wheats produced in temperate and southern latitudes a large proportion of the hard wheats grown in northern countries, and it is said that the larger the proportion of hard wheat used the stronger and better will be the flour. While India produces some hard wheat in limited quantities, most of the hard wheats which find their way to the markets of the world are the growth of the northern plains of Russia, the northern United States, and the North-West Provinces of Canada.

Fife Wheat.

The varieties of wheat known as Red and White Fife, grown in the Canadian North-West, deservedly rank among the best wheats in the world, and the high grades of flour produced from them command the best prices obtained for this product, and were the Fife wheats a little earlier in ripening, nothing better need be desired. In the northern parts of the United States the same or similar wheats are grown under the names of Fife, Saskatchewan Fife, and Wellman's Fife. The following account of the origin of Red Fife Wheat is given in the *Canadian Agriculturist* for 1861: "About the year 1842 Mr. David Fife, of the Township of Otonabee, Canada West, now Ontario, procured through a friend in Glasgow, Scotland, a quantity of wheat which had been obtained from a cargo direct from Dantzic. As it came to hand just before spring seed time, and not knowing whether it was a fall or spring variety, Mr. Fife concluded to sow a part of it that spring and wait for the results. It proved to be a fall wheat as it never ripened, except three ears, which grew apparently from a single grain. These were preserved, and although sown the next year under very unfavourable circumstances, being quite late and in a shady place, it proved at harvest to be entirely free from rust when all wheat in the neighborhood was badly rusted. The produce of this was carefully preserved, and from it sprung the variety of wheat known over Canada and the Northern States by the different names of Fife, Scotch and Glasgow."

Russian Wheats.

In Russia a number of different sorts are grown, but in the northern provinces the Saxonka and Kubanka varieties form a large proportion of the shipments. The Saxonka wheat is known also under the name of Colonist wheat, and it is alleged that it is the identical wheat which was distributed by Peter the Great among the colonists whom he forcibly placed on the great plains of Russia. It is rather small in grain, but hard in texture, and is held in esteem by millers in Great Britain as a mixing wheat, but does not command the high price which the best qualities of hard wheats from Canada and the United States readily bring. The Kubanka appears to be identical with what is known in Canada as Goose wheat, a variety of a hard ricy structure more or less transparent, which is regarded with much disfavour by millers in Canada who pronounce it to be one of the poorest varieties grown. In Russia it is highly esteemed and in the wheat markets of Europe it usually commands a price about equal to the Saxonka, which is usually about three-fourths the price of the best

American hard wheats. It is a variety held in some favour by Canadian farmers in localities where the wheat midge prevails, as a midge proof wheat, for the reason that the kernel hardens so early that the midge is not able to injure it much. The outer covering of this wheat is thick, and the proportion of bran to flour is greater than in most other varieties, and notwithstanding that it is fairly rich in gluten its growth should not be encouraged where wheats of better quality can be matured.

The Ladoga.

In Bulletin No. 2 reference was made to the importation of an early ripening spring wheat from one of the northern Provinces of Russia. The object sought in its introduction was to obtain a hard wheat of good quality which would ripen early enough to escape the autumn frosts which sometimes injure the crops in some parts of the north-west of Canada. This wheat was selected by a seed dealer in Riga who had made a special study of the cereals of northern Russia, but the exact locality of its growth, and the name under which it is known had not been ascertained at the time Bulletin No. 2 was issued.

It was grown in latitude 60° near Lake Ladoga, north of St. Petersburg, and is known under the name of Ladoga. The locality referred to is by latitude 840 miles north of the city of Ottawa, 600 miles north of Winnipeg and north of the northern boundary of Lake Athabasca, in the Peace River country. The Ladoga wheat is said to be highly esteemed in those parts of Russia where it is grown, and is in favour as an early ripening sort. The first consignment was brought to Canada in the spring of 1887, when 667 sample bags were distributed for test, from which 275 returns were received, and from these reports the average period of ripening was estimated from ten to fifteen days earlier than Red Fife, a gain in time of maturing which would if maintained materially lessen the risk of injury from frost. In the spring of 1888 a second distribution of this wheat was made, when 1,529 sample bags of 3 pounds each, were sent out, from which 501 reports have been received. These place the period of ripening, taking the entire Dominion, at 10 days earlier than the Red Fife.

Its Fertility.

The relative fertility of this wheat is also an important feature, and in this particular it will be seen from the following table that the Ladoga makes a very fair showing:

Returns Received for 1887.	No. of Returns.	Yield from 3 lbs. Sown.			Time from Sowing to Harvesting.
		Largest.	Smallest.	Average.	
		Lbs.	Lbs.	Lbs.	Days.
Manitoba	83	165	30	76½	102
North-West Territories	68	236	21	85	105
British Columbia	3	112	64	85	93
Ontario	67	60	10	27	90
Quebec	15	40	6	19	85
Nova Scotia	15	89	20	53	102
New Brunswick	24	60	8	30	97

Being an average yield of a little over 53 pounds from each 3 pounds sown.

The returns for 1888, as indicated by the reports received, may be thus summarized:—

Returns Received for 1888.	No. of Returns.	Yield from 3 lbs. Sown.			Time from Sowing to Harvesting.	Number of Days earlier than Red Fife.
		Largest.	Smallest.	Average.		
		Lbs.	Lbs.	Lbs.	Days.	
Manitoba	51	100	12	38	123	9½
North-West Territories	69	178	12	63	122	10½
British Columbia	8	183	53	126	113	8½
Ontario	113	97	8	44	99	9
Quebec	20	138	16	50	101	11½
Nova Scotia	14	44	10	26	120	10
New Brunswick	11	92	34	59	107	12
Prince Edward Island	15	199	15	46	115	9½

This is equal to an average yield of a little more than 50 pounds from each 3 pounds of seed, and compared with Red Fife it is just ten days earlier.

The summer of 1887 was exceptionally hot and dry in Ontario and Quebec, and the crops of all cereals were light and their ripening premature. On the Central Experimental Farm a field of fourteen acres of Ladoga wheat sown on the 7th of May was harvested in 76 days from the date of sowing, the Ladoga ripening eight days earlier than the Red Fife sown at the same time in an adjoining field. On the 17th of May, 1888, this experiment of sowing was repeated and the field of Ladoga ripened in 81 days, the Red Fife in 92 days, a difference of eleven days. During the past season the grain in Manitoba and the North-West Territories has been unusually slow in ripening, so also in the Maritime Provinces owing to the remarkably low average temperature during the growing season; the conditions in Ontario and Quebec have on the whole been more favourable. These circumstances will aid in explaining the differences in the results for the two years. The falling off in yield in Manitoba and the North-West Territories during 1888, was mainly due to the very backward season and to the advent of unusually early frosts which in many cases nipped the grain before it was mature and materially lessened the crop.

Relative Quality.

The quality of the Ladoga wheat is a very important consideration. The very high character of the Red Fife wheat grown on the western plains of Canada and the excellent quality of the flour prepared from it, has created a demand for this wheat at the highest market prices, and it is of the utmost importance that this good reputation be maintained; the introduction of any wheat of a manifestly inferior quality which would tend to lower the standard of Canadian hard wheat would be highly impolitic. The original Ladoga wheat has been submitted to a number of experts, the majority of whom place it in the next grade below No. 1 hard, and estimate its value at from 4 to 5 cents per bushel less than the best quality of Red Fife, but some of the samples grown from this seed have improved so much as to entitle them to grade with grain of high quality.

With the view of ascertaining the opinions of those who are held to be the most competent judges eight samples were chosen, representing the average quality of those received together with a sample of the original importation and a small sample of the Saxonka and Kubanka wheats, which had been received from a correspondent who had grown them in Manitoba. Subsequently three of the heaviest and best samples of Ladoga were selected, making 14 in all. A portion of each was sent to the Boards of Trade in Montreal, Toronto and

Winnipeg, to Mr. W. W. Ogilvie of Montreal, and to Mr. Frank E. G... ominion Grain Inspector at Port Arthur, for inspection, and to the Chemist of the Experimental Farms, Mr. F. T. Shutt, for analysis. The several Boards of Trade manifested a deep interest in the subject, and referred the samples in each case to a select committee of experts. Mr. W. W. Ogilvie kindly gave his personal attention to the subject, and Mr. F. E. Gibb reported fully on the first lot of average samples sent him, but through illness was prevented from reporting on the last and best samples.

The list of samples and the reports thereon are herewith submitted, with the numbers under which they were sent.

		Weight per bushel.
7	Ladoga—Original importation	61 lbs.
1	do grown at Lethbridge, N.W.T.	60¾
2	do do Edmonton, N.W.T.	61½
3	do do Plum Creek, Souris, Man.	60¼
4	do do Brandon Hills, Man.	60
5	do do Tatamagouche, N. S.	60
6	do do Guysboro', N. S.	61¼
8	Kubanka—grown in Manitoba.	
9	Saxonka do do	
10	Ladoga—grown at Wolseley, N.W.T.	63
11	do do Touchwood Hills, N.W.T.	64
12	do do Binscarth, Man.	65
13	do do Mowbray, Man.	64¾
14	do do St. Mary's, New Brunswick	64

A letter was forwarded with each set of samples similar to the following, which was addressed—

"To the Secretary of the Board of Trade, Montreal.

"DEAR SIR,—I desire to get the opinion of your Board of Trade regarding a wheat which was distributed last spring from the Experimental Farm in Ottawa for test in different parts of the Dominion. It is well known that farmers in the northern parts of Manitoba and the Territories have in the past suffered much loss from frozen wheat, and they are very anxious to obtain some variety which will ripen a few days earlier than the Red Fife, so as to admit of its being harvested before the early frosts occur. So strong is this feeling that farmers are willing to grow inferior varieties rather than suffer such losses as they have experienced in the past.

"In view of this condition of things, efforts are being made under instruction of the Minister of Agriculture, to endeavour to secure an earlier ripening wheat of *good quality* as nearly up to the standard of the Red Fife as possible. You will bear in mind that the object of this introduction is not by any means to displace the Red Fife; I think the growth of that variety should be encouraged in every practicable way, but the Minister desires that an earlier wheat of *good quality* should be secured to be grown where the Red Fife does not succeed, and thus discourage and prevent as far as is practicable the introduction of soft and inferior varieties of wheat, so that the present high standard of our North-West grain may be generally maintained and at the same time the necessities of the farmers met and the settlement of the country stimulated.

"After much correspondence and enquiry, it was decided to order a supply for the first experiment from Riga, Russia. This wheat arrived late last spring, and not having been advised of its correct name, it was distributed provisionally under the name of 'Northern Russian Wheat.' I have since learned that it is known in Northern Russia under the name of Ladoga.

"I send you a sample of the original importation under No. 7 and the samples from 1 to 6 and 10 and 11 inclusive, have all been grown from this seed. In considering these samples it should be borne in mind that the seed was not received by the growers until from two to three weeks after the usual time of seeding, hence the

grain is plump and well developed as it would have been had it been sown earlier. re'

"No. 1 was grown at Lethbridge, Alberta, N.W.T.
do 2 do Edmonton do do
do 3 do Plum Creek, Souris, Manitoba.
do 4 do Brandon Hills do
do 5 do Tatamagouche, Nova Scotia.
do 6 do Guysboro' do
do 10 do Wolseley, Assiniboia, N.W.T.
do 11 do Indian Reserve, Touchwood Hills, N.W.T.

"I desire to have the opinion of your Board of Trade as to how these wheats would grade in the markets of this country and how they would compare with Red Fife in the price they would command. I also enclose, under Nos. 8 and 9, a few grains (I am sorry I cannot just now send more) of Kubanka and Saxonka wheats, which are being sold in Manitoba for seed. Kindly let me know how these compare in value with Red Fife and Ladoga and the prices these varieties would now command if placed on the market in quantities. I desire this information for the reason that frequent enquiries reach me from Manitoba and the North-West from farmers who seek information on these points.

"The reports which have been received show that the Ladoga wheat has ripened during the past season from 10 to 15 days earlier than the Red Fife. Should this early ripening habit prove permanent—which there is every reason to expect—and the wheat of a desirable quality, its further encouragement in the districts referred to is most important.

"You will I trust, in view of the importance of this subject to the whole country, pardon the liberty I have taken and obtain for me the information asked.

"Yours very sincerely,
"WM. SAUNDERS,
"*Director Experimental Farms.*

"OTTAWA, 30th January, 1888."

The three samples referred to under Nos. 12, 13 and 14 were forwarded on the 2nd of February to the several experts and Boards of Trade, with letters, explaining that these were the three heaviest specimens which had been obtained.

The following replies were received:—

"OFFICE BOARD OF TRADE,
"10 St. John Street and 39 St. Sacrament Street.
"MONTREAL, 9th February, 1888.

"The Board of Examiners for wheat and other grain having taken communication of the letters from the Director of the Central Experimental Farm, Ottawa, dated 30th January and 2nd February, and having compared and examined the samples of wheat forwarded by the Director, reports as follows:—

"That the Board learns with pleasure of the action of the Government in endeavouring to secure, through the Director of the Experimental Farm, a hard wheat of good quality that shall ripen earlier than Red Fife, the Board believing that while Red Fife should most certainly be grown wherever there is no danger to be apprehended from early fall frosts, it is of the greatest importance that a choice hard wheat shall be found that will ripen earlier than Red Fife and so may be safely grown in districts where such frosts occur.

"That the samples of Ladoga wheat would, with the exception of No. 3 all grade as hard wheats and the Board consider that presuming the stated advantage of time in maturing is fully established, its introduction will be very advantageous wherever early harvesting is desirable.

"That a comparison of the Ladoga wheat samples with the Fife wheats, to be of any value can only be made by providing a miller with a sufficient quantity to be ground and afterwards baked. From a trade point of view, however, the Board con-

siders that should any difference in favour of Red Fife be established, the advantage would be trifling as compared with the importance of securing to the farmer a wheat that would ripen from two to three weeks earlier.

"That the exception made by the Board regarding sample No 3, is because that wheat would not grade above ordinary spring wheat; and it would appear either that some mistake must have been made respecting the original seed, or in the product sent to the Director, for it seems scarcely possible that the samples of Ladoga wheat submitted could have so deteriorated in one sowing as to produce so inferior a grain.

"That with regard to the samples of Kubanka and Saxonka wheats, the Board condemns both as being very inferior grain, and quite unsuitable for seeding purposes.

"Signed on behalf of the Board of Examiners for wheat and other grain.

"HUGH McLENNAN,
"*Chairman.*"

"TORONTO BOARD OF TRADE.

"Report of the Committee of Millers, Grain Dealers, Grain Exporters and Grain Inspectors, to whom was referred the communications and samples sent to the Secretary of the Board by Prof. Wm. Saunders, Director of the Central Experimental Farm.

"To the President and Council of the Board of Trade.

"Your Committee sat on the afternoon of the 4th February, 1888, examined the samples and discussed the subject, which, in their opinion, is one of very great importance.

"The conclusions to which they arrived are as follows: —

"The most important test of commercial merit in a spring wheat sample is the percentage and quality of gluten it contains.

"The examination made by the committee of sample 7, the original importation, and of samples 3 and 4 (those grown at Plum Creek and Brandon Hills), shows that all three are very deficient in gluten, or strength, being not superior to the present standard of No. 2 spring of Ontario growth.

"No. 2 spring is at present worth 80 cents per 60 lbs. here; No. 1 Manitoba hard, which contains 85 per cent. of Red Fife, is worth 90 cents. The answer to the enquiry as to how these wheats would compare in value with Red Fife would therefore be: Pure Red Fife is worth 11 to 12 cents per bushel more than samples 7, 3 and 4.

"The committee selected samples 7, 3 and 4 for comparison for the reason that they were grown in the same section of Manitoba from which comes the bulk of the Red Fife with which they are familiar."

"Sample 8, Kubanka, is the wheat grown to some extent in Ontario, under the different names of Arnecta, Rice or Goose Wheat. The demand for this wheat is limited, and when the quantity grown in Ontario was large compared with the quantity grown in Ontario now, the price was 20 to 23 cents below the price of No. 2 spring, say 35 cents below the price of No. 1 hard Manitoba. This wheat is also a later wheat to ripen than Fife wheat."

"Sample 9, Saxonka, is a poor, thin sample, containing a small mixture of Kubanka or Arnecta. If free from this it would inspect No. 3 spring, worth 77 cents as against 90 cents for No. 1 hard."

"The Ladoga would be a fair marketable wheat of the soft variety and preferable to badly frosted Red Fife."

"If it is a fact that any section of the wheat-growing North-West cannot be made to produce unfrosted Red Fife by proper farming, we would recommend that the Ladoga be tried in such localities, if by further experiments you fail to find a more glutinous wheat, possessing all the early ripening quality of the Ladoga."

"In the interests of the North-West, however, it is to be hoped that every experiment will be exhausted in the direction of retaining pure Red Fife sowing before settling down to soft wheats of any variety."

"An exceptionally bountiful crop of Red Fife, and an exceptionally poor crop of winter wheat, in the same year might result in the price of the latter approximating the price of the Fife, because the flours from the two varieties are not interchangeable for many purposes. But no surplus of Red Fife and scarcity of such wheats as samples submitted, could bring the value of the latter to, or nearly to, the value of Red Fife. The Red Fife flour will answer in every case where flours from your samples will answer, and with greater satisfaction and economy."

"Instances are known to some members of the committee of No. 1 hard and No. 2 frosted, being ripened side by side, from the same field in Manitoba, the soil and seed the same; the only difference being, in the first case the ground was ploughed and harrowed in the fall, thereby admitting of a few days earlier seeding, than in the second case where the ploughing was done in the spring."

"In view of the great importance of keeping up the growth of hard wheat, important to all interests, but most important of all to the North-West farmers, the committee report that in their opinion the greatest efforts should be made to extend its growth, and if other varieties than Red Fife must be used, such varieties as contain the largest percentage and best quality of gluten should be given preference."

"For determining the percentage and quality of gluten, the committee would recommend chemical analysis of all samples proposed to be experimented with, this being the one reliable test for a small sample."

"The samples last received (12, 13 and 14), are excellent in their plumpness and weight, but are quite as soft and deficient in strength as the former samples, and in value would bring about 2 cents per bushel more if offered for sale in quantity, than the samples first received."

(Signed,) H. McLAUGHLIN,
Chairman of Committee.

COMMITTEE.

H. McLaughlin,	R. J. Stark,	J. L. Spink,
John Reed,	H. N. Baird,	J. Carruthers,
Thomas Flynn,	S. A. Chapman,	R. C. Steele,
Joseph Harris,	W. Taylor,	W. D. Matthews, Jr.

WINNIPEG BOARD OF TRADE.

SECRETARY'S OFFICE, CIVIC BUILDINGS,
WINNIPEG, Man, 16th February, 1883.

The Council Winnipeg Board of Trade.

GENTLEMEN,—Your Board of Grain Examiners have to report that they have carefully examined the samples of Russian wheat forwarded to the Board by Prof. Saunders, Director of the Government Experimental Farm at Ottawa, and which he requests the Board will express an opinion on.

After viewing the samples your grain examiners find as follows:

The original sample of Ladoga wheat, and some of its best matured products grown in Manitoba, would value with grades of the "Northern" classes.

We find that most of the samples submitted are not fully matured, and they are all lacking in good colour.

Sample No. 3 (grown at Souris, Man.), would seem not to belong to the Ladoga variety of wheat, being a wholly soft specimen which would grade as "No. 3 spring."

Nos. 1 and 11 (grown at Lethbridge, N.W.T., and Touchwood Hills, N.W.T., respectively), show the effects of frost action.

No. 2 (grown at Edmonton, N.W.T.), has a bleached look, which might arise from a very slight touch of frost or the effects of hot winds.

For seeding purposes we would recommend the original sample from Russia in preference to any of the others submitted.

The best sample, No. 13 (from Mowbray, Man.), and the original from Russia would be worth five cents less than No. 1 Manitoba Hard (containing 85 per cent. of Red Fife), for milling purposes. Necessarily this opinion must be subject to a milling test, or chemical analysis.

None of the eleven samples of the products of the Ladoga variety, bear any close resemblance to the original sample forwarded, and are, for the most part, unlike one another. This may be owing to the lateness in sowing or other unfavourable conditions, and we are of the opinion that a test, during another year or two, must be made before its value for this country could be positively ascertained.

Prof. Saunders has asked, also, for the Board's opinion as to the relative value borne by certain samples of Kubanka and Saxonka wheat (forwarded by him) to the Red Fife and Ladoga varieties.

In the opinion of this Board of Grain Examiners the millers and grain dealers of Manitoba would not purchase Kubanka wheat at any price, though it might, however, be useful for feed purposes. We understand that this variety of wheat is being sold in Manitoba this season for seed. In the opinion of your Examiners the sample submitted by Prof. Saunders is none other than "goose" or "rice" wheat and of little value.

The Saxonka variety belongs to the spring or soft class of wheats. The sample examined, however, is so poor that it would only grade as "rejected."

Your Grain Examiners are firmly of the opinion that the cultivation of Red Fife wheat should be persevered in, and that farmers will speedily discover the system of soil preparation by which they can insure early seeding with the early and safe maturing of this invaluable variety.

All of which is respectfully submitted.

(Signed) GEO. J. MOULSON,
Chairman.
CHAS. W. BELL,
Secretary, Board of Grain Examiners.

REPORT OF W. W. OGILVIE, ESQ.

MONTREAL, 3rd February, 1888.

Prof. W. SAUNDERS,
Director Central Experimental Farm,
Ottawa.

DEAR SIR,—Your favour of the 30th ult., with 11 samples of wheat, came duly to hand. I have examined them carefully and beg to submit the following report:—

The sample of Kubanka wheat grown in Manitoba is what is known as Goose wheat. Its growth should be discouraged as much as possible, as its value is fully 15 cents per bushel less than Red Fife wheat.

The sample of Saxonka wheat grown in Manitoba is also poor wheat that should not be encouraged for seed.

Sample No. 7, Ladoga wheat, being the original importation from Riga, is not pure hard wheat, having a mixture of soft wheat in it.

Sample No. 10, grown at Wolseley, shows the best result of last year's growth, and would inspect Extra Hard.

Samples No. 1, No. 2, No. 6 and No. 11 would inspect No. 1 Hard, and sample No. 5, grown in Nova Scotia, would inspect No. 2 Hard.

Sample No. 3, grown at Plum Creek would inspect No. 1 Spring, being the fourth grade of wheat. From the way this sample has degenerated in one year,

would lead me to infer that the Ladoga wheat would not long maintain its hardness but will degenerate into ordinary Spring wheat.

I have had a good deal of experience in the growing of Russian wheat in Canada, my father having been among the first to import it. I have also visited the wheat fields of Russia and experimented upon its growth in this country. The Mennonites in Southern Manitoba also brought Russian wheat with them. My experience has proved that these wheats soon degenerate into ordinary Spring wheat in this country, and at best never had the bright shining gloss that you find on Red Fife wheat. The Russian wheat also grinds harsh, and the flour is not equal to Red Fife.

Notwithstanding all that has been said and written about early ripening wheat, after many experiments, my experience has been that Red Fife wheat will ripen as early and yield as well as softer wheats, and is worth 10 cents per bushel more than soft wheat. Many of these tests have been in Manitoba. The complaints from Red Fife wheat in Manitoba have been caused by late sowing, the richness of the soil, weather and cool nights in August; but I am of opinion that with early sowing and favourable August weather, these complaints will disappear.

We must also bear in mind that Manitoba and the North-West Territories are among the few countries that can grow hard wheat, and therefore we should discourage the growth of soft wheat that can be grown in more than three-fourths of the wheat fields of the world, while hard wheat can only be grown in Hungary, Russia, Dakota and Minnesota, the farmers in Dakota sow entirely Red Fife wheat, and its flour has attained a world wide reputation. The soil of Manitoba is better than Dakota and Minnesota and will grow Red Fife wheat better than any country in the world, so I hope you will realize the necessity of encouraging the growth of Red Fife as much as possible and discouraging all other varieties of wheat.

I have had many tests made of the value of flour ground from Red Fife wheat grown in Manitoba, and they have always been satisfactory. I enclose you a few copies of the last test taken in London, Eng., with other prominent brands of flour.

Many farmers who have gone from Ontario to Manitoba, have taken seed wheats of soft varieties with them, which affect many samples of Manitoba wheat and causing so much of it to inspect Northern. The complaint that has been made against Red Fife not ripening as early as any other wheat, I think is altogether a mistake and can be attributed largely to the farmers or cold nights in August, that would have had the same effect on soft wheat.

Yours truly,

W. W. OGILVIE.

MONTREAL, 7th February, 1888.

Prof. W. SAUNDERS,
Experimental Farm, Ottawa.

DEAR SIR,—Your esteemed favour of the 2nd instant to hand, with 3 samples of wheat. The 3 are splendid wheat, being brighter than those previously received, but still have not the gloss of Fife wheat, and would not make so saleable a flour. Sample No. 13 is the best, No. 12 nearly as good; both would inspect Extra No. 1 Hard. No. 14 shows too many soft grains for first sowing and gives indication that it would soon degenerate into soft wheat. Notwithstanding what Mr. Smellie reports, I am inclined to think that the weather between the 8th and 26th April, must not have been good sprouting weather, or the Fife wheat would have ripened as early as the Russian. I am very strong upon this point, after my past experience, and my anxiety to have Red Fife wheat sown for Manitoba, and no others, as I am satisfied it is the best wheat for the country.

Yours truly,

W. W. OGILVIE.

PORT ARTHUR, 24th December, 1887.

Prof. W. SAUNDERS,
Central Experimental Farm, Ottawa.

DEAR SIR,—Yours to hand with samples of wheat grown at different points in the Dominion from seed purporting to have been imported from Russia. I do not express any opinion as to the milling qualities as compared with Red Fife as grown at present in Manitoba, as you say you are to have that from the best millers. Judging from the samples I have from you I should think this Russian wheat is not likely to improve on any light soils, it will run into soft wheat. It is more adapted to heavy clay land, and I think when grown there will be found to produce a very hard berry, grading equal to the best Red Fife.

A comparison of No. 3 with No. 2 shows such extreme points that it is difficult to believe they were both grown from the same seed. I have seen the same thing occur when the points were only seven miles apart but different soils.

If the millers pronounce this Russian wheat equal in milling properties to the Red Fife, and the testimony as to its ripening from 10 to 15 days earlier, undoubted, there will be no question about its being the wheat for Manitoba to grow. The Red Fife was so good in quality for the crop of 1886, and both in quality and yield for 1887, that I doubt very much the advisability of trying anything else until that fails entirely. The Russian, however, if not the Red Fife itself, bears a very strong resemblance to it.

The "Knbanka" and "Saxonka" had better be left in their original fields, being simply "Goose" or "Rice" wheat. Herewith I append Inspection Grades on the different samples.

Yours truly,

FRANK E. GIBB.

INSPECTION OF NINE SAMPLES OF WHEAT RECEIVED FROM WM. SAUNDERS, CENTRAL EXPERIMENTAL FARM, OTTAWA.

7. Ladoga, from Riga, Russia, would grade No. 1 Northern. Resembles much of this year's crop in Manitoba

1. Ladoga, grown at Lethbridge, N.W.T., grade No. 1, frosted, all hard, outside bran blistered, bright kernel, fair milling sample.

2. Ladoga, grown at Edmonton, N.W.T., grade No. 2, Manitoba hard wheat, all hard, bleached.

3. Ladoga, grown at Souris, Man., grade No. 1, spring, over 50 per cent. soft.

4. Ladoga, grown at Brandon Hills, Manitoba, grade No. 2, Manitoba hard wheat, nearly all hard, bleached.

5. Ladoga, grown at Tatamagouche, N.S., grade No. 3 Northern, much bleached.

6. Ladoga, grown at Guysboro', N.S., grade No. 2, Canada hard wheat, bleached.

8. Kubanka, grown in Manitoba, grade No. 1, Goose.

9. Saxonka, grown in Manitoba, no grade, much bleached, thin, and principally "Goose" wheat.

FRANK E. GIBB,
Grain Inspector.

PORT ARTHUR, 24th December, 1887.

A sample of Ladoga, grown at Moosomin, N.W.T., was also sent to Mr. Gibb with the others, which, through an oversight, was not included in the subsequent distribution. This was graded by Mr. Gibb as "No. 1 Manitoba hard wheat, good."

Another sample of Ladoga wheat, which was grown on one of the Indian Reserves from seed sent from the Experimental Farm at Ottawa, of the first importation, was sent by Mr Wm. McGirr, of the Indian Department, Regina, to Mr. S. A. McGaw, of Ogilvie's Royal Mill, Winnipeg, which was submitted for examination by Mr. McGaw to the analyst employed by Messrs. Ogilvie in testing wheats. In a letter

from S. A. McGaw to Mr. Wm. McGirr, dated 4th December, 1887 (which I am permitted to publish) he says: "Our analyst in Montreal reports very favourably of the Russian wheat, and states that it contains a large amount of gluten, and being in most respects nearly if not equal to Red Fife."

The suggestions of the Toronto Board of Trade regarding the importance of determining the proportion of gluten by chemical analyses has been acted on, and a full account of a careful series of analyses will be found in the appended report of the Chemist of the Experimental Farms, Mr. F. T. Shutt. Those of the Boards of Trade of Montreal and Winnipeg have also been carried out, by providing a miller with a sufficient quantity of the wheat to be ground into flour, and having this flour made into bread.

All the samples which have been referred to as submitted for inspection were carefully put up by myself, taken from the same bags, and were all exactly alike, but the several reports of the experts to whom they were sent are of a very contradictory character. The Montreal Board of Trade grade all the samples of Ladoga, excepting one, as hard wheats. The Toronto Board of Trade grade every one of them as soft wheats. The Winnipeg Board of Trade give a definite opinion on three only. One of them, No. 3 (the same lot as was graded soft by the Montreal Board), is pronounced soft; Nos. 7 and 12 are graded hard wheats, worth 5 cents less than No. 1 hard. Mr. W. W. Ogilvie gives an opinion on ten out of the twelve samples submitted to him. Of the original Ladoga as imported (No. 7), he says this "is not a pure hard wheat, having a mixture of soft grains in it." This opinion would probably entitle No. 7 to a place among the lower grades of hard wheat, but of the other nine samples No. 3 is the only one pronounced soft, and it is graded No. 2 Spring. Two of the others are said to be extra No. 1 hard, one extra hard, four No. 1 hard and one No. 2 hard. Mr. F. E. Gibb pronounces the original sample of Ladoga as resembling much of the Manitoba crop of 1887, and grades it as No. 1 Northern; of the other seven samples grown from this grain, which Mr. Gibb reported on, five were returned as hard wheat, and two as soft.

As one of the more striking examples of difference of opinion, the sample grown at Mowbray, Man., may be cited. This the Montreal Board of Trade pronounced to be hard; the Toronto Board of Trade, soft; the Winnipeg Board of Trade as a hard wheat, worth 5 cents a bushel less than No. 1 hard; and Mr. W. W. Ogilvie as extra No. 1 hard. It cannot be said that Mr. Ogilvie is in any sense unduly in favour of Ladoga wheat, for while he practically pronounces eight out of the nine samples on which he gives an opinion as marked improvements on the original, he argues from the one soft sample that this wheat is degenerating, and likely to degenerate to a soft wheat, apparently forgetting that the contrary argument could be sustained with an eightfold force.

A better idea will perhaps be given of the differences of opinion throughout by placing the results in a tabulated form.

No.	—	Weight per Bushel.	Opinion of Montreal Board of Trade.	Opinion of Toronto Board of Trade.	Opinion of Winnipeg Board of Trade.	Opinion of W. W. Ogilvie, Montreal.	Opinion of F. E. Gibb, Port Arthur.
		Lbs.					
7	Ladoga, original importation	61	Hard wheat.	Soft Wheat, No. 2 Spring	Hard wheat, Northern, 5 cts. less than No. 1 hard.	Not a pure hard wheat.	Hard wheat, No. 1 Northern.
1	do grown at Lethbridge, N.W.T.	60¾	Hard wheat.	Soft wheat.		No. 1 hard.	Hard wheat, No. 1 frosted.
2	do do Edmonton, N.W.T.	61½	Hard wheat.	Soft wheat.		No. 1 hard.	No. 2 Manitoba hard.
3	do do Souris, Man.	60¼	Soft wheat.	Soft wheat, No. 2 Spring.	Soft wheat, No. 3 Spring	Soft wheat, No. 1 Spring.	Soft wheat, No 1 Spring.
4	do do Brandon Hills	60	Hard wheat.	Soft wheat, No. 2 Spring.			No. 2 Manitoba hard.
5	do do Tatamagouche, N.S.	60	Hard wheat.	Soft wheat.		No. 2 hard	Hard wheat, No. 3 Northern.
6	do do Guysboro', N.S.	61½	Hard wheat.	Soft wheat.		No. 1 hard.	No. 2 Canada hard
10	do do Wolseley, N.W.T.	63	Hard wheat.	Soft wheat.		Extra hard.	
11	do do Touchwood Hills, N.W.T.	64	Hard wheat.	Soft wheat.		No. 1 hard.	
12	do do Binscarth, Man.	65	Hard wheat.	Soft wheat.		Extra No. 1 hard.	
13	do do Mowbray, Man.	64½	Hard wheat.	Soft wheat.	Hard wheat, 5 cts. less than No. 1 hard	Extra No. 1 hard.	
14	do do St. Mary's, N.B.	64	Hard wheat.	Soft wheat.		Shows too many soft grains.	No. 2 Canada hard
8	Kubanka, grown in Manitoba.		Very inferior grain	Goose wheat	Of little value	15c. per bushel less than Red Fife.	No. 1 Goose.
9	Saxonka do do		Very inferior grain	A poor thin sample No. 3 Spring.	Soft and rejected.	Poor wheat.	No grade.

The only sample that all the authorities agree on as being a soft wheat is No. 4, and this is so unlike the other samples that there is good reason for believing that some accidental foreign mixture has occurred either in the seed sent out or the sample returned.

CHEMICAL ANALYSES.

We shall next consider the chemical analyses which, in the opinion of the Toronto Board of Trade, is the one reliable test for determining the percentage of gluten. In order to have good samples of Red Fife to compare with the Ladoga, the Boards of Trade were asked to send authenticated samples of No. 1 hard, of the best character, and a similar request was made to Mr. W. W. Ogilvie. These solicitations were kindly responded to, and among the six samples of Red Fife referred to in Mr. Shutt's report one was sent from the Toronto Board of Trade, one from the Winnipeg Board of Trade, and one from the mills of Ogilvie & Co., Winnipeg, all of them graded as No. 1 hard. Of the other three, one was from Indian Head, N.W.T., a sample from a bag of Red Fife which had been awarded a first prize at several of the North-West agricultural exhibitions; one was obtained from Whyte's mills, Galetta, Ont., which had been purchased as Manitoba No. 1 hard in 1886; the sixth being a sample of Red Fife grown near Galetta from the last named imported Manitoba wheat.

It is singular that the sample of No. 1 Red Fife from the Toronto Board of Trade shows a fraction less of gluten than any of the other five samples, one of which was grown in Ontario, and that both the specimens from the Winnipeg Board of Trade and the first-prize specimen from Indian Head should yield a fraction less of gluten than the Ontario sample grown at Galetta from Manitoba seed.

In Mr. Shutt's report, appended, the average proportion of albuminoids (a term held as synonymous with gluten) in 11 samples of Ladoga is 14·31, while that from the six samples of Red Fife is 14·00. But if the comparison is restricted to the samples of Ladoga and Red Fife grown in Manitoba and the North-West Territories the proportion would be as follows: Ladoga, 14·57; Red Fife, 13·98—an appreciable difference in favor of the Ladoga variety. No chemical tests have yet been devised for determining the quality of gluten in flour. That which possesses the greatest elasticity is most esteemed in bread-making, and flour in which this quality of gluten predominates is designated "strong;" while that containing gluten, which is more of a ductile or pliable character without much elasticity is not esteemed by bakers, but is sought for by the manufacturers of maccaroni, and some forms of pastry. It would appear that the gluten in wheats having a ricy structure, such as the Kubanka or Goose wheat, the Polonian wheat and others of the same nature, while existing in fair proportion in their composition, lacks that elasticity in its character which is necessary to make "strong" flour. This difference in the quality of the gluten may be recognized by chewing a few grains of these different sorts of wheat, and noting the relative character and volume of the plastic mass which remains in the mouth. The reports of the bakers who have tested the flour of the Ladoga wheat, show that the gluten it contains is not lacking in this desirable elastic or "strong" quality. Full particulars of the analyses of the Ladoga, Red Fife, and other varieties of wheat will be found in Mr. Shutt's report.

TESTS OF THE FLOUR.

On the 16th of November, 1888, sixteen bushels of Ladoga wheat, which had been grown on the Experimental Farm at Indian Head, was taken to the Qu'Appelle Valley Roller Mill at Fort Qu'Appelle, with a similar quantity of Red Fife, of the best quality, which had been grown in an adjoining field. The proportion of bran, shorts and middlings to the flour obtained could not be accurately ascertained, as there was much waste in grinding so small a quantity. The flour of the Ladoga, when compared with the Red Fife, had a slight yellow shade. Bread from both these flours was carefully made under my own supervision, all the ingredients weighed, and it was found that the Ladoga flour absorbed more water and produced

a little over 2 pounds of bread more from each 100 pounds of flour than could be made from the same quantity of Red Fife. This had been anticipated by Mr. Shutt from the the smaller proportion of water found in the grain. The bread from both samples had a yellowish tint, but there was a more decided yellow shade in that made from the Ladoga.

A sack of each sort of flour was sent to two of the leading bakers in Ottawa to be made into bread, and samples from each lot examined, compared and tested, and it was found that the only disadvantage that the Ladoga flour had was in point of colour. With larger quantities available for milling, better results will no doubt be obtained, and by skilful admixture of some of the whiter soft wheats with this strong glutinous variety there is every reason to believe that this yellowish tint can be successfully overcome and a highly satisfactory flour produced.

The following letters were received from the bakers to whom the flour was sent:—

OTTAWA, 27th December, 1888.

Prof. WM. SAUNDERS,
Central Experimental Farm.

Dear Sir,—Having made bread from the two samples of flour sent me, I beg to say that the Red Fife is the weaker flour of the two, but it is a little better in colour than the Ladoga brand.

The Ladoga would, in my opinion, make a good flour if properly dressed, with a per cent. of low grade taken out. It is a strong flour, and would make more bread to the barrel than Red Fife.

Yours respectfully,
S. S. SLINN,
Palace Bakery, Ottawa.

OTTAWA, 18th February, 1889.

Prof. WM. SAUNDERS,
Central Experimental Farm.

Dear Sir,—We have baked at your request two samples of flour, one made of Red Fife wheat and the other called Ladoga. We are of opinion that the Red Fife would command the highest price, as it has the better colour, although neither of the samples are up to the mark in that respect. As to strength, Ladoga has more than the other, but the flour being darker, we consider the Red Fife the flour suited for our trade.

Yours truly,
R. E. & J. C. JAMIESON.

It would be unreasonable to expect that any variety of grain would succeed equally well on all the different soils and in all the varied climates of the Dominion, yet it is interesting to compare the reports of tests of the same wheat grown under so many different conditions. Both rust and smut have been much more common in 1888 than they were in 1887, and the Ladoga seems to have suffered more than some other varieties; yet the total number of unfavourable reports among the 301 returns is but 45, of which 26 were from Ontario, 1 from Quebec, 1 from Nova Scotia, 9 from Manitoba and 8 from the North-West Territories. The best results obtained with the Ladoga wheat have been on soils of medium character, not too rich and heavy, but on mixed sandy and clay loams, associated with more or less gravel. The Ladoga is very vigorous in its growth, and when sown on very rich soil it has rusted in some instances very badly. This, however, has been the case with Red Fife also during 1888; indeed rust has been very general and very injurious. The Ladoga seems to be much more affected with loose smut than the Red Fife is, but in many localities the Red Fife is seriously afflicted with the "bunt" smut, which is much the more objectionable of the two, and from this the Ladoga appears thus far to be free. In Bulletin No. 3, Mr. James Fletcher, Entomologist and Botanist to the

Experimental Farms, gives a very instructive account of the life history of these parasitic growths which every farmer should read. It is believed that both can be subdued, if not entirely got rid of, by soaking the seed for ten or fifteen minutes in strong brine shortly before sowing, draining off, and drying the seed with lime, plaster or ashes. Solution of blue vitriol (Sulpbate of Copper) has also been found useful for this purpose, while immersing the grain in hot water at a temperature of 135° is said to have been entirely successful.

Mr. C. Montgomery, of Hilton, Ontario, uses salt very successfully for preventing smut, but in a different way. In a letter dated 12th December, 1888, he says: "I give you with pleasure my method of treatment for smut. I place my wheat on the barn floor and mix one bushel of salt to five bushels of wheat, mixing thoroughly with a scoop. Then moisten with sufficient water to dissolve the salt, after which add fresh air-slacked lime until no more will adhere to the wheat; put up into a snug pile and let it stand for a couple of hours, after which I put it in bags and allow it to stand one day before sowing. Grain so prepared can only be sown by hand." Mr. Montgomery says that he has used this remedy for many years past.

INDIVIDUAL RESULTS AND OPINIONS.

The following individual opinions are given as examples of the most successful results with the Ladoga wheat in the North-West Territories and Manitoba. Many more of the same character have been received, not only from the North-West but also from other Provinces in the Dominion:

Mr. Wm. Gibson, of Wolseley, N. W. T., a practical Scotch farmer, has the greatest record of success with the Ladoga of any person in the Dominion. From the 3 pounds sent him in the spring of 1887 he harvested 236 pounds, and from the second sowing has a few pounds over 150 bushels of clean seed. Another 3-pound bag was sent him in the spring of 1888 of the second importation from Russia. He says: "I sowed the same quantity of Red Fife, on the same day, 16th April, alongside of the Ladoga. The Ladoga was harvested on the 31st of August, the Red Fife on the 13th of September."

Mr. Wm. Summerton, of Moosomin, N. W. T., who received 3 pounds in 1887 has over 30 bushels this year. He sowed the Ladoga on the same day as the Red Fife, and alongside of it. The Red Fife was frozen, and brought 65 cents only on the Moosomin market, while the Ladoga was graded by the buyers as No. 1 hard, and $1.05 was offered for it for milling purposes. Mr. John Day, of Fleming, N. W. T., received the same quantity in 1887, and has also over 30 bushels this year, of excellent quality.

Mr. G. L. Smellie, of Binscarth, Manitoba, received a 3-pound sample in 1887. In his report he says the Russian (Ladoga) wheat was sown on the 26th of April, while our Red Fife was sown on the 8th of April. The former was cut dead ripe on the 17th of August, the latter from the 23rd August to 3rd September. The sample sent by Mr. Smellie was one of those submitted to the experts for inspection under No. 12.

R. B. Chappell, of Moosomin, who raised 170 pounds from the 3 pounds sent, says: "I sowed the Ladoga on the 28th of April and sowed Red Fife alongside of it on the same day. The Ladoga was cut on the 18th of August, the Red Fife on the 26th of August." T. D. Stewart, of Carman, Manitoba, harvested 90 pounds from the 3 pounds sown in the spring of 1887. He sowed the Ladoga three and a-half weeks later than his earliest sowing of Red Fife, and the Ladoga was cut a week earlier, and was so ripe at that time that nearly one-third of the crop was lost by shelling.

David Craig, of Edmonton, N. W. T., threshed 105 pounds from 3 pounds of seed, found it to be from seven to ten days earlier than Red Fife. Duncan McCuaig, of Portage la Prairie, harvested 100 pounds from the same quantity of seed, and says it is ten days earlier than Red Fife. Hugh Munro, of Calgary, N. W. T., harvested 160 pounds from 3 pounds of seed, and says it was ten days earlier than Red Fife sown in the same field. Geo. D. Long, of Edmonton, harvested 100 pounds from a

like quantity, and says that with him it is more productive than Red Fife, and ten days earlier. Thos. Miller, of Kirkpatrick, N. W. T., had a yield of 141 pounds, and says: "I am favourably impressed with the wheat; it is eight days earlier than Red Fife." Chas. Bowering, of Fleming, N. W. T., had a yield of 93 pounds, and says it is ten days earlier. Rev. L. Gaetz, of Red Deer, N. W. T., had 93 pounds from the 3 pounds sent him, and says it is ten to fourteen days earlier than Red Fife, and is more prolific.

Summary.

The Ladoga wheat has been subjected to a searching criticism, tables of the entire results of its growth have been given, the public have been advised of such defects as have been noted during the progress of the two years' tests, and making the most liberal allowance for these defects, it seems not too much to say that the evidence thus far obtained is sufficient to show: That the Ladoga is a productive and valuable variety of hard wheat, which has thus far ripened over the whole Dominion ten days earlier on the average than the Red Fife. That the better samples obtained are fully as rich in gluten as the best Red Fife, and while the cultivation of the Red Fife should be recommended in every section of the North-West, where it is likely, with early sowing, to escape the autumn frosts, the growth of the Ladoga may be safely encouraged wherever the ripening of the Red Fife is uncertain, without incurring the risk of materially lowering the reputation or the general quality of Canadian hard wheats.

PART II.

REPORT *on the Chemical Composition and Physical Characters of Ladoga, Red Fife and other Varieties of Wheat by Frank T. Shutt, M.A., F.C.S., F.I.C., Chemist, Dominion Experimental Farms.*

Objects of the Investigation.

This series of analyses was undertaken with a view (1) to ascertain the composition, and hence the relative value, from a chemical standpoint, of the different varieties of wheat hereinafter enumerated, and more particularly those of Red Fife and Ladoga; (2) to determine what improvement or deterioration, if any, had taken place in the Ladoga grain by its culture in the various Provinces of Canada; (3) to find out what such alterations in composition, if any, were due to, *i. e.*, what influence, soil, climate and cultivation had exerted upon the grain.

To answer *all* these questions fully and satisfactorily will necessitate, first, the analysis of a larger number of samples and an investigation extending over several years, with a full and accurate knowledge of all the conditions of growth. It is therefore proposed to continue this inquiry in the future as time permits; and as the Experimental Farms are now established throughout the Dominion we shall be enabled to do so with all the reliable information regarding the nature of soil, the extent of cultivation and the climatic changes necessary to the solution of such difficult problems. In most cases where farmers have grown the Ladoga wheat and sent back samples, only incomplete data as to soil, &c., have been furnished, and thus I am not in a position to draw conclusions, which I might otherwise have been able to draw.

While, therefore, at the present juncture and with such limited knowledge, it is impossible to offer a satisfactory solution to the third question, it will be my object in the present bulletin to indicate such conclusions as can be safely drawn from the analytical data for the elucidation of the first and second objects of this investigation.

From the results of the analyses satisfactory answers can, I believe, be given as to the relative values of the wheats, and also as to the effect on the composition of the Ladoga grain when grown in Canada.

Varieties Analysed.

Twenty-eight different samples of wheat have been analysed, including twelve of Ladoga, six of Red Fife, three of Saxonka, two of Kubanka, one of Onega, one of Red Fern, one of Clawson, one of Wellman's Fife and one of Blue Stem.

The specimens of Ladoga wheat are from the following localities: One from Riga, Russia, imported by the Central Experimental Farm in 1887, from which seed all the other specimens of this grain have been grown; four from the North-West Territories; four from Manitoba; two from Nova Scotia, and one from New Brunswick.

Of the Red Fife, one sample was grown in the North-West Territories; four, presumably, in Manitoba (two of these being graded as No. 1 Hard by the Boards of Trade at Toronto and Winnipeg, respectively, and a third as "No. 1 Hard" by the Ogilvie Milling Company, Winnipeg,) and one was grown in Ontario.

The Saxonka specimens include one imported direct from Russia, and one grown from this seed in the North-West Territories. The third was furnished by J. G. V. Field Johnson, Esq., of Manitoba.

The two samples of Kubanka comprise one grown by J. G. V. Field Johnson, Esq., in Manitoba, and one grown at the Central Experimental Farm, Ottawa.

The Onega grain was imported from Russia in the spring of 1888.

The Red Fern variety was furnished by the Citizens' Milling Company, Toronto, and was raised within five miles of that city.

The Clawson, the only winter wheat of the series, was obtained from Galetta, Ontario.

The Wellman's Fife and Blue Stem were kindly sent by Prof. Porter, of St. Anthony's Park, Minn., and were grown in that State. Prof. Porter reports these as the two best varieties in that district.

Detailed Analyses of the Wheats.

The following table shows in detail, and in percentage quantities, the component parts of the grains analysed. The results in all the columns, save those headed Carbo-hydrates and Albuminoids, have been found by direct determination. The amount of albuminoids is obtained by multiplying the quantity of nitrogen by the factor 6·25, and that of carbo-hydrates (principally starch) by subtracting the sum of the other constituents from 100. Besides indicating the chemical composition, I have thought it well to insert in tabular form certain other data of a physical character which must be taken into consideration, together with the chemical results, when endeavouring to find the solution of the problems for which this investigation was undertaken. These data consist of the weight of 100 grains in grams, the colour, hardness or consistency, weight per bushel, together with some additional explanatory remarks upon the nature of soil, &c.

The numbers under which the wheats are designated in the table are not the same as those which were used with them when they were sent to the experts for inspection.

In the following table, No. 1 is identical with No. 7 of Part I.

2	"	1
3	"	2
4	"	10
5	"	11
6	"	3
7	"	4
8	"	12
9	"	13
10	"	5
11	"	6
12	"	14
21	"	9
23	"	8

TABLE I.

Detailed Analyses of the Wheats.

Number.	Name of Variety.	Locality where Grown.	Spring or Winter.	Colour.	Consistency.	Year of Growth.	Weight of 100 Grains in Grams.	Weight per Bushel in lbs.	Water.	Ash.	Fat.	Fibre.	Carbo-hydrates.	Albuminoids. N x 6·25.	Nitrogen.	Remarks.
1	Ladoga.....	Riga, Russia	Spring.	Red	Hard.....	1886	3·378	60½	8·76	2·00	1·90	2·54	72·05	12·75	2·04	Original importation, O.E.F., 1887.
2	"	Lethbridge, N.W.T.....	" ...	"	"	1887	3·897	60¾	8·12	2·00	2·20	2·56	69·94	15·18	2·43	Dark loam; ripened 122 d'ys.
3	"	Edmonton "	" ...	"	"	1887	3·217	61½	8·20	1·70	1·89	2·39	73·96	11·87	1·90	Sandy loam, laid by storm in August; frozen after cutting; 121 days.
4	"	Wolseley "	" ...	"	"	1887	3·855	63	7·00	1·65	2·00	2·12	71·30	15·93	2·55	
5	"	Touchwood Hills, N.W.T.	" ...	"	"	1887	3 450	84	7·93	1·40	2 07	1·71	69·52	17·37	2·78	Light and heavy loam; 104 days.
6	"	Souris, Man.	" ...	"	P. Soft..	1887	3·199	60¾	9·00	1·70	1 91	2·80	72·47	12·12	1·94	Dry, sandy loam; 105 days.
7	"	Brandon Hills, Man..	" ...	"	Hard	1887	3·240	60	8·38	1·70	1 89	2·38	73·40	12·25	1·96	99 days.
8	"	Binscarth, Man.....	" ...	" ...	"	1887	3·450	65	7·88	1·53	2·07	1·60	70·11	16 81	2·69	113 days.
9	"	Mowbray, Man	" ...	"	"	1887	3·470	64¾	7·50	2·06	1·98	1·71	71·75	15 00	2·40	87 days.
10	"	Tatamagonche, N.S.....	" ...	"	"	1 87	3·167	65	8·74	1·84	1·96	1·63	70 08	14·75	2·36	Gravelly loam.
11	"	Guysboro', N.S.	" ...	"	"	1887	3·412	61½	7·84	1·00	1·83	2·55	73·03	13·75	1·20	112 days; wet clay.
12	"	St. Mary's N.B.....	" ...	"	"	1887	3·265	64	7·78	2·13	2 10	2·30	73·01	12·68	2·03	99 days; sandy and argillaceous soil.
13	Red Fife.	Manitoba.....	" ...	"	"	1886(?)	2·900	.....	8·84	1·53	2·15	2·35	70 38	14·75	2·36	Obtained from White's Mills, Galetta, Ont.
14	"	Ontario.....	" ...	"	"	1887	2·355	...	10·06	1·99	1·91	2·81	69·51	13·87	2·22	Grown from No. 13 in Ontario.
15	"	Manitoba.....	" ...	"	"	1887	3·105	.....	9·22	1·58	1·90	2·12	70·87	14·31	2·29	Graded No. 1 hard by Ogilvie & Co., Winnipeg.
16	"	Indian Head, N.W.T.....	" ...	"	"	1887	3·194	.....	9·50	1·37	2·03	1·76	71·67	13·68	2·19	Grown near Indian Head.
17	"	Manitoba (?)	" ...	"	"	1887	3·075	73¼	8·76	1·61	2·12	2 02	71·99	13·50	2·16	Graded No. 1 hard by Toronto Board of Trade.
18	"	"	" ...	"	"	1887	2·956	.....	9·27	1·84	2·06	1·68	71·67	13 68	2 19	Graded No. 1 hard by Winnipeg Board of Trade.
19	Saxonka	Russia.....	" ...	L. Red ..	"	1886	2·515	.....	9·99	1·95	1·87	1·60	71·28	13·31	2·13	Original importation, O.E.F., 1887.
20	"	Broadview, N.W.T.....	" ...	" ...	"	1887	2·750	.....	8 60	1·56	1·89	2·20	71·19	14·56	2·33	Grown at Crooked Lake Reserve from No. 19.
21	"	Manitoba.....	" ...	" ...	"	1887	2·097	.....	8·00	1·72	2·01	2 87	71·53	13·87	2.22	Obtained from Field Johnson, Esq.

22	Kubanka.....	Ottawa, Ont.....	Spring .	Red	V. Hard	1887	2·755	.....	8·73	1·90	1·93	2·16	71·80	13·43	2·15	From seed grown in Russia.
23	"	Manitoba	" ...	"	" ...	1887	3·612	.....	8·35	1·60	2·08	2·62	71·29	14 06	2·26	Obtained from Field Johnson, Esq.
24	Onega	Russia..	" ...	"	.....	1887	1·750	.....	9·23	2·00	2·32	1·54	71·48	13·43	2·15	Original importation, C.E F., 1888
25	Red Fern.....	Toronto, Ont.....	" ...	D. Red..	M. Hard.	1887	2·275	....	9 36	2 07	2·20	1·94	70 18	14·25	2·28	Obtained from Citizens' Milling Co., Toronto.
26	Clawson..	Ontario.....	Winter..	Y. White	Soft.....	1887	3·534	...	9·45	1·84	1·69	2·98	72·44	11 62	1·86	Obtained from White's Mills, Galletta, Ont.
27	Wellman's Fife	Minnesota	Spring ..	Red	Hard	1887	3 481	.....	10·19	1·73	2·09	2·41	69 90	13·68	2·19	Obtained from Prof. Porter, St. Anthony's Park, Minn.
28	Blue Stem.....	"	" ...	"	M. Hard	1887	2·951	..	8·73	1·90	2·13	2·62	72·87	11 75	1·88	Obtained from Prof. Porter, St. Anthony's Park, Minn

Albuminoids (*Gluten*).

The most important constituent of wheat is gluten, the amount of which in the different grains is found in the column headed albuminoids. I therefore propose to discuss, first, the relative qualities of the wheats from the quantity of this constituent they possess.

For practical purposes, the terms gluten and albuminoids may be considered synonymous. Scientifically speaking, however, gluten is regarded as a mixture of several albuminoids which behave differently to various solvents. Chemical analysis, however, has demonstrated that, though differing in physical properties these albuminoids are almost if not entirely identical in composition, and therefore may be viewed as one, under the generic term albuminoids. As already stated, the quantity of such is ascertained by the multiplication of the amount of the contained nitrogen (directly determined) by 6·25.

Government inspectors and milling experts grade wheats principally by the consistency or relative hardness of the grain, a character which depends almost directly upon the percentage of gluten—it being true, as a rule, that the greater the percentage of gluten the harder the wheat.

To compare these wheats among themselves from this standpoint I have prepared the following table of averages. It shows the average percentage quantity of gluten in the different wheats, and also the percentage of this constituent in the same wheat when grown in the various Provinces, which latter is intended to bring out the effect of locality in increasing or diminishing the amount of gluten. Another column gives the weight of 100 average grains in grams, and the relation which this has to the quantity of gluten, will be discussed in a succeeding paragraph.

TABLE II.

AVERAGE Composition of the Wheats with respect to Gluten—Weight of 100 grains in grams.

Name of Wheat.	Locality where Grown.	No. of Analyses	Nitrogen.	Albuminoids, N x 6·25.	Weight of 100 Grains in Grams.
Ladoga	Russia	1	2·04	12·75	3·378
"	North-West Territories	2	2·415	15·08	3·605
"	Manitoba	4	2·25	14·06	3·335
"	Nova Scotia	2	2·28	14·25	3·289
"	New Brunswick	1	2 03	12·68	3·265
Red Fife	North-West Territories	1	2·19	13 68	3·194
"	Manitoba	4	2·25	14·06	3·031
"	Ontario	1	2·22	13 87	2·355
Saxonka	Russia	1	2·13	13·31	2·515
"	North-West Territories	1	2·33	14·56	2·750
"	Manitoba	1	2·22	13·87	2·097
Kubanka	"	1	2·26	14·12	3·612
"	Ontario	1	2·15	13·43	2·755
Onega	Russia	1	2·15	13 43	1·750
Red Fern	Ontario	1	2·28	14·25	2·275
Clawson	"	1	1·86	11·62	3·534
Wellman's Fife	Minnesota	1	2·19	13·68	3·481
Blue Stem	"	1	1·88	11·75	2·954
Ladoga, general average	Canada	11	2·29	14·31	3·420
Red Fife "	"	6	2·24	14 00	2·931
Saxonka "	Russia and Canada	3	2·23	13·91	2·454
Kubanka "	Canada	2	2·20	13·77	3·183

The average for the eleven Canadian grown Ladoga specimens is: Albuminoids, 14·31 per cent., the same for the six Red Fife being 14·00 per cent. These figures clearly demonstrate that the Canadian grown Ladoga fully equals the Red Fife variety, as far as gluten is concerned—in fact, slightly surpasses it. Although the samples of Red Fife do not number as many as those of the Ladoga, yet those examined are believed to be typical examples of the best grain—three of them being graded as "No. 1 Hard," by experts. We may therefore state that chemical analysis shows the Ladoga and Red Fife wheats to be almost equal and identical in value.

The Saxonka and Kubanka are both Russian varieties, though four out of the five samples analysed were grown in Canada. Like most of the Russian wheats they show a very fair proportion of albuminoids. As the number of specimens of these grains examined is much smaller than of those of the Ladoga and Red Fife, the averages of the former cannot be viewed in exactly the same light as those of the latter. A further mention of the comparative value of these wheats will be made, however, when speaking of the relation existing between the gluten and the weight of the grain.

Of the remaining varieties, but one sample of each has been analysed. They are all, however, believed to be typical specimens.

The Onega, recently imported from Russia, would appear to be a grain very similar in composition to the Saxonka obtained from that country.

The Red Fern sample was sent by the Citizen's Milling Company, of Toronto, and was spoken of very highly as worthy of growth and encouragement. Judging alone from the percentage of gluten, it appears to be a very desirable wheat, and one that compares favourably, from a chemical standpoint, with Ladoga and Red Fife.

The Clawson is the only winter variety in the series. It is known as a soft wheat, and was analysed in order to show a comparison between hard and soft wheat in the percentage of albuminoids. By its low percentage of nitrogen it takes a rank much below that of any of the varieties hitherto discussed.

Wellman's Fife and Blue Stem are two wheats furnished through the courtesy of Professor Porter, Director of the Minnesota Experimental Station, St. Anthony's Park, Minnesota. They are said by him to be typical samples of the best varieties grown there. Having analysed but one specimen of each it would be unwise to pronounce judgment upon them in emphatic terms, or to draw a close comparison between them and the Ladoga and Red Fife. Suffice it to say, therefore, that the Wellman's Fife equals in composition several of the Red Fife specimens, and that in other respects it bears a strong resemblance to that grain. The Blue Stem, if we may judge from a single analysis, is a much less valuable sort.

Effect of environment upon the percentage of Albuminoids.

The term environment is intended to embrace all the varying conditions of climate, soil and cultivation. Professor Clifford Richardson, of the Department of Agriculture, Washington, has shown that wheat is the most susceptible of all grains to the influences of environment. After an investigation extending over several years, he says: "The quality of the grain produced in any locality is dependent on several conditions, namely, climate, soil and cultivation. Each of these is made up of several elements." Having made analyses of grain from all parts of the United States he has been able, from the results of the same, to map out that country into divisions—each division having in its own peculiar effect upon the composition and physical characters of the grain. The influences which modify the wheat in each of these divisions are discussed, and satisfactory explanations offered to account for such modifications.

Following up this line of enquiry, let us see what the effect has been upon the Ladoga wheat by growing it in the various Provinces of Canada. An inspection of Table 1 shows us that in seven instances out of eleven there has been a well marked increase in the percentage of albuminoids; one specimen remains practically the same, and three have receded from the amount contained in the imported sample, the probable cause of which will be discussed later on. Taking all the Canadian-grown Ladoga specimens, we obtain an average of 14·31 per cent. albuminoids, as against

12·75 in the imported seed—indicating a well marked increase. Examining the effect produced in the different Provinces we perceive that of the four specimens grown in the North-West Territories only one (No. 3) falls below the imported seed in the proportion of albuminoids. This falling off is, I think, satisfactorily explained by the fact that the wheat was laid by a storm during its growth in August Prof. Richardson has shown that the composition of a wheat may be greatly modified and its albuminoids diminished by such an interruption in its development. Notwithstanding this sample (No. 3) the average for albuminoids of those grown in the North-West Territories is larger than that of any other Province (*vide* Table II.) Nos. 2, 4 and 5 all show high percentages of albuminoids, especially No. 5, which was grown on Poor Man's Reserve, Touchwood Hills, N.W.T. This sample contains the largest amount of gluten of any of the series.

The average for the Manitoba samples stands about midway between that of the North-West Territories and the quantity possessed by the Russian seed—though two of the samples fall below the latter. Unfortunately no data have been received respecting the conditions of growth of these two samples (Nos. 6 and 7), and consequently it is impossible to advance reasons why the albuminoids should have decreased to such an extent in them. Leaving these two exceptionally low samples out, the Manitoba grain stands equal to that of the North-West Territories.

The albuminoids of the Nova Scotia samples also show an increase over the quantity possessed by the original importation, and are a little higher than the average of the four Manitoba specimens. The conditions of growth during last season in that Province, or, at all events, in the districts where these were raised were evidently favourable to an improved development of the Ladoga grain.

The sample grown in New Brunswick is practically identical in its percentage of albuminoids with that of the imported seed.

The effect of environment on the Red Fife cannot be as well studied as in the case of the Ladoga, as we have no imported seed to compare it with. The cases of Nos. 13 and 14 are, however, of particular interest in this connection. No. 13 is a sample from Manitoba, and No. 14 is seed grown from it in Ontario. In the course of one year's growth it is seen that in this instance the albuminoids have diminished when grown in Ontario. Whether this would still further continue by successive croppings in this Province remains yet to be proved. It indicates, however, that in the North-West the conditions are more favourable to the perfecting of this grain, and that like all wheats it is susceptible to change of conditions. As might be expected, the samples of Red Fife show smaller fluctuations in their albuminoids than do those of the Ladoga, having had many years in which to adapt itself to its environment, and the average of 14·00 per cent. for albuminoids no doubt represents fairly its quality.

The Saxonka also shows improvement when grown in the North-West. No. 20, grown at Crooked Lake Reserve, Broadview, N.W.T., is the seed of No. 19, imported from Russia.

The same remarks, though in a modified manner, apply to the Kubanka. Though Nos. 22 and 23 bear no relation to one another, yet the sample grown in Manitoba possesses a larger proportion of albuminoids than that raised in Ontario. We have thus seen that in every case examined a decided improvement has occurred when the grain is grown in Manitoba and the North-West Territories, and particularly in the latter. Granting that the cultivation in these Provinces is about the same as in the older one—Ontario—and in Russia, we have to look for the explanation of such an increased absorption of nitrogen in either the peculiarities of the climate or the composition of the soil. As yet sufficient data are not to hand to justify one in drawing conclusions as to which of these causes affect the wheat most, though undoubtedly both contribute towards that end. The prairie soil of the North-West has long been noted for its exceptional fertility and its almost inexhaustible store of available plant food. But this of itself is not sufficient to account for the uniform difference observable between the wheats of Ontario and the North-West, and it is quite probable that Prof. Richardson is correct in his deduction when he says of the United States

grain, that a high ripening temperature together with a short period of growth produces a grain with a relatively higher percentage of albuminoids than a long period of growth and moist climate—which latter conduce to the development of a plumper grain with a greater abundance of starch.

Relations between the weight of one hundred average grains and Albuminoids.

The weight of a grain of wheat depends on its size and its specific gravity, or density. Thus, it is easy to imagine that we might have a small grain of a close, hard texture that would equal, or perhaps surpass, in weight a much larger grain of a less density. The main difference between a hard and a soft wheat is that the former is richer in albuminoids while the latter contains more starch. This larger percentage of starch would lower the specific gravity of the grain,* and we should expect to find, bulk for bulk, the soft wheat the lighter grain. Let us go one step further. From what has already been said it is apparent that if we were comparing a hard and a soft wheat, both having grains of an equal size, the weight of 100 grains of the former would exceed that of 100 grains of the latter; but if, as is often the case, the soft wheat possessed the larger grain, then it might happen that the excess of starch made up for the difference of albuminoids, and the softer wheat per grain prove heavier.

From the foregoing we should predict that a ratio would be found to exist, when comparing different samples of the same wheat among themselves, between the weight of the grain (or 100 grains) and the albuminoids, and that the greater the weight the larger the percentage of albuminoids and *vice versa*. That this law—if so it might be called—would not hold good when comparing wheats of different varieties is obvious from the fact that the normal size and composition of all wheats are not alike. In discussing the relative values of any two or more kinds, even if they be all hard wheats, cognizance must be taken of this fact. One more point has to be noticed in this connection. Suppose that two wheats, the one small and the other large in grain, are identical in composition, the larger wheat would be the more valuable, because measure for measure it would yield more flour and less bran than the smaller grain.

Having made this preliminary explanation, let us first see if any ratio exists between the weight of the average grain and the percentage of albuminoids in the Ladoga wheat. An inspection of Table I shows that there is a well-marked tendency for the albuminoids to increase with the weight of the grain. Thus Nos. 2, 4, 5, 8 and 9 contain a percentage of albuminoids over 15·00 per cent. and the weight of 100 of their average grains is equal to or exceeds 3·450 grams; while the remaining six have less albuminoids than 15·00 per cent. and the weight of 100 of their grains falls below in every case 3·450 grams. The original seed, which is not included in the above comparison, also shows this rule to be true.

Comparing the Red Fife samples among themselves, we notice, first, that there is more uniformity both in the weight of the grain and the percentage of albuminoids, and the differences being but small it is not a matter of surprise that this principle should not be so strikingly exhibited among them. The greatest difference between the two extremes in the weights of 100 of their average grains is but ·4 of a gram, while in the Ladoga the same difference is over ·8 of a gram. It is more than probable that if as many samples of Red Fife had been examined as of the Ladoga, this relation of weight of grain to gluten would have been more apparent.

In the case of the Saxonka and Kubanka, both recently imported grains, we see this ratio well exemplified, though with an exception in the Saxonka.

The four averages at the foot of Table II are very instructive. The Ladoga ranks first, both as to albuminoids and the weight of the grain, the Red Fife taking a second place, for the reason that it is slightly lower in its albuminoids and somewhat less in the relative weight of the grain. The Kubanka, of which unfortunately

*This has been experimentally proved. Thus, the specific gravity of No. 2 is 1·333, while that of No. 26 is 1·269.

we have only two examples to average from, is slightly lower in its albuminoids; but one of the samples being an exceptionally fine one as to size, the weight of its average grain is a trifle higher than that of the Red Fife. The Saxonka presents the smallest weight for 100 of its average grains, while its albuminoids are almost identical with the Red Fife. This may be readily explained, that like the other three of this series it is a hard wheat, but has a very small grain. The albuminoids in a wheat grain exist in a greater percentage in the outer coats. While, therefore, measure for measure, or weight for weight, the smaller grain yields more bran and less flour than the larger, the percentage of albuminoids in the *whole* grain may be equal in both cases. And further, where a variety of wheat has a very thick skin, such as the Kubanka (which produces less flour and more bran from a given weight than most other sorts), the percentage of albuminoids which would be found in the flour may be materially less than that shown to be contained in the whole grain.

Water.

Taking an average of the water contained in the twelve Ladoga samples we obtain the figure 8·09; the six samples of Red Fife in like manner give 9·27.

In Bulletin No. 4, Department of Agriculture, Washington, Prof. C. Richardson has shown a special feature of spring wheats to be their *dryness*. Thus, on page 57 of the above bulletin he gives the average water contained by eight Eastern States flours as 12·49 per cent., while the same for Minnesota and Dakota flours is 8·96 per cent. From these figures he rightly deduces that "other things being equal, a barrel of Western flour would make more bread than a barrel of Eastern." This is certainly an important factor in the consideration of the value of flours.

Arguing from the same premises, we conclude that a given weight of the Ladoga flour will make more bread than the same weight of Red Fife. It remains to be seen by an actual test of the bread-making powers of these two wheats whether this conclusion is borne out. The difference, however, between these two cannot be so great as between fall and spring flours, as the percentages of water more closely approximate each other in Ladoga and Red Fife than in the case of wheats known as fall and spring varieties.

Direct Estimation of Gluten in the Flour of Red Fife and Lodoga Wheats.

This operation consists in washing away the starch, the cohesive residue being dried in a water-oven until thoroughly dry, and weighed. This crude gluten consists of several closely allied albuminoids, chiefly gluten fibrin, gliadin and mucedin, besides small quantities of fat and mineral matter.

It has been shown by M. Bertrand (Comp. rend. xcvii, 496) that the same flour will yield different proportions of this gluten according to the method of operation and amount of washing. I shall therefore outline the process which I have used.

Ten grams of the flour were weighed out and kneaded into a dough with 5 cubic centimetres of water. This dough was then washed with successive portions of 50 cubic centimetres of water until the wash-water was free from starch. The crude gluten so obtained was spread out on a watch glass and dried in the water-oven until the weight was constant. To get figures as nearly correct as possible, four determinations of the gluten of each flour were made, and the mean of the resultant figures taken. They are as follows:

	Dry Gluten.
Ladoga	15·26 per cent.
Red Fife	15·35 "

From the nature of the operation, this direct determination of gluten must not be considered as accurate an estimation as that of the "albuminoids" obtained by multiplying the percentage of nitrogen by 6·25. For, as already stated, the proportion of gluten thus found varies according to the mode and time of procedure. Nevertheless, it forms confirmatory evidence as to the similarity in composition of these wheats, and together with the analytical data before given, bears out what I have said when discussing the relative value of Red Fife and Ladoga wheats in re-

spect to the amount of albuminoids or gluten they possess, as determined by chemical analysis.

The flour used for this direct determination of gluten was not in either case made from wheat which had been analysed. The Ladoga flour is from grain grown on the Experimental Farm, at Indian Head, during the summer of 1888. The flour of the Red Fife was furnished by grain grown on an adjoining field, yielding a crop of 40 bushels to the acre, the wheat being of excellent quality, and graded "No. 1."

Ash.

The mineral constituents of the wheats are denoted under the term ash. Time did not allow of the detailed analysis of such; but as Prof. Richardson has shown that among the chief constituents, viz., phosphoric acid, potash and magnesia, there is but little variation for different wheats, this is not a matter of vital importance.

The average of the ash of the four principal varieties analysed is here tabulated:—

AVERAGES OF ASH.

Name.	Number of Analyses.	Per Cent. of Ash.
Ladoga	12	1·81
Red Fife	6	1·62
Saxonka	3	1·74
Kubanka	2	1·75

Whether the Red Fife, when it was first introduced into the North-West, contained a larger percentage of ash cannot, of course, be said. As they stand to-day, it would appear that the Russian varieties, and particularly the Ladoga, have the property of assimilating from the soil larger quantities of mineral food than the Red Fife. This may be an inherent property in the wheats, or due, in this case, to more favourable environment than they formerly enjoyed. The original Ladoga seed, however, contains 2·00 per cent. ash, which would go to show that the grain, as grown in Russia, has a higher percentage of ash than when grown in the North-West. The same also appears in the case of the Saxonka. If, then, the Russian wheats take less mineral matter from the soil when grown in the North-West than when grown in Russia, we have to look for an explanation in either the composition of the soil or in the climate which regulates, to such a great extent, the growth of the wheat plant. This interesting feature deserves further investigation.

Form, or Appearance, and Relative Hardness of the Wheats.

The Ladoga, is a red wheat, plump, and semi-translucent. The grains, on an average, are slightly longer than those of the Red Fife, and none of the better samples possess those opaque spots which betoken the presence of an increased development of starch. The figures show that the individual grain weighs heavier than that of the Red Fife. The Red Fife is also a red wheat, but even the best samples are not free from those spots of opacity just mentioned. In general characteristics these two wheats bear a very strong resemblance to one another. The Kubanka is yellower in colour than either of the preceding, and is certainly the hardest of the series. Its grain is long, and has the semi-translucency more marked than that of either Ladoga or Red Fife. Saxonka, as already stated, is a very small wheat, red in colour, and not very "bright" in appearance. The Red Fern is also a small wheat, of a dark red colour, and is not quite as hard as either Red Fife or Ladoga. Clawson is a yellowish white variety, and very soft. Its grains are of a very fair size, and plump. The Onega is small in grain, and dark red of colour. Wellman's Fife and Blue Stem are

both red wheats, the former the larger of the two. Neither is free from opaque spots, the Blue Stem predominating in this respect.

Comparison of Ladoga and Red Fife with some American Wheats, as Analysed by Professor C. Richardson.

In Bulletins Nos. 1, 4 and 9 of the Department of Agriculture, Washington, D.C., Professor Richardson gives the results of a large number of analyses which have been made of wheats grown in many States of the Union. The series extends over several years, and both the analyses and the deductions drawn from them prove the exhaustive manner in which the whole question of the physical properties and chemical composition of wheat, as grown in the United States, has been treated by the author.

In concluding this bulletin, therefore, I think it will be of interest to compare some of these results with those of the present investigation.

The following are abstracted from the table on page 30, Bulletin No. 4, Division of Chemistry, Department of Agriculture, Washington, 1883–84.

Locality.	Number of Analyses.	Weight of 100 Grains	Albuminoids, N x 6·25.	Ash.
United States and British America	407	3·644	12·15	1·92
Atlantic and Gulf States	117	3·489	11·35	1·77
Middle States	91	3·537	12·10	1·85
Western States	177	3·763	12·74	2·06
Pacific States	20	4·091	9·73	1·87
Canada	6	3·325	10·87	1·56
Minnesota	13	3·245	13·19	1·77
Dakota	12	3·149	14·95	1·96
Manitoba	2	3·288	14·53	1·63

The following are from Table II of this Bulletin, and inserted for comparison with the above:—

Locality.	Number of Analyses.	Weight of 100 Grains	Albuminoids, N x 6·25.	Ash.
Canada Ladoga	11	3·420	14·31	1·81
" Red Fife	6	2·931	14·00	1·62

By reference to the table on page 20, Bulletin 1, we see of the six varieties of Canadian wheat analysed five were soft winter wheats, the remaining being Imperial Fife. I have already pointed out that the soft wheats contain very much less gluten than the hard, and thus we see how it comes about that the average of 10·87 per cent. albuminoids is here given for Canadian wheat.

If the quantity of soft wheat raised in Canada in 1883 was in excess of hard grain, and this average fairly represented Canadian wheat at that time, it certainly does not do so now; for of late years the growth of Red Fife has greatly increased in Manitoba and the North-West Territories.

The two samples of Manitoba wheat analysed by Prof. Richardson give an average in albuminoids slightly in excess of our results for Red Fife. Taking the Minnesota and the Dakota samples together, we obtain an average of 14·07 per cent. albuminoids—practically identical with our determinations for Red Fife. The grain

grown in Minnesota and Dakota is the richest in gluten of that raised in the United States.

Conclusions.

1. That as far as gluten is concerned (as determined by chemical analysis) the Red Fife and the Ladoga are almost equal in value, with a small balance in favour of the latter wheat.

2. That a very well marked improvement has taken place in the Ladoga wheat by its growth in Canada, and particularly in the North-West, and that the same appears to be true of other Russian varieties.

3. That there appears to be a direct relation between the percentage of albuminoids and the weight of the grain, viz., the heavier the individual grain the greater the proportion of albuminoids.

4. That with respect to size, weight and hardness of the grain the Ladoga compares very favourably with the Red Fife, and judging from the samples analysed, ranks above this grain in these features.

5. That the Manitoba hard wheats (Red Fife and Ladoga) most certainly equal in value the best grown in the States of Minnesota and Dakota, and this deduction is made both from my own and Prof. Richardson's results.

6. That from a mechanical estimation of gluten in the Ladoga and Red Fife flours, the conclusion may be drawn that in the possession of this valuable constituent these flours are almost equal.

INDEX.

INDEX.

INDEX.

INDEX.