APPENDIX TO THE REPORT OF THE MINISTER OF AGRICULTURE.

EXPERIMENTAL FARMS.

REPORTS

OF THE

DIRECTOR - - -	PROFESSOR SAUNDERS
ENTOMOLOGIST AND BOTANIST -	MR. FLETCHER
CHEMIST - - - - -	MR. SHUTT
HORTICULTURIST - -	MR. HILBORN

FOR

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APPENDIX

TO THE

REPORT OF THE MINISTER OF AGRICULTURE

ON

EXPERIMENTAL FARMS.

OTTAWA, 31st December, 1887.

SIR,—I have the honour to submit for your approval the following report of the progress made in regard to the establishment of Experimental Farms inaugurated by you last year, with an outline of the work accomplished on the Central Experimental Farm during the current year. Appended you will also find reports from the Chemist, Mr. Frank T. Shutt, from the Entomologist and Botanist, Mr. James Fletcher, and from the Horticulturist, Mr. W. W. Hilborn. In all of these I trust you will find much information useful to the public and specially useful to the farmers and fruit-growers of the Dominion of Canada.

I have the honour to be,
Your obedient servant,

WM. SAUNDERS.

To the Honourable
Minister of Agriculture.

CENTRAL EXPERIMENTAL FARM.

The land purchased for this important central station comprises in all 466 acres. It is very conveniently situated near the boundary line between the Provinces of Ontario and Quebec, in the Township of Nepean, Carleton County, less than three miles from the Parliament Buildings, at Ottawa, and can be reached by good roads in several directions, also by water and by rail. The land lies high, being from forty to eighty feet above the adjacent rivers, and is so placed that part of it drains to the Rideau River and a part to the Ottawa River. The north front of the farm occupies a commanding position, overlooking the city of Ottawa, the highest point of land being thirty-two feet higher than the main entrance to the Government buildings. The land has that desirable variety of soil which will make it very suitable for the purposes of an experimental farm, including within its area every grade from heavy clay to light sandy loam, much of the larger part, however, is either a dark sandy loam of good quality, or a friable clay loam.

On taking possession of this farm, which comprises a number of small holdings, the dividing fences were found to be well packed with surface stone collected from the fields; there were also many heaps at different points and large boulders scattered over the surface. While this farm is much less stoney than most of the land in the immediate neighbourhood of Ottawa, nevertheless much labour and expense was entailed in clearing the fields of surface stone. These stones have been got together in piles, a part of them has already been used in improving the roads on the farm, and the remainder will all be useful for a like purpose. In every field there were also many stumps, chiefly pine, either single or in groups, while at the rear end of the farm there were about 140 acres on which the pine stumps were very numerous and the greater part of this area was also covered with a second growth of poplar and birch. With the aid of dynamite which has been freely used, all these stumps—some four or five thousand in number—have been entirely removed, the second growth trees rooted up and burnt, and the whole of this heretofore waste land brought under the plough and it is now ready for crop.

Virgin Soil for Experimental Purposes.

As a result of this clearing the Central Experimental Farm will have the great advantage of a large quantity of virgin soil, on which experiments can be conducted to test the relative value of fertilizers on different sorts of crops, which will permit of important conclusions being reached, comparatively free from the errors which are necessarily associated, to a greater or less extent, with all lands on which fertilizers have previously been used, or with soils more or less exhausted. This feature will add very much to the value and usefulness of this most important section of the work in experimental farming, for no knowledge is more eagerly sought or more highly appreciated by intelligent farmers than accurate information regarding the effect of different fertilizers on crops. This vantage ground will be at once taken up, and a series of experiments are being planned to be begun next spring, including tests with barnyard manure in different stages of decomposition, mineral phosphates, both raw and manufactured, animal phosphates, wood ashes, nitrate of soda and various mixtures of fertilizing salts. These will be associated with similar plots on which the same crops will be grown without manure for the purposes of comparison. By continuing these experiments with the same crops on the same land for a number of years, the possibilities of error in the conclusions which may be reached regarding the usefulness of certain fertilizers as special food for particular crops will be reduced to a minimum.

Within this newly cleared tract there are a number of acres of peaty soil, representative of a very large area in both Quebec and Ontario, on which experiments with some varieties of grasses for meadow and permanent pasture can be carried on with great advantage.

Draining.

To bring the land referred to, as well as some other parts of the farm, into good condition, a thorough system of drainage was early devised, and before the close of the season 6 miles and 46 yards of tile drains had been laid, also 489 yards of box and open drains, including all the larger main drains, which will be required to complete the entire system of drainage. Some unlooked for expense has attended this work, from the fact that in many places ledges of rock were met with from two to four feet below the surface, which necessitated much blasting. The work, however, has been carefully and thoroughly done, and the land thus put in order will give increased returns, and will also aid in demonstrating the value of under drainage.

Grading and Fencing.

A substantial new fence has been erected, enclosing the entire farm. Owing to the irregularities of the ground this has necessarily involved much grading, in order to avoid unsightliness and give a reasonably neat appearance to this part of the work. The roads along each side of the farm approaching the higher ground were hemmed in on either side by high banks, and when the snow drifted badly in winter, these cuttings became filled to such a depth as to make the highway at times impassable. These banks have been cut down, the roads widened, and the material thus obtained used in filling the hollow places along the fence line. These improvements have added much to the appearance of the property, increased its value, and at the same time removed the obstacles to winter travel.

Plans.

A complete topographical plan was prepared at the outset, giving the relative heights all over the farm, which has been of much service in determining the best course for the main drains, and has been found very useful in other respects. A careful plan of the prospective farm, including locations for buildings, roads, shelter and forest belts, &c., has also been prepared by an eminent landscape gardener. This approved plan is being followed as a guide in all work, so that any part once completed will need no further modifying, a condition of things which can scarcely exist without some well devised plan as a guide.

Horses, Waggons, Implements, &c.

The necessary supply of horses required for permanent work, with implements, waggons, &c., were purchased in season for spring work, and from the second of May, when operations began, until frost put an end to farm labour, both horses and men, supplemented by such additional temporary help as was needed, have been kept actively employed.

Buildings.

A temporary office and a seed testing house were provided early in the year, and, as soon as practicable, work was begun on the permanent buildings. Dwellings for the several officers composing the working staff are being erected, and

substantial barns and stables are now approaching completion, which will provide the accommodation necessary for the farm horses and room for a sufficient number of animals to permit of the conducting of such experiments as may, from time to time, be found desirable in the interest of stock-raising in this country. From this source it is also expected that surplus stock can in time be had, both of pure bred and grade cattle to test in the different climates of the several Provinces in which the other experimental farms will be located. A temporary laboratory has been fitted up for the use of the chemist in the city which will serve a useful purpose until the permanent laboratory can be erected, which it is hoped will be done during the coming year.

The temporary office is quite inadequate to the requirements of the work, but better facilities for transacting business with the public will no doubt before long be provided. The proposed agricultural museum which is to occupy the upper storey of the new office building is also much needed, so that space may be had in which to store samples of the grain and other products of the Experimental Farms, where visiting farmers will have the opportunity of comparing the different varieties, and of gaining much useful information regarding their respective merits, and of the success attending the growing of different crops under the varying climatic and other conditions which obtain in different parts of the Dominion of Canada. The structure erected for the time being for seed testing and propagating and in which valuable work has been done, is now altogether too small to meet the public demand for this class of work, and much useful experimental and preparatory work, which might be carried on, did space permit during the winter, has necessarily been deferred until better accommodation can be provided.

Water Supply.

Recognising the importance and value of an abundant supply of water for all the purposes required in connection with this farm as well as for fire protection, satisfactory arrangements have been made with the city authorities of Ottawa for obtaining a supply from the Ottawa waterworks. A water main, five inches in diameter, has been laid from the city to the highest point on the farm; hydrants have been located near the barns and stables and similar protection will be afforded to the other buildings as the work progresses. From the main, suitable pipes can be laid, to all buildings where water is required.

Arboretum and Botanic Garden.

Sixty-five acres of very suitable land are to be devoted to the important purposes of an Arboretum and Botanic garden where all the useful trees, shrubs and plants of the Dominion, as far as climatic conditions will permit, will be brought together, their growth carefully noted and a knowledge of many other facts acquired, so that useful data in regard to forest questions may be accumulated for future guidance. Such varieties of foreign trees and shrubs as can be obtained will also be tested, for the purpose of ascertaining the relative value of each and every sort for timber and fuel as well as for shelter and ornamental purposes. Canada has been the last of the more important British colonies to undertake this useful department of public work, and it is hoped that by entering on it with vigour and enthusiasm, that although last, our country will not long remain least in this very necessary branch. There is no country where the knowledge obtainable in relation to tree culture can be put to more important and useful purposes, and the establishment of this section will prepare the way for the dissemination of much needed information regarding tree culture and the most serviceable trees to plant over this wide domain, which Canadians will not be long in turning to practical account. A large accumulation of suitable material

for planting this arboretum, including many hundreds of varieties of trees, shrubs and plants, has already been made, and the stock will be materially increased during the coming summer.

Dow's Lake.

Along the northern front of the Central Experimental Farm there is a fine sheet of water, an enlargement of the Rideau Canal, known as Dow's Lake. The usefulness of this water stretch has in the past been much interfered with on account of the presence of a large number of unsightly stumps which protruded above the surface. As soon as winter had put an end to all operations in the field, and by the emptying of the canal the level of the water was lowered some four or five feet, choppers were set to work, and the stumps, over 2,600 in number, were cut down to the ice level and removed. As a result of this clearing the lake will in future be a beautiful sheet of water, affording a convenient and unobstructed approach to the farm and will also add very much to the attractiveness of its surroundings.

Bulletins.

During the year two bulletins have been issued, giving details of the work carried on in testing the vitality and germinating power of seeds, the importing and distribution for test of early ripening wheat from the northern part of Russia, and the results of the trial of a large number of varieties of spring wheat, barley, oats, potatoes and other field crops on the Central Experimental Farm. The bulletins also contain a brief summary of the work done in horticulture and forestry, showing that very large collections of fruit trees, vines and young forest trees have been obtained and planted on the farm for test. further particulars regarding the fruits will be found in the appended report of the Horticulturist, Mr. W. W. Hilborn. Reference is also made in the bulletins to the results of correspondence with institutions engaged in similar work in other parts of the world, by which means large collections of the seeds of useful and hardy trees, shrubs and plants have been obtained and sown, giving a crop which will add much to the interest of the collections at the farm, and provide for the testing of these useful products in other parts of the Dominion, especially in the treeless regions of the North-West. The demand for these publications has been so great that a much larger edition has been required than was at first anticipated. Several additional bulletins are now in process of preparation.

Acknowledgments.

In the arduous work of clearing, grading, preparation of the land and planting I have been ably aided. Valuable help has been rendered by Mr. Wm. M. Blair of Truro, N.S., the superintendent of the experimental farm for the Maritime Provinces, who directed portions of the work in progress during the early part of the summer, also by Mr. A. Mackay of Indian Head, N.W.T., superintendent of the experimental farm for the North-West Territories, who took charge of the planting of a large collection of the seeds of forest trees and shrubs. Able assistance was also given by Mr. S. A. Bedford of Moosomin, N.W.T., who undertook the forest tree planting and who subsequently pushed forward the clearing of the land with much vigour and ability, and by Mr. W. W. Hilborn who while carefully attending to his horticultural duties aided also in the oversight of other departments of the work in progress. But my acknowledgments are specially due to the farm foreman, Mr. John Fixter, who has been untiring in his devotion to the work and who has brought his practical knowledge to bear on the varied operations he has had in charge during the season with the best results, and to his persevering industry in carrying out the plans devised much of the present advanced condition of this part of the farm work is due.

Other Experimental Farms.

Since my appointment in October, 1886, as Director of the Canadian Experimental Farms I have been three times to the Maritime Provinces and twice to Manitoba, the North-West Territories and British Columbia. These journeys were undertaken for the purpose of gaining information as to the character of the soil, the nature of the climate and the present condition of agriculture in the several Provinces, also to examine the most promising of the sites offered for the proposed experimental farms, so that information might be available which would aid in determining where they might be best located, for the present and future benefit of the resident farmers. Although this labour has been beset with many difficulties, it is hoped that the careful attention which has been paid to this important part of the undertaking will prepare the way for the selection of suitable lands in desirable locations where the work contemplated can be carried on to the greatest advantage and where it will give that constant and needed stimulus to agriculture which is required.

For the Maritime Provinces.

A site for the experimental farm for the Maritime Provinces has been selected at Nappan, Nova Scotia; a very central point for the three Eastern Provinces. The farm consists of 302 acres in all, and combines a sufficient area of cleared land for all farm and horticultural experiments, with wooded land for shelter from prevailing winds. It has a suitable soil of varied character, and a sufficient proportion of both "English" and "broad leaf marsh" land to meet the requirements for stock. It has excellent railway facilities, the main line of the Intercolonial crosses the front of the farm, which is not more than half a mile from the railway station at Nappan. The central position of this farm, and its railway advantages will make it easy of access to visitors from all the Maritime Provinces, it is also so situated as to climate as to be fairly representative of the largest area of territory in the three Provinces. It is intended as soon as possession can be had that prompt preparations shall be made for spring work. New varieties of cereals, grasses and hardy fruits are much needed in some parts of the Maritime Provinces, these lines of experiments will early claim attention. It is hoped that the other experimental farms which it is proposed to establish will also be selected in time to admit of active operations as soon as the spring season opens.

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

REPORT OF THE ENTOMOLOGIST AND BOTANIST.

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

To Prof. W. SAUNDERS,
Director of the Dominion Experimental Farms,
Ottawa.

SIR,—I have the honour to submit herewith a report of observations on injurious insects, chiefly during the year 1887, with the methods of prevention and remedy which I have suggested when their ravages have been brought under my notice. My last and second report as Dominion Entomologist covering the year 1885, was issued by the Hon. Minister of Agriculture as an appendix to his report in the spring of 1886. Since that time no opportunity has been lost to distribute information concerning injurious and beneficial insects amongst those engaged in farming and horticultural operations. Through the generosity of the Hon. Minister I was allowed to have 1,000 copies of my last report printed separately, for distribution amongst my correspondents. This number he again increased at the request of the Committee on Agriculture and Colonization to 11,000 in English and French. The whole of the issue has been exhausted, and I trust that the information distributed by this means amongst the farming community may have been found useful. I have to thank the press, particularly the French press of Lower Canada, for drawing the attention of their readers to this publication, also the clergy of the Province who aided me materially in this work. Although no report upon injurious insects was prepared last year, the Government has published in full some evidence upon the same subject which I had the honour of giving before the Select Committee on Agriculture and Colonization during the last Session of Parliament. As that report will be distributed widely amongst the constituents of Members of Parliament, I am in hopes that the facts there related may be found useful to those who may read them. Up to the 1st of July last, my work as Dominion Entomologist had to be performed in addition to my duties as accountant in the Library of Parliament. This necessarily curtailed my opportunities for gathering and disseminating facts concerning the injuries committed by insects and the most suitable remedies. Since my transfer to your department as Entomologist and Botanist at the Central Experimental Farm, other pressing work connected with the office has taken up the greater part of my time; but plans have been laid for execution during the ensuing season, by which it is hoped that some of the usual attacks by insects will be anticipated and the farmers reminded beforehand of such preventive remedies as have been found useful in the past. Up to the present this has been done chiefly by means of letters addressed to the press; but upon one subject, the Clover-seed Midge, which demanded special attention, it was thought advisable to issue a printed letter giving an enlarged figure of the insect, and the most successful method of dealing with it. This was sent to farmers in those districts where clover is grown for seed. For the future I believe that all information of this nature will be most advantageously conveyed to the agricultural classes in the way which you have proposed, namely, by inserting it in the Bulletins to be regularly issued from the farm. In this way it will come into the hands of all who receive these bulletins, which will be doubtless fully appreciated and carefully preserved.

During the past autumn efforts were made to gather together from the woods and fields in this locality, as large a collection as possible of the roots of our native plants. These were carefully removed and placed in nursery rows preparatory to

such time as arrangements can be made for their permanent location in the Botanic garden. Large quantities of the seeds of our local forest trees were collected and planted in the autumn, as well as others received from different parts of the Dominion. A large collection of seeds of indigenous plants of all kinds has been got together, either collected by the officers or presented to the institution by sympathisers outside. As soon as circumstances will permit, the work of laying out such part of the Arboretum and Botanic garden as you may decide upon, will be pushed forward with vigour. The plants and seeds now in hand form the nucleus of a nice and interesting collection. Collections of seeds have been received from the Department of Agriculture, Washington, U. S. A.; the Arnold Arboretum, Boston, U. S. A.; the Royal Gardens, Kew, England; the Imperial Gardens, Tokio, Japan; and Dr. Regel, of St. Petersburgh, Russia.

Promises of co-operation and assistance, accompanied by collections of native seeds, have been received from Mr. J. Walker, of Calgary, Mr. N. H. Cowdry, of Macleod, N.W.T., and Rev. W. A. Burman, of Griswold, Manitoba.

Particular attention will be paid to the examination and cultivation of our native grasses. Many of the seeds collected by yourself in the North-West Territories last year, from apparently desirable species, are already planted, and give promise of satisfactory results. As relating to this subject, I beg to repeat some words used by Prof. Macoun, when transmitting a large collection of seeds and bulbs which he had gathered for us in British Columbia: "I am delighted that you are going to grow these plants. It is the only way to understand some of our difficult species, and I have no doubt that before very long you will be able to solve in this way, many of the difficult problems which now bother us. The botanist who often has to work with imperfect and badly-preserved specimens, will now be able to examine the plants at all stages of growth. I wish you every success, and believe that your farm will be a great benefit to the country and to science."

In addition to the above, reference collections of preserved entomological and botanical specimens will of course be necessary for the advantageous prosecution of entomological and botanical work. Temporary cases have already been provided, for the former, and no effort will be wanting on my part to build up, with all expedition, a collection, showing the injurious and beneficial insects which affect our crops.

The value of having an extensive collection of our indigenous Canadian plants is easily apparent. Already numerous enquiries have been received concerning the identity and economic uses of wild plants, and it is most desirable that all such enquiries should receive prompt answers. To further this end, which I consider one of great importance, I have much pleasure in presenting to the farm museum my own Herbarium, comprising upwards of 3,000 species, collected in Canada, mainly by myself.

I beg also to announce that Dr. Selwyn, the Director of the Geological and Natural History Survey, has kindly given Prof. Macoun permission to fill up many of the deficiencies from the duplicates of his own vast collections in the National Museum, as soon as our museum is built and we are in a position to receive and preserve the specimens. Similar promises have been received from Dr. T. J. W. Burgess, of Hamilton, and Mr. J. Dearness, of London, Ont. Some rare species have already been received from the latter gentleman.

The acknowledgment of the importance of economic entomology and the allied sciences is daily becoming more apparent. These investigations for many years (with the notable exception of Miss Ormerod's excellent work in England) were almost entirely confined to this continent. Now, however, systematic study of insects and plants is being carried on, with the object of obtaining remedies for injurious species, in many parts of the world. In England, by Miss Ormerod, who continues to issue her most excellent annual reports, as well as smaller pamphlets, whenever occasion calls for them. In the same country there has appeared from the pen of Mr. C. Whitehead, a series of five reports on insects injurious to the leading crops. These reports have a peculiar value, from the fact that their author is not only a good

entomologist and botanist, but has also had a long experience as a practical farmer in one of the best farming counties of England. In Belgium, Germany, France and Russia, good work is now being done in this line. Nor are our sister colonies behind hand. In South Australia, Mr. Frazer S. Crawford has studied the fungous and insect pests which attack the apple and pear, and his admirable report is an important contribution to science. The fungous "coffee leaf disease," *Hemileia vastatrix*, so injurious in Ceylon, has been reported upon by Mr. Marshall Ward, and the same disease has been investigated in the island of Fiji by Mr. P. J. Storck, with the satisfactory result of discovering what promises to be a successful remedy. Briefly, this consists in placing vessels containing a mixture of carbolic acid and water at short intervals through the coffee plantations. Mr. Storck found that the vapour given off had a most destructive effect upon the injurious fungus. I mention this fact, because the *Hemileia* being somewhat of the same nature as the *Fusicladium* or "black spot" on the apple, I am under the impression that good results might follow its application here in years when this disease is prevalent.

The Government of New Zealand has issued its report of the Joint Codling Moth Committee, and in Surgeon General Balfour's "Agricultural Pests of India," published by order of the Secretary of State for India, the planters of that Empire have a concise and convenient source of reference concerning most of the diseases which attack vegetation.

In the United States, in addition to the varied and effective work which is being done at Washington by Prof. C. V. Riley and his staff of able assistants, of which it is not too much to say that it is the most important in the world, there is a vast amount of work being prosecuted in this line at the various State Agricultural Colleges and Experimental Farms.

In the Dominion of Canada I may perhaps be permitted to mention the Entomological Society of Ontario, from whose members I receive much assistance in carrying on the work which devolves upon my office. Their annual reports, published by the Ontario Government, are valuable repositories of the latest discoveries and most successful methods of treating insect enemies.

Besides Ontario the only other Province which has recognized the necessity of having economic entomology studied, is British Columbia. During the past year the Rev. Geo. W. Taylor has been appointed Provincial Entomologist and I anticipate much good from this selection. The appointment will naturally give the farmers of that Province a means of obtaining information much more quickly, than when they had to write and receive a reply from Ottawa. In some cases before an answer could be obtained the attack had proceeded too far for the successful application of any remedy. In addition to this there is always the possibility of error creeping in through correspondence, which would be avoided were it possible to visit the infested district.

The report submitted herewith covers the observations of the season of 1887; but it has, on some occasions, been found necessary to refer to correspondence which took place during the previous summer. In carrying on the investigations here recorded I have been much assisted by other students in the science of entomology, and I wish specially to acknowledge my indebtedness to Mr. W. H. Harrington, of Ottawa, not only for aid in the identification of *Coleoptera* and *Hymenoptera*, in which orders he is a high authority; but also for invaluable assistance which he with Prof. Guignard, also of Ottawa, rendered me in the work of correcting the proof and seeing through the press my last report. This had to be done at the time when I was absent from Canada officially attending the Colonial and Indian Exhibition, to lay out and arrange the Canadian garden in which were exhibited the useful and ornamental plants of the Dominion. To Miss Eleanor A. Ormerod, the entomologist of the Royal Agricultural Society of England, my thanks are also due for copies of many valuable reports and for advice on several points with regard to the treatment of insect attacks. To Prof. C. V. Riley and his assistants at Washington, particularly Mr. J. B. Smith, I am also much indebted for the identification of specimens, as also to Mr. Henry Edwards, of New

York, and Prof. A. R. Grote, of Bremen, Germany, who have spared no pains in determining for me some difficult species of moths.

Finally I beg again to thank my many correspondents for their assistance in the past and to request a continuance of the favour for the future. I am more than ever convinced that if my work is to be of use to the country, much of the information made use of and distributed through this means, must be derived from practical men, actually engaged in the cultivation of the soil. In this way *theory* as such, will be eliminated as much as possible and will make way for *practical experience*, the most important element of all success. Moreover, this experience will be gained under ordinary circumstances and with the usual methods which are found practicable on the average Canadian farm. Thus the most applicable remedies will be discovered and made known as promptly and widely as possible. If suggested remedies fail, the reason must be sought for, and if they prove useless, farmers must be warned against them, so that no time may be lost which might be better employed.

The subjects treated of in the following pages are those concerning which I have been most frequently asked for information. These in no way represent all the facts which have been contributed by correspondents from all parts of the country. These have been tabulated and will be of use at some future time when full credit will be given for all original observations.

I have the honour to be, Sir,

Your obedient servant,

JAMES FLETCHER, F.R.S.C., F.L.S.,
Entomologist and Botanist of the Dominion Experimental Farms.

CEREALS.

WHEAT.

Had it not been for the exceptionally good crop of wheat in Manitoba and the North-West Territories, the output of this staple crop would have been considerably below the average. To the excessive drought which prevailed over the greater part of Canada this shortage was mainly due; but there were also many complaints of the fungous diseases, rust, smut, and bunt. The "Wheat Midge" attacked wheat more or less in every section heard from. The Hessian-fly was reported from a few localities, but it is probable that in some of these cases the true depredator was the Wheat-stem Maggot. This last named is apparently on the increase in the districts where it has been observed.

The Wheat Midge, "the Weevil" (*Diplosis tritici*, Kirby.)

Attack.—When the wheat is in blossom in the month of June, tiny yellow Midges with black eyes, may be found, particularly as evening comes on, flying over and laying eggs in the florets of the wheat. These eggs in about a week hatch into small reddish-orange maggots which lie inside the chaff and suck the juices from the swelling kernel. When mature they leave the ears of wheat and penetrate about an inch beneath the surface of the ground, where they remain for a time, and either produce the perfect Midges that same summer or remain dormant until the next spring. Prof. F. M. Webster, of Purdue University, Indiana, a close observer and energetic worker, writes: "It has been supposed that these larvæ when full fed either entered the ground and remained until the following June, or remained ensconsed in the

heads; in any case not further attacking the grain, although the latter might remain unthrashed until winter. But since I came to Indiana I have not only reared the adults from volunteer wheat until in November, but have found the larvæ on and about young wheat plants growing in a field sown among growing corn. Furthermore it is known that the insect affects the seeds of grasses also." In the report of the United States Entomologist for the year 1885, p. 319, Prof. Webster records having observed the adult flies from 20th May right through the season up to September. It would appear then that there are sometimes two broods in the season, the second brood subsisting on volunteer wheat.

Remedies.—Under this heading I would first of all draw attention to the careless practice of farmers in not destroying the dust and rubbish from the threshing machine, when they know their crop to have been infested with this insect. I have over and over again seen the ground beneath the machine coloured quite preceptibly by the pupæ which have remained in the ears when the crop was carried.

The greater part of these pupæ, although apparently much dried up, are yet in a condition to mature if left undisturbed on the ground. I would strongly recommend that the wise precaution taken by Nova Scotian farmers should be more widely adopted. Col. Blair, of Truro, N. S., tells me that "it is the usual custom in Nova Scotia for good farmers to gather up all the rubbish from the threshing machines, and take it out on to a cross road or other hard ground and burn it. This is a means not only of destroying the larvæ of the "Weevil" and other insects, but also the seeds of pernicious weeds."

Although so well known from its injuries, it would appear from late developments that after all the life-history is not yet thoroughly understood. It is to be hoped that now this is recognized, efforts will be made to fill up the missing links, and perhaps in this way a more practicable remedy may be devised than has yet been discovered, for that portion of the summer brood which hibernates in the ground. Deep ploughing directly the crop is cut has been advocated, and would probably be attended with good results, especially where the field can be left untouched until after the time that the perfect Midges mature the next year. Another method which should receive more attention is the cultivation of such varieties of wheat as are found to be least attacked. Most of these, however, partaking much of the character of the variety known as "goose wheat," are of poor quality; but it is within the bounds of possibility that by careful hybridizing, the quality might be improved without at the same time rendering them susceptible to the attacks of the Midge. Amongst the better varieties almost free from the attacks of this insect, the fall wheat known as the Democrat is one of the most highly esteemed.

For many years the Midge has been so bad in the Province of Nova Scotia that in some districts no efforts are made to grow wheat. Mr. James Clark, writing from Tatamagouche, N.S., writes concerning one variety of wheat which is not attacked: "It is five years since I began to grow 'Midge-proof wheat,' and in that time it has given me the best satisfaction of any variety I ever had, having never been infested with either Midge or rust, both of which are very common here. It gives very fair returns. I have had as high as 20 to 1. The only objection I have to it is that it is rather coarse-grained, and if it could be improved a little in that way would be a great benefit to the farmers. I do not know of any other variety that is altogether Midge and rust proof."

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 transparent green maggot.

There are probably three broods of this insect in a season. The egg is laid on the young plants of fall-wheat in the autumn, and the maggots work their way down the centre of the stem to the base where they lie all the winter, and turn to pupæ the

next spring. During May and June the first brood of flies appears, and the eggs are laid on the young stems of the wheat plant. These in due time hatch to the green transparent maggots which produce the characteristic appearance of the attack described above, *i.e.* the withered and bleached ear, which has gained for it one of its local names, "Silver-top." This was the insect referred to in my last report as the "Joint worm," under which name it is probably better known in Canada than any other. The perfect flies of the second brood appear in the beginning of July. There was a gap in the life-history of this insect until quite lately, when Prof. Webster discovered that the gap between July and the time when the eggs were laid in autumn, was filled up by a brood which passed through its transformations in volunteer wheat; this brood probably also lives in some of our native or cultivated grasses. This is an important discovery, for if it be true that the fly will deposit at once in volunteer wheat, it suggests a trap which may be set by preparing beforehand near infested fields a strip of wheat to which the July brood will be attracted to lay their eggs, and which may then be ploughed in.

The perfect insect is a pretty little active yellowish fly about one-fifth of an inch in length with three dark stripes extending right down its back. It has a habit of resting with the fore part of its body very much raised up.

From the reports which I have received during the past two years I fear that this insect is decidedly increasing. Besides the operations of the July brood, which are easily recognized, I am convinced that much of the injury to fall wheat laid to the charge of the Hessian-fly, is in reality done by the autumn brood of this species. It is reported chiefly from Ontario, from Tuckersmith, Huron, by Mr. John Burgess, from Pembroke by Mr. A. T. White, and especially from the district around Ottawa. A severe attack is also reported by Mr. D. James, of Thornhill, York County, who says "It is working in the variety of wheat known as 'goose' spring wheat. In my fields it is three or four times worse than last year; at a rough estimate about every thirtieth head is affected."

OATS.

Oats as a rule have suffered little from insects. One attack of the grain Aphis, *Siphonophora avenæ*, Fab, was reported by Mr. D. James, of Thornhill: "There is an Aphis which is attacking my oats pretty badly in some places. They cluster around the stems of the head of oats, taking the substance that the grain should have."

In Vancouver Island Mr. Henry King tells of a serious attack of Wireworms by which he lost a whole field of oats, and from Manitoba it is reported that late oats were injured by grubs.

BARLEY.

Where reported on is stated to be free from all insect attacks, but a few cases of smut have occurred.

PEAS.

This crop still remains virtually exempt from the attacks of the Pea Weevil, (*Bruchus pisi*, L.,) but in some districts it was very seriously affected by the drought. In the County of Prince Edward, where peas are now largely grown for seed, there was much anxiety owing to a sudden failure in the pea crop. There were various theories rife at the time to account for the failure, and at the request of Dr. J. M. Platt, M.P. for Picton, I was instructed to visit the locality and investigate the trouble.

Upon arriving at Picton, Dr. J. M. Platt kindly gave me every opportunity for examining the pea fields and discussing the matter with the growers. The condition

of the pea fields at the time of my visit (the first week in July), may be briefly summed up as follows:—

The early varieties were all ripe and nothing could be seen except that the crop was thin. The late varieties were just beginning to produce their fruit, the peas in the primary pods being well formed, but for the most part few others. The fields presented the following aspect. In low spots the vines, although somewhat faded from the great heat and want of rain, were healthy and well-grown, but on gravelly knolls or in sandy uplands were in some places quite dead, or were in such a state that recovery was considered impossible.

The plants themselves over large areas were found to have been injured at the collar, immediately on the level of the soil, and consisted in fact of an apparently healthy top and root, but having these two portions separated by a short piece of dead stem at the collar. This injury I attribute almost wholly to the heat of the sun. As the plants faded for want of moisture, they drooped and left their bases exposed to the direct rays of the sun as well as the heat refracted from the parched earth. Upon the roots of the leguminosæ, the natural order to which the pea belongs, are found tuber-like organs the nature of which until lately has not been understood. Upon the pea-plants in question these were found to be particularly well developed, but in many instances were in a state of partial decay. One of the theories prevalent in the district was that the trouble was due to a fungous disease, and there were certainly indications that this view might be correct. Upon the roots bearing decayed tubers, many showed a fungous mycelium emanating from those bodies and running along the adjacent roots. Another feature was the patchy nature of the fields, and further, most of the farmers stated that this "disease" showed itself first in small spots which then increased in an ever-widening circle; or again, that it would run in a straight line along the side of a fence. Now all of these would point to the ravages of a parasitic fungus. A microscopic examination of the tubers on the roots did not, as might have been expected, give an easy solution to the mystery, for the organization of these bodies is exceptional in vegetable morphology, and they contain bodies known as "bacteroids" which much resemble the reproductive organs of some fungi. In discussing the matter with Dr. Platt we came to the conclusion that these bodies might be normal structures of the plant, as, although disproportionately larger and of quite a different configuration, they bore a close resemblance to the tubers upon the roots of other leguminosæ. There were, however, several points which seemed to indicate that something more than drought was affecting the crops, such as the occurrence of a few dead plants together, amongst other healthy vines, and the reiteration by farmers of the fact that when once the disease showed itself in a field it spread rapidly from a given centre.

The nature of the information gathered from pea-growers in this instance was very contradictory.

Upon my return to Ottawa I despatched a series of specimens to my friend, Prof. W. G. Farlow, the eminent American authority of Harvard University, who upon this, as on many previous occasions, rendered me great assistance and kindly forwarded me an article detailing the recent discovery of the nature of the tubers referred to.

He writes: "I have examined your specimens; they are such as are found in a large number of leguminosæ. They have generally been supposed to be due to bacteria, but within six months or a year, papers have been published which throw new light on the subject, and seem to show conclusively that the tubers are not due to bacteria but are normal structures containing reserve material. With this I send by mail a copy of the 'Berichte der Deutschen Botanischen Gesellschaft' for January, 1887, which contains a good paper by A. Tschirch, with a plate. This will give you the information you need." This article shows that these bodies are reservoirs for nitrogenous materials which are laid up during the active growth of the plant previous to the formation of seed. When, however, these latter are formed, a transfer takes place and the nitrogenous matter collected in the root tubers is drawn off and provides the large supply which is found in the seeds of

leguminosæ. Now, applying this to the above case, all can be understood with ease. The large development of these tubers on the roots of the pea-plants in Prince Edward county showed what is well known, that this district is exceptionally well adapted for the production of good peas. The failure of the plants to produce seed was due to the injury in the stem mentioned above, by which the supply of nitrogenous material in the root tubers was cut off. These latter again being unable to perform their functions began to decay. Dr. Farlow wrote concerning some of these damaged tubers: "The tubers I examined were somewhat decayed on the outside and had on them some small mould like *Fusisporium* which, however, had nothing to do with causing the tubers."

With regard to the nature of the supposed attack alluded to above, I feel convinced that it was mainly a result of the exceptional drought, and the fact that it appeared upon gravelly knolls and uplands first, would merely be due to the greater aridity of the soil in those spots. The occurrence of a few dead plants, amongst healthy vines, might have been due to attacks by insects previous to the examination.

In confirmation of the above opinion as to the injury being due to the drought, I quote the following from the August agricultural returns of the Ontario Bureau of Industries: "This crop was, of course, more or less injured by the prevailing drought, but on the whole there are larger areas from which good reports come of peas than of wheat. Wherever the seed was sown early, and on good soil, the crop made progress sufficient to cover the ground, and in a measure retain the moisture before the severe drought set in, while what was sown later, and on poorer soil, grew sparsely and did not afford shade to the roots of the plant."

I may mention that some of the growers who had used salt upon their fields claimed that their crops were better than where this had not been used.

HAY AND CLOVER.

HAY.

Notwithstanding the dry weather the crop of hay in many localities is reported as up to the average in quantity and above it in quality.

Two reports only of serious injury to the hay crop have been received—one from New Brunswick of the ravages of the Army-worm, the other from various parts of the Provinces of Ontario and Quebec. The exact nature of this last attack is not yet understood, and I must again refer to it by the popular name used by correspondents and mentioned in my last report, viz., "Joint-worm." It is possible, however, that it may be due to the attacks of a mite

"Joint-worm."

Attack.—Exactly similar to the attack of the Wheat-stem Maggot, the top portion, together with the head, withering and turning white just before the seed is ripe.

In the first week of July I found at Desoronto, Ont., stems of Timothy hay (*Phleum pratense*, L.), and Kentucky Blue-glass (*Poa pratensis*, L.), injured in the way described. Upon examination it was found that the stem had been severed, and was decayed immediately above the top joint. In some of the stems small white mites were found, but in others were the larvæ of some minute hymenopterous fly. Unluckily, owing to the excessive heat which occurred just at that time, I was unable to get these specimens home safely.

Mr. W. Brodie, of Toronto, writes to me as follows:—"In addition to a dipterous larva which attacks the timothy, we have found here a mite very common and very injurious. We have collected the ova, the immature and the adult forms. It

has been common in the counties around Toronto for some years, and has done much injury to timothy, 3 species of spear grass and to *Triticum repens*, L. Farmers knew of it and said it was 'the blight.' About June I demonstrated to all, that it was the work of a mite, and read a short paper on it before the Natural History Society of Toronto, and showed specimens of the injured culms and the living mites."

In the beginning of July, I received through the Hon. Minister of the Interior a letter and specimens of timothy injured in the manner described above, and forwarded by Dr. Ferguson, M. P. for North Leeds, with the statement that it had been common for years in all good seasons. "When there are great drought and a small crop the insects have not appeared, but when the growth is vigorous and there is a good deal of moisture, they have appeared almost invariably."

Remedy.—The remedy suggested by Dr. Ferguson is probably the best that can be adopted. He says: "When this attack is general the course here has been to put the mower in and cut the crop. Usually, however, the attack is not general, although sufficiently so to enable anyone looking at the field to see the white tops here and there where the insect has attacked the stem." And again, writing later, he says: "It always appears when we have a luxuriant growth resulting from frequent showers and followed by great heat. Many of our meadows are attacked I should judge, to at least, five per cent. of the stalks. The effects are never evident until after the head is fully ont of the blade. As none of our spring wheat is sufficiently forward yet, I have not been able to get a sample in the grain stalk."

Dr. Ferguson is of the opinion, with many others, that the injury is done by a worm in the stem. If this view is correct, it may possibly be the "Wheat-stem Maggot" that is the culprit.

In the third report of Prof. Lintner, State Entomologist of New York, just issued, he describes a mite as attacking timothy, so that "the infested places looked as if they had been scalded." The mite he refers to, however, is black with red legs, whilst those referred to above, are white and transparent.

The Army-worm (*Leucania unipuncta*, Haworth.)

Fig. 1.

Attack.—A brown striped Caterpillar destroying all the leaves of grass and cereals. When occurring in large numbers, migrating in bodies from one food patch to another.

During the past summer sensational accounts appeared in the newspapers to the effect that the whole hay crop on the Sackville marshes in New Brunswick, was being demolished by the caterpillar known as the Army-worm. This caterpillar (Fig. 2) is produced from eggs laid by a light brown moth (Fig. 1), with a slight metallic lustre, about an inch in length, when the wings are closed, with a small white spot on each wing. I have never been able to trace more than two broods of this insect in Canada; but in the United States they have three. The eggs are laid in the autumn, and like many of the Cut-worms pass the winter as very small caterpillars. In the following spring they attack the young grass and grain crops. The moths from these caterpillars appear in July, and the eggs laid by this brood produce the moths in August and September.

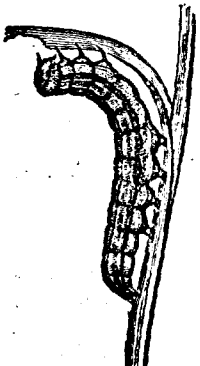


Fig. 2.

Upon the appearance in the press of the items referred to above, I at once wrote to the infested district for reliable information, and through the kindness of Prof. Burwash and Mr. W. F. George, both of Sackville, N.B., I found that these accounts were much exaggerated. Prof. Burwash writes, after extensive enquiry amongst the farmers of Westmoreland County: "I find that reports vary considerably as to the extent of injury. The most careful and accurate

observers say that two, or at most three per cent. of the whole hay crop would be a liberal estimate. Of course in some places the damage is much greater. All agree in saying that the worm does not touch the grass newly 'laid down,' that it is confined to the old meadows, of which we have a great many here; some of our marsh not being broken up for ten or more years. This year, in order to avoid its ravages, the farmers have ploughed a great deal, which they would not otherwise have disturbed."

"The worms 'work' about the lowest part of the stalk, among what they call here the 'moss,' that is the dead leaves, &c., which cover the ground, so that by far the greater part of them are out of sight. Indeed unless they are very numerous their presence is only detected by the unthrifty appearance of the grass, until a closer observation and 'rooting' about the grass brings them to light. However, when they are very numerous they may be seen climbing stalks, but they always look as if they were 'out of their latitude.'"

Mr. George writes: "In some localities they damaged the English grass to a considerable extent by eating all the fine grass and clover in some places, not leaving anything green standing. This did not extend over large areas and only occurred where the marshes are not well drained. I am quite confident that thorough drainage and good cultivation will prevent the ravages of the Army-worm in this locality."

Dr. T. J. Leeming, of Charlottetown, P.E.I., sends me the following dates for some of the stages of this insect in the Maritime Provinces: "August 19th, at Great Burin: Hay field entirely devastated by the Army-worm; caterpillars of all sizes. August 29th: On shore at Trepaney, Nfld., Army-worm abundant; they appear to avoid clover; on ground that has suffered from their depredations the clover patches stand out untouched. September 8th: The larvæ taken at Trepaney 29th August, pupated to-day. October 17th: Arrived at Charlottetown 6 a.m.; during the night the Army-worm moths obtained at Trepaney, August 29th, came out."

Remedies.—Although only complained of in certain localities, this insect is very wide-spread all over Canada, and may generally be found in low spots. This would show the reason why the attack is so severe in marsh lands where the caterpillars have a suitable habitat and an abundance of food. The remedies which have been found most successful are systematic drainage of low-lying lands, by which they become an unsuitable habitat for the young larvæ, and the moths are probably prevented from laying their eggs there. When the attack has been very severe in any locality much good may be done by burning the old grass and stubble in the autumn or spring; in this way not only are many young larvæ destroyed, but the old stems, which seem to be the favourite place for the spring brood to lay their eggs, are also removed. The conditions which seem most favourable for the undue increase of the Army-worm are a dry autumn, followed by a wet spring and summer. Whenever the first of these occurs, therefore, it would be well to adopt the precautionary measure of burning over the meadows.

The worms may be prevented from marching from one field to another by ploughing a deep furrow across their path. This should be cleaned out so as to leave one edge perpendicular, and holes may be dug in it at intervals, into which the worms may be shovelled and killed by covering them with earth and pressing it down. Prof. Riley also suggests dusting the plants on the opposite side of the ditch with a mixture of Paris Green and Flour or Plaster, so that if any worms succeed in crossing the ditch they will be killed by feeding upon the plants so poisoned. This mixture should be in the proportion of one of Paris Green to 25 or 30 of the other materials.

CLOVER.

Clover as a hay crop has been short, owing to the drought and to winter killing. There was little seed reaped, but I am pleased to find that this was not owing to the ravages of the Clover-seed Midge. Some complaints of injuries by this insect have

come in, but most of my correspondents agree that losses by this cause are much less than they were a few years ago. This improvement is due to the general adoption through the clover seed districts of the method of feeding off their clover before the middle of June and reaping the seed from the second crop. Mr. T. Farrow of Bluevale, Ont. writes: "For the last two or three years there has been none, or scarcely any clover seed after mowing, but last season there was a little, not enough though to make it worth threshing out. The seed on the pastured fields has been exceedingly good. Alsike seed was very good and yielded well, notwithstanding the great drought of last summer."

Clover was, in the Ottawa district, considerably damaged by the larvæ of the common Clouded Sulphur Butterfly (*Colias Philodice*, Godt) which this year appeared in enormous numbers. The caterpillars were also destructive to a great number of other leguminous plants in the seed beds of the Experimental Farm, species of Cytisus, Caragana and allied plants, having to be constantly watched and kept clean by the use of Hellebore and Pyrethrum. Towards autumn large numbers of these caterpillars were found dead in the fields, bearing a cluster of the bright yellow cocoons of a small parasitic Ichneumon Fly (*Megarismus nubilipennis*, Ashm). I am indebted to Mr. W. H. Ashmead of Jacksonville, Florida, for the identification of this and many other microhymenoptera.

As usual during hot, dry, summers a large amount of injury was done to grass crops by grasshoppers, but there were no complaints of excessive injury.

ROOT CROPS AND VEGETABLES.

Root crops all over the country seem to have suffered more from the drought than any others, the result of the absence of autumn rains being very perceptible in the gross returns.

TURNIPS.

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

From all quarters come in complaints of injury by the Turnip Flea-beetle.

Attack.—Small shining black beetles, with yellow markings on the wing covers which eat the seed-leaves of turnips and all other crucifers, directly they appear above the ground.

These troublesome little beetles live in the larval state upon the roots of plants of the Mustard and Cress family, to which the Turnip belongs. The grub is described by Dr. Cyrus Thomas (Illinois Rep. VI, 159) as "a minute, slender grub, with six tiny feet on the anterior segments and an anal pro-leg; white, with a faint, dark medial line along the anterior part of the body; a horny light brown head and a brown spot on the posterior extremity. This state lasts about seventeen days when it changes into a naked white pupa in a little earthen cocoon near its feeding place, in which it remains but a short time. From the observations made, Dr. Shimer is of the opinion that they live exclusively on the roots and underground stems of cruciferous plants."

Remedies.—These will come under three heads:

1. Selection of varieties the least liable to attack. One variety which has been recommended is the "Grey Stone," it is claimed that this is even obnoxious to the beetles and that if sown amongst Swedes it will keep the beetle away. I have not experimented in this line.

2. Judicious management in the time of sowing the seed. This will vary in different localities. Some of the beetles appear early in the spring and attack any cruciferous plants they may find. If turnips are sown too early they will be destroyed. There is then a short time when very few of the mature beetles are to be

seen. This is when the second brood is in the larval condition beneath the ground. This period is what the farmer must discover for his own neighborhood and take advantage of his knowledge to get his turnips up and "into the rough-leaf" before the beetles appear again. This period is, for this part of Canada, about the middle of June, a little later in the Maritime Provinces and earlier in the west.

3. Active poison. I have tried some experiments with Paris Green and have had most satisfactory results. A mixture was made of 1 part of Paris Green to 50 of Land Plaster and this was sown along the rows of turnips, directly they appeared. A single application was found sufficient and the plants soon pushed out their little bud of rough leaves and were not afterwards injured by the beetles.

A Turnip Aphis—(*Aphis brassicæ, L.*)

Attack.—Clusters of grey plant-lice, situated all round the bases of the stems and beneath the leaves of Swede turnips from which they suck the juices. Not noticed in numbers until late in the autumn when many of the turnips were found seriously injured and past recovery. Complaints of this injury have been received from Vancouver Island, Quebec and Nova Scotia, all of which were after the manner described above.

Remedies.—Of several remedies experimented with, the most satisfactory results were obtained with a Kerosene Emulsion made of the ordinary strength for general application, viz.: Kerosene or refined coal oil 1 pint, common laundry soap ½ oz., rain water, ½ pint. The soap was boiled in the water till all was dissolved, then the boiling soap suds were poured into a watering pot containing the kerosene and churned with a garden syringe until the emulsion was complete. This generally takes about 5 minutes but sometimes longer. When this emulsion is made it can be bottled up for future use. When using it either as a wash for sponging trees or for spraying, it must be diluted with 9 times the quantity of water. Should the oil in the emulsion after a time separate it is well to warm it and by violently shaking the bottle it will again become fit for use. In diluting the emulsion use warm water. With the Aphides above mentioned the wash was syringed amongst the clusters and one application was found sufficient. Single experiments with Pyrethrum both dry and in solution were found unsatisfactory, but possibly the material experimented with may not have been fresh.

The Red and Black Turnip Beetle (*Entomoscelis adonidis,* Fab.)

Attack.—A showy scarlet beetle, with three black stripes down its back, and a black patch on the collar, about two-thirds as large as the Colorado potato beetle; but narrower in outline. Eating the leaves.

I collected on turnips at Regina in August, 1885, several specimens of this showy beetle. They were sluggish in their habits like most of the Chrysomelidæ, including their relative the Colorado potato beetle. They were not in sufficient numbers to do much injury, but were thick enough to show that with an increased cultivation of their food plant, they might develope into a troublesome pest. The specimens collected on the North-West prairies cannot be distinguished from specimens in my collection from Austria, in Europe. Should a remedy become necessary an application of Paris Green would be the most convenient.

POTATOES.

Potatoes have not escaped the effects of the dry weather in Ontario and Quebec, and although of good quality they are very small, and there is a serious shortage in the crop. Insect enemies have also levied tribute.

The Colorado Potato Beetle (*Doryphora decemlineata*, Say) has made itself apparent in Nova Scotia and Manitoba in such numbers as to demand the attention of farmers. Specimens of the true Colorado beetle were sent to me by Mr. E. H. Struthers which had been collected in St. James's west of Winnipeg. Paris Green still remains the standard remedy for this pest, and the most advantageous way to apply it is by mixing a teaspoonful in a pail of water and shaking it over the vines with an ordinary whisk. Wisps of straw and hay or small boughs which I frequently see used by farmers are a mistake, and waste more time and poison than would pay for many whisks. Of course all beetles which attack the plant in the same way as the Colorado beetle may be treated in a similar manner. Of this class are a small flea-beetle which Rev. G. W. Taylor reports as riddling the foliage of potatoes at Victoria, B.C., and also one of the Blister Beetles (*Epicauta maculata*, Say) specimens of which have been sent to me from different localities in the North-West Territories.

His Honour Lieutenant Governor Dewdney writes in July last: "I enclose herewith three specimens sent by our Indian agent at the Blackfoot Crossing, Gleichen, which he states were found in his garden. They appear to be in numbers and have been particularly destructive to his potatoes, having destroyed 50 hills in a very short space of time, apparently the potatoes are destroyed in a similar way as by the Colorado bug in the east; but much more rapidly."

About the same time in 1886 I also received specimens from Mr. Acton Burrows, then Deputy Minister of Agriculture for Manitoba, which had been "sent in by Mr. S. W. Chambers, farming instructor on the Blood Indian Agency, Fort Macleod, and which he said were working sad havoc in the gardens on the reserve."

In the larval state, the beetles of this family are parasitic on other insects, but in the perfect condition they eat vegetable food. The present species I have also taken in numbers at Stillwater, Montana, where it was feeding on the Grease-wood (*Sarcobatus vermiculatus*. Tor.)

Wire-worms, which are the larvæ of the Skip-Jack beetles (*Elateridæ*) have not been complained of as attacking potatoes, except in one instance, where they were very severe in their attack. Rev. G. W. Taylor, of Victoria, B.C., tells me of a farmer who lost nearly every tuber on an acre planted to potatoes. The best remedy for these troublesome insects is a frequent use of the hoe, by which all weeds are kept down, and care must be taken to remove all the injured potatoes at once when dug. If this be done, and the crop at once carted from the field, the Wire-worms are carried away with the potatoes, and as they very soon leave the tubers when the latter are removed from the soil, they can be gathered up from the bottom of the cart and destroyed.

CARROTS.

Carrots and parsnips are little troubled with insects as a rule. During the past year I have received from several quarters, the beautiful larvæ of the common Black Swallow-Tail Butterfly (*Papilio Asterias*, Fab.), which had been found commonly upon both of the above plants, as well as upon the fruiting stems of parsley. In addition to this, specimens of the leaves of carrots were sent to me by Mr. E. D. Arnaud, of Annapolis, N.S., in 1886, which were simply swarming with a species of Aphis. Again during the past summer, Mr. Josiah Wood, M.P., of Sackville, N.B, sent me leaves of both carrots and parsnips in exactly the same condition. Unluckily the species could not be identified from the crushed state in which the contents of both packets were received. All that could be seen were wingless females. I hope next year to get some winged specimens and identify the species. The first mentioned attack was cleared off by a visitation of large numbers of one of the beneficial "Lady-Bird" beetles (*Coccinella transversoguttata*, Fab.), and did nor appear again the following season. The most serious attack upon the carrot crop to be recorded was by the

Carrot Fly, "Rust Fly" (*Psila rosæ*, Fab.)

Attack.—1. Early in the season the leaves of young carrots turn reddish, and the roots will be found to be blotched with rusty patches.

2. Carrots stored for winter use will be found to contain long transparent white maggots, which bore holes in every direction.

During the past season I have received no report of injuries by this insect, but in 1886 it did a great deal of damage, particularly to roots stored for the winter. Mr. F. B. Caulfield, of Montreal, says, in February, 1887: "They must be pretty numerous in this district, for nearly all the carrots that I have seen exposed for sale are more or less attacked." Mr. Thomas Henderson, of Nepean, Ont., when enquiring for a remedy, states: "The Early Horn Carrots in my garden are badly attacked, nearly every root shows signs of their presence, at any rate two thirds are seriously injured for the market."

In a garden at Ottawa I found the young plants badly attacked in the spring of 1886, but the injury was checked and did not again recur.

Remedies.—The remedy applied above was as follows: Immediately upon the detection of the injury, sand saturated with kerosene (coal oil) was sown along the rows, this was repeated 5 or 6 times with one week intervening, and was always put on immediately after the carrots had been thinned out. Upon consulting Miss Ormerod, she was kind enough to send me the following advice which was subsequently adopted: "My view of the best way to prevent *P. rosæ* from doing damage is so to manage operations that there may be the smallest possible number of chinks or cracks in the ground down which the flies may travel to start mischief at the roots. I always advise that the greatest amount of thinning that can be managed should be done as early as possible, and give good waterings after thinning, and from time to time to drive the surface soil together."

Where carrots are stored during the winter in sand or earth this of course must be treated to destroy the pupæ which leave the roots and enter the soil to pass their last preparatory stage. Miss Ormerod suggests that this earth might be put into a wet manure pit or soaked with gas water so as to prevent the hatching out of the flies. Should neither of these methods be convenient, at any rate it might be buried in a deep hole dug in the ground for the purpose.

CABBAGE.

The value of the cabbage crop has been very seriously diminished during the past year or two. During the last season where no efforts were made to put a stop to their depredations, the caterpillars of the imported White Cabbage Butterfly utterly ruined whole patches of this vegetable. Nor were the Anthomyian flies or Root Maggots much less injurious.

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

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.

Notwithstanding all efforts to keep it down, and the great prevalence of the infectious disease known as *flacherie*, in all the districts to which it has penetrated in Canada, this injurious insect continues to spread. In every garden in the Ottawa district last season great damage was done, unless special efforts were exerted to prevent the loss. Nor were its ravages confined to the cabbage alone. Turnips and many wild cruciferous plants were attacked. Mr. A. T. White, writing from Pembroke says, "a year ago last summer I had a field of turnips that was so badly attacked that they literally stripped the leaves and left only the stalks. Last season, however, we had none or so little that they did really no damage."

A curious fact which has been observed by more than one correspondent is mentioned by Mr. R. Brodie, of St. Henry, Montreal, an extensive and successful grower of cabbages. "Strange to say, the green worm does not trouble me much where we have the cabbage and cauliflower in large fields, but if we plant a few convenient for the kitchen, especially where they are in any way shaded, the worm makes short work of them." Mr. Andrew Hickey, of Ottawa, also confirms this observation, saying "they only attack the outside rows of the field."

Remedies.—Several of the remedies which are from time to time recommended were experimented with. Iced water syringed right into the heads of cabbage had no effect whatever on the caterpillars infesting them. Boiling water was found to be almost impraticable for application on a large scale, although when used many of the caterpillars were destroyed without great injury to the plants. After trying several substances, the greatest satisfaction was given by a mixture of 1 part of Pyrethrum insect powder diluted with 5 times the quantity by weight of common flour, weaker dilutions gave good results, but this was decidedly the most successful.

The pure powder was used but was not appreciably more efficacious than the above. This powder can be quickly applied by means of one of the numerous instruments sold under the name of "insect guns," but these should have the tubes properly bent down so that they may not clog with the powder.

A sample packet of Hammonds "slug shot" was sent to me by the manufacturers for trial. This I found very useful against the caterpillars and propose to make a more extensive use of it next season.

The Cabbage Maggot (*Anthomyia brassicæ*, Bouché).

Attack.—One or more white maggots burrowing into the stem of young cabbages when freshly set out. About the beginning of July, freshly transplanted cabbages occasionally assume a bluish green appearance and the leaves become faded and flaccid during the heat of the day. This is generally a sure sign that the root is attacked by the maggot. When, as is sometimes the case, it is desirable to preserve some new or choice variety, the plants should at once be taken up and the roots examined. If they are only slightly injured they may be washed in strong soap suds and replanted, care being taken to remove the soil immediately around where the plant was growing before. Very successful experiments were carried out in this line during the past summer, the plants after two or three weeks showing no difference from those not attacked.

The parent of the maggot is a small fly, closely resembling the common housefly but smaller and with longer wings, which flies about close to the ground and lays its eggs close to the stem of the newly planted cabbage, thrusting its ovipositor beneath the soil.

This insect is one of the most troublesome pests the market gardener has to deal with. Mr. R. Brodie, of Montreal, says: "The Cabbage Maggot has been very destructive to our cabbages and cauliflowers in this neighbourhood these past few years, but especially the last season." The same information comes from almost every quarter. Mr. J. Lang, of Barrie, says: "A large number of people round this part complain of this grub which destroys their cabbages."

Remedies—These consist chiefly in putting something round the young cabbages at the time of transplanting to destroy the natural odour of the plant. Sand saturated with coal oil (a large cupful to a pailful of dry sand), a little sprinkled round each plant has produced good results; and gas-lime when procurable, applied in the same manner, is even more efficacious. Late planting has also been attended with good results. Mr. Brodie, of Montreal, has also found the following treatment beneficial: "In 1885, I planted two acres of early cabbage and lost about half of them by the maggot. This was a great loss as I ploughed in about 75 tons of manure to the acre. The past season (1886) I put cabbage in the same land, and manured in the drill and applied a fertilizer composed of Superphosphate of Lime, Ammonia and Potash in

the drill also; after the plants were set out I put about a tablespoonful of Nitrate of Soda around each plant, leaving one row without any Nitrate of Soda or the above mentioned fertilizer, and this was the only row that was any way destroyed by the maggot. I think, probably, it was the Nitrate of Soda that prevented the maggots from destroying the plants, for a field of cauliflower treated in the same manner, with the exception of the Nitrate of Soda, was partly destroyed by the maggot. I did not apply the Nitrate of Soda as a preventive of the maggot, but to give nitrogen to the plants when the land was cold in spring. I got this idea from an article in the *Rural New Yorker* by J. J. H. Gregory."

Fresh unrotted manure and particularly cow-manure seems to attract these flies to plants grown in soil so fertilized.

Onions.

Onions have again suffered from the attacks of Root Maggots, and Cut worms. Under the latter heading the only new item of important information is the successful use of a Kerosene Emulsion, as described in Prof. Riley's annual report for 1885, p. 272. "If the worms should appear in great numbers by migration from the surrounding fields, we would sprinkle the fields at night, while the worms are at work, with a diluted emulsion of Kerosene. Mr. J. B. Smith shows that pure Kerosene has been tried at Goshen with the effect of killing the worms, and simply blackening, but not killing the onion tips. We are not satisfied, however, that the free use of pure Kerosene would not seriously injure the plants, and we recommend instead an emulsion as being safer and much cheaper, while just as effective in killing the worms. For the proper preparation and application of the emulsion a good force-pump is needed, but beyond this no apparatus is necessary."

The best formula for this emulsion is given under the heading "A Turnip Aphis," p. 19, and is the one recommended by Prof. Riley.

The Onion Maggot (*Phorbia Ceparum*, Meigen).

Attack.—A white maggot which bores into the bulb of the onion from beneath and destroys it. When not feeding it generally lies outside the onion in a chamber of wet mud, which is kept moist by the juices of the decaying bulb.

Remedies.—The most successful remedies up to the present time are of a deterrent nature by which the perfect females are kept from laying their eggs on the young plants it is wished to protect.

Mr. E. Bell, of Archville, grew a very good crop of onions, which he considered were much protected by sowing broadcast over the bed, once a fortnight, a light sprinkling of gas-lime. Unluckily he was unable to keep the application up regularly throughout the season, and a proportion of the crop was lost. From what we saw of the effects of this remedy we feel confident that good results would follow a persistent application of this material. Great care must however be taken not to put it on too thickly, as it is extremely caustic, and a light sprinkling just enough to colour the soil answers the purpose.

A greater degree of success attended the application of a Carbolic wash detailed in the next paragraph.

The Radish Maggot (*Anthomyia raphani*, Harr).

Attack.—Very similar to the attack of the Onion Maggot.

Remedies.—The sprinkling of gas lime at short intervals over the beds had a like good effect in protecting radishes as was noticed with onions; but the best results were obtained by the use of the carbolic preparation mentioned in my last report, as devised by Prof. A. J. Cook, of Michigan. "Take two quarts of soft soap and boil

it in rain water until all is dissolved, then turn in a pint of Crude Carbolic Acid. When required for use take one part of this mixture with fifty of water and when mixed well together sprinkle directly upon the plants. This was done once every week and perfectly clean radishes were obtained. The first application was made two days after the seed was sown and before any of the young plants had ppeared above the ground.

As a good effect probably due to not using green cow manure, I give the experience of Mr. G. A. Knight, of Mount Tolmie, Victoria, B.C., a careful and painstaking observer who knows most of the insect pests and has tried many experiments. He says: "I have used no cow manure this year, what I had was mostly horse manure bought from farmers. I have had better radishes this year than I have ever had in this Province before. My turnips are good but I had a great time with the Flea-beetle as usual. I sowed three or four times and sowed plenty of lime on them as soon as they came up and now I have a pretty good crop. I used no preventive on the radishes against the maggot."

Mr. Ferrier, of Barrie, has had successful results by treating these troublesome insects with a strong Kerosene emulsion. His method of applying it, was to pour the diluted emulsion along the rows with a watering can.

FRUITS.

The fruit crop of the year, with the exception of grapes, has been rather below the average. This deficiency too, it must be acknowledged, is largely due to the attacks of injurious insects. The most notable attacks reported are those on the apple tree. The Canker Worm and "Shot Borer" in the Maritime Provinces, the Tent Caterpillars from Quebec to the Pacific, the Codling Moth and Oyster-shell Bark-louse from the Atlantic to the Pacific, as well as many less important and more local attacks to other fruits. The Plum Curculio still does considerable damage. Perhaps one of the most important discoveries of late years in economic entomology is the application of Paris Green and other arsenical poisons for preventing the ravages of the Codling Moth and Plum Curculio.

APPLE.

The Codling Moth (*Carpocapsa pomonella*, L.)

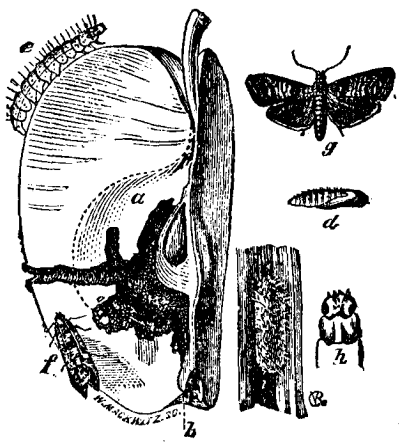


Fig. 3.

Attack.—A white or pinkish caterpillar, about $\frac{3}{4}$ of an inch in length, boring into the centre of the apple and injuring it considerably. (Fig. 3.)

Remedy.—This insect is so well known to fruit growers that very little need be said of it. Enquiries as to the best methods of treating it are received constantly. I have no hesitation in saying that for this, as well as for the Canker Worms (*Anisopteryx vernata* and *A. pometaria*, Harr.) and the Plum Curculio (*Conotrachelus nenuphar*, Herbst) the most economical and certain remedy is spraying the trees with Paris Green or London Purple. As being of a more uniform strength the former is preferred.

As to the efficiency of this remedy, if properly applied, there can be no doubt. Prof. Forbes gives the following as a summary of his systematic and thorough experiments for 1885 "attending only to the picked apples and condensing our statements of results to the last extreme, we may say that under the most unfavourable circumstances, Paris Green will save to ripening, at a probable expense of 10 cents per tree, seven-tenths of the apples which otherwise must be conceded to the Codling Moth." (Forbes Miscellaneous Essays on Economic Entomology, 1886, p. 41.)

Mr. B. Gott, of Arkona, Ont., says: "Notwithstanding a certain amount of trouble and the great care necessary in applying these poisons I am satisfied that with proper caution and if properly applied they may be used as deterrent remedies against the two chief enemies of our plum and apple crops."

There are however certain difficulties in the way of obtaining satisfactory results from this remedy. The amount of the poison to be used is so small that it seems almost impossible to induce fruit growers to use it only of the strength recommended and to stop applying it when the tree has received enough.

Then again there seems to be a difficulty in always obtaining the poison of a regular strength (*i. e.* containing always the same proportion of arsenious acid.) Mr. C. R. H. Starr writing from Port Williams, Nova Scotia, says. "We were less troubled with insects this season than in some previous years. Our chief enemy the Canker-worm has been kept in check by printer's ink or a substitute for that article and Paris Green or London Purple. Many of our orchardists have not had satisfactory results from the latter method, the great difficulty being in the uncertain strength of Paris Green. Take my own experience for instance. I made the attack when leaves and blossoms were about half or less out, the worms hardly visible, using ¼ lb. to a kerosene cask full of water. On some trees this seemed to be sufficient, at that early stage, but later finding in some quarters that they had grown and were doing much damage, I doubled the quantity (*i. e.*) ½ lb. to the same cask, with the result of bringing off nearly all the leaves and of course fruit as well. Some of my neighbors about the same time used 1¼ lbs. to the same quantity of water without serious effects. Some of our farmers have decided they are liable to do more harm with Paris Green than to allow the Canker-worms to have it their own way. Many have gone back to the paper bands and ink, I have used a composition made of the component parts of printer's ink with satisfactory results, and at very trifling cost compared with the ink."

In the above experience Mr. Starr would have been wiser to repeat the weak application, rather than to double the quantity of poison.

The efficiency, and when properly applied, the safety with which these arsenical compounds can be used upon vegetation, have now been established without a doubt by the experiments of Professors Riley, Forbes and Cook. I therefore give below what I consider the most useful proportions of Paris Green, the only one of these compounds with which I have experimented to any extent. I regret that as yet I have not compared the different makes of pumps and nozzles for the distribution of these poisons, so I am not in a position to recommend any one above the others. Paris Green is an arseniate of copper said to contain about sixty per cent. of arsenious acid. It is therefore very poisonous and must be kept out of the way of children and domestic animals. It is also very corrosive and if used too strong or carelessly, will injure the foliage of plants. This material can be used as an insecticide in two ways, either as,—

(I.) A dry application:

One part of Paris Green may be mixed with from 25 to 50 of land plaster or common flour. This is useful on all plants of which the foliage is not used as food.

(II.) A liquid application:

(*a.*) For Codling Moth, Plum Curculio and the young Canker-worm, not more than from 2 to 4 oz. in a barrel of water (40 gallons) or in smaller quantity, $\frac{1}{8}$ to $\frac{1}{4}$ oz. in a pail of water. To be applied as a fine spray by means of a force pump. The foliage must not be drenched, but the spray should only be allowed to fall upon the trees until it begins to drip from the leaves.

(*b.*) For general use on mature foliage:—

$\frac{1}{2}$ lb Paris Green,
50 gallons water.

Or in smaller quantities the following formula may be used, which is almost in the same ratio as the above:—

$\frac{1}{2}$ oz. Paris Green.
1 pailful of water.

First mix the Paris Green separately with a small quantity of water, then add to the whole supply. All washes containing Paris Green must be constantly stirred to keep it in suspension or it will sink to the bottom.

For the Codling Moth, liquid application (*a*) should be sprayed upon the trees as soon as all the petals have fallen from the flowers. For the Canker-worms the eggs of which hatch out during a comparatively long period, two applications should be given of liquid application (*a*), one before the buds open, and the other as soon as the petals have fallen. For the Plum Curculio, liquid application (*a*) should be sprayed over the trees as soon as the young plum has formed. This may be repeated a fortnight later.

With the above, as with all attacks by injurious insects, the great secret of success is prompt action, and when making trial of this remedy let the spraying be done exactly at the time, and in the manner recommended. The spring applications are of the greatest importance. Prof. S. A. Forbes, State Entomologist of Illinois, who was one of the first to systematically investigate these remedies, in comparing his operations for 1885 and 1886, writes to me: "Our work of 1886 differed in the time and number of applications from one to three, early in the season. The general result was almost the same as the year before, going to show that these early applications are the only ones that are effective and necessary."

Frequent enquiries are made, and occasionally misstatements appear, as to the possible danger of poisoning the consumers of fruit and crops, protected with these arsenical poisons, which it is urged may be absorbed by the plants. These statements are however quite inaccurate as a very elementary knowledge of vegetable physiology will show. The two plants most frequently enquired about are the potato when treated for the Colorado beetle, when it is suggested that the tuber may absorb arsenic from the soil; and the apple when treated for the Codling Moth, when fear is expressed that the poison may be absorbed through the stigma and laid up in the seeds. With regard to the first it must be borne in mind that the tuber of the potato is not a root, but a repository of prepared nutriment for feeding the next year's growth, in fact a winter bud, a form of consolidated vegetation found in many plants as a means of carrying them over the winter. The starch with which it is stored is not laid up from anything that can be taken in through the roots; but is manufactured in the leaves from the liquid and gaseous food of the plant taken in through the roots and leaves, and is then passed down again through the tissues of the plant and laid up as starch in the tubers.

With regard to the second statement, it should be remembered that the stigma of a flower is without any epidermis and is exceedingly delicate, so that any corrosive poison like arsenic, in even a very week solution, would be much more likely to injure the stigma than to be absorbed, and further than this, even in the natural operation of fertilization, the stigma is a passive member and absorbes nothing. The activity is on the part of the pollen which pushes out its fovilla-bearing

pollen tubes and protrudes them through the tissues of the stigma down the style into the ovary. In corresponding on this matter Professor Forbes says: "Of course you will have no trouble in proving by the highest authority that there is no possibility of the poisons being absorbed by the plants," which statement, with the following letter from Professor A. J. Cook, should, I think, set this contention at rest.

"22nd November, 1887.

"DEAR SIR,—In 1871 I used Paris Green on potatoes just as strong as I could and not kill the plants. I also put the poison on the ground where it would be washed to the roots of the plants. I had both vines and tubers analysed by a very careful chemist, and not a trace of arsenic was found either in foliage or tubers. In this case the opportunity for absorbtion of the poison was ten to one more favorable than in the common use for the destruction of the potato-bug. (*D. decemlineata.*)

"In 1881, six years ago, when I found the arsenites were a certain specific against the Codling Moth larvæ, I applied a very concentrated mixture of London Purple at two separate times to some apples. The foliage was totally destroyed by the application, so strong was it. It was made thus strong on purpose for a test. The middle of August the calyx of each of 100 (one hundred) apples was cut out; by holding the knife so as to remove a funnel-shaped piece. Two different analyses were made and not a trace of arsenic was found. I have now used the arsenites for eight years in this warfare and know that it is safe and wonderfully efficient. Yes, I think that less than 1 lb. to 100 gallons will do. My last recommendation is ½ lb. to 100 gallons of water. The important thing is to make the application early enough, as soon as the blossoms are well off the tree; and second, to make it so thorough that every apple—the calyx—shall receive its mite of the poison."

Upon this matter being brought under Professor Cook's notice, he wrote a letter to the *Rural New Yorker* (vol. 46, page 784, 26th Nov., 1887) which is well worthy of perusal by any one interested in the subject.

The Apple Aphis (*Aphis mali*, Fab).

Attack.—Green plant-lice clustered around the outside and in between the young leaves of the opening buds in spring; also in large numbers beneath the leaves in autumn.

Remedies.—This insect which frequently appears in vast numbers in spring is produced from small black shining eggs which are laid the previous autumn on the twigs and branches of the apple tree. This is apparently the only mode of hibernation and suggests the direction in which we may look for a remedy.

Before the discovery of the value of Kerosene emulsions, the usual method of treating this insect was to syringe the trees at the time the eggs were hatching with a strong soap or tobacco wash. This was attended with a large measure of success and may be used where it is not convenient to use the emulsion.

The efficacy of weak emulsions of Kerosene for plant lice makes it imperative that all fruit growers should become familiar with the best way to use them.

Prof. A. J. Cook, in Bulletin 26, of the Agricultural College of Michigan, states as follows:—

"I have found nothing so satisfactory in treating plant lice as the Kerosene and soap mixture. To make this I use one-fourth pound of hard soap, preferably whale-oil soap, and one quart of water. This is heated till the soap is dissolved, when one pint of Kerosene oil is added and the whole agitated till a permanent emulsion or mixture is formed. The agitation is easily secured by use of a force pump, pumping the liquid with force back into the vessel holding it. I then add water so that there shall be Kerosene in the proportion of one to 15."

(N.B.—This mixture although differently prepared gives the proportion of Kerosene to the water almost identical with that mentioned on page 19.)

"On Snow Ball * we find that this mixture in the proportion of one to eight, used just before the plant lice eggs hatch is astonishingly efficient. A twig not treated and one from the same bush that had been treated were each put into a glass bottle in a warm room. In a few days the one bottle was alive with the newly hatched lice, while in the other only one live louse was found. Bushes side by side, the one treated the other not, give equally satisfactory results. This early treatment is absolutely necessary in such cases as the Snow Ball, and is to be recommended on the score of economy in case of nursery stock and fruit trees. It is easier and requires less of the liquid to thoroughly drench a leafless tree than one in full foliage. It is also less difficult to make the application very thorough, which is all important. We have just applied this liquid to orchard trees where the buds were literally covered with lice, and we find the lice totally used up."

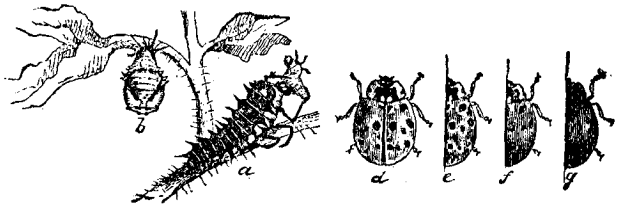
These plant lice are so exceedingly prolific that were there not some natural check imposed upon them, they would soon overrun all vegetation. We find, however, that they provide food for several kinds of predaceous insects and there is seldom a heavy visitation of Aphis without a corresponding appearance of its enemies. Some of the most useful of these are the following:—

Fig. 4.

The larvæ of the *Syrphidæ*, a class of beautiful and active flies marked with yellow and black (Fig. 4), which may be seen in the summer around flowers, poised apparently motionless in mid-air for a few seconds, then, darting a yard or so, stopping again, and dashing off suddenly in another direction. The larvæ are elongated brownish maggots, with the front segments much smaller than the rest and capable of being extended some distance to the right or left. These larvæ, which may generally be found crawling upon the stems of plants infested with aphides, destroy enormous numbers of plant lice.

Perhaps the most industrious and business-like destroyers of these injurious insects are the numerous species of the Lady-Bird Beetles (*Coccinellidæ*)

Fig. 5 represents the Fifteen-Spotted Lady-Bird (*Anatis* 15-*punctata*, Oliv) a large and abundant species. It varies much in appearance; at *d*, *e*, *f*, *g*, are shown four of the different forms under which it is found; *a* shows the larva devouring a grub of the Colorado potato-beetle and *b* is the chrysalis.



(Fig. 5.)

I frequently receive accounts of how much these active little friends have assisted the fruit-grower; but sometimes, unfortunately, their presence in numbers amongst infested crops is misunderstood and they are mercilessly destroyed by those who are not acquainted with their habits. Other beetles which have shown themselves vigorous assistants to the fruit-grower in British Columbia, are the Soldier-Beetles (*Telephoridæ*) Mr. G. A. Knight writes from Vancouver Island, "the amount of green flies this spring was awful, and they threatened small apple trees with complete destruction. I was preparing for war when an army of soldiers made their appearance and fought the fight for me. I never saw such quick work. In one week there was not a green-fly to be seen, and the beetles disappeared almost as suddenly as they came. They are the same kind† as cleared my black currant bushes when you were here in 1885. Since they went the Lady Bugs have kept the green-flies in check."

*Note.—*Viburnum opulus* or Common Guelder Rose.
Note.—(*Podabrus comes*, Lec.)

Mr. P. T. Johnson, nurseryman of Victoria, B. C., also speaks of the good offices of this same beetle. "I want to tell you about the Aphides on the apple and cherry trees this year. They came out in the spring in great numbers and I thought we were going to have the usual trouble; but almost immediately afterwards, I noticed a beetle something resembling a house fly but double as long and of a deep grey colour come out of the earth in myriads. They ascended every apple and cherry tree and quickly cleared them of the Aphis."

Besides these beetles there is a family (*Aphidius*) of small parasitic flies belonging to the *Braconidae* which feed entirely upon the green flies. In examining a colony of Aphides some will generally be found which are much larger, of a different colour, and with the body swollen and rounded. These after a time fasten themselves to the leaves and die, and a little later the parasite, a tiny four-winged fly, emerges through a hole in the back.

Tent Caterpillars (*Clisiocampa Americana*, Harr; *disstria*, Hubn, and *Californica*, Pack.)

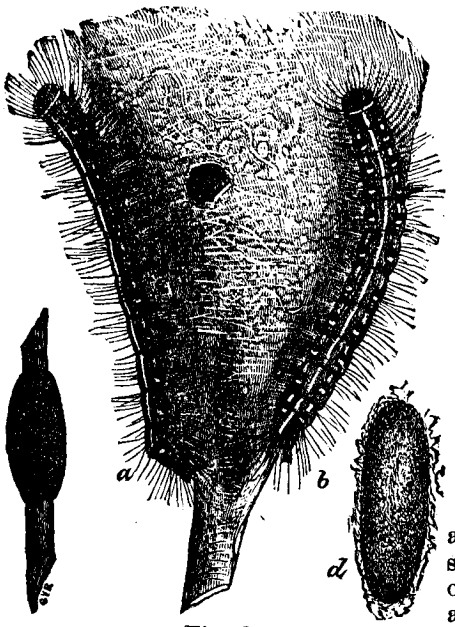


Fig. 6.

Fig. 7.

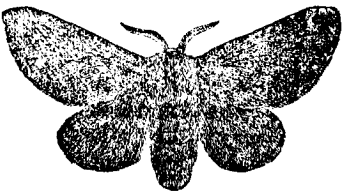


Fig. 8.

These caterpillars have appeared in great abundance all over Canada during the past season and seemed to attack the foliage of of almost every kind of deciduous tree. The apple, of course, came in for its share of attack.

The habits of these different species are very similar, and the same remedies will apply to all. The larva of the American Tent Caterpillar (*C. Americana*) Fig. 6*b* is known from the Forest Tent Caterpillar (*C. disstria*, Hubn) by having the

Fig. 9.

white stripe down the back unbroken, while in the latter it is broken up into white blotches, each consisting of a large and a small spot joined at their ends, as shown at Fig. 9. There is one

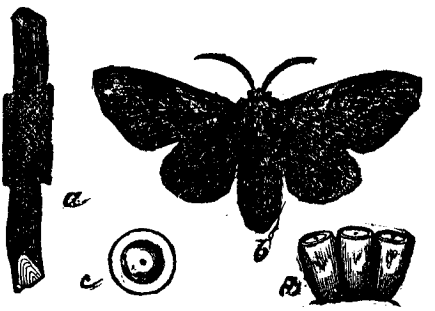


Fig. 10.

of these blotches on each segment. The Western Tent Caterpillar (*C. Californica*) is found in British Columbia and closely resembles *C. Americana*. The two eastern species differ in their habits. They are both found in orchards, but *C. Americana* forms in the fork of one of the small branches a tent-like web into which the caterpillars retire when they are not feeding, while *C. disstria* (Figs. 9 and 10) weaves a silken mat on the side of the tree to which the whole colony returns to rest. From these nests silken paths lead up all the main branches to the foliage. As the caterpillars approach maturity they take to wandering extensively, and as I noticed during the last summer they can traverse long distances. I have frequently observed in the same nests specimens of the two species of all sizes, a somewhat remarkable fact, considering the difference in their habits.

The western species was sent to me by Dr. Trew, of New Westminster, who states: "I send you some specimens of one of the pests of apple trees in this province, nor are its ravages confined to the apple, as the parent moth will lay its eggs on the twigs of plums, pears, roses and even raspberries at times; but the apple is its favourite, and so far as my observation goes, Russets and Red Junes are preferred, perhaps because of earlier foliage; although Pearmains are early they seem to escape visitation."

Remedies.—From the regular habits of these caterpillars, retiring to their nests when not feeding, they are, with a little care, comparatively easily dealt with, when they do not occur in overwhelming numbers.

During the winter all egg masses, which can then be easily seen, should be removed.

If this be not done the conspicuous nests of the American Tent Caterpillar should be cut off as soon as observed and destroyed.

The Forest Tent Caterpillars, which generally rest in masses on the trunks of trees, can be either crushed with any hard instrument or they may be swabbed with a mop dipped in coal oil.

During last summer an experiment was tried of puffing Pyrethrum powder into a nest of the American Tent Caterpillar, which was in the fork of a small apple tree in my garden, and a few of the caterpillars were killed. The larger number, however, remained perfectly still in a lethargic state inside the web for over a week. After that time they gradually began to recover and all left the nest, and two days later I found several of them, still thickly covered with the powder, on some raspberries about 60 feet distant, apparently none the worse either for their fast or for the powder.

This remedy then is not practically useful for these caterpillars.

Paris Green, sprinkled over the foliage where they were feeding, gave much more satisfactory results.

The Oyster-shell Bark-louse (*Mytilaspis pomorum*, Bouché.)

Attack.—Minute insects furnished with a beak and protected by a waxy scale, which is about $\frac{1}{10}$ of an inch in length and shaped like an elongated oyster-shell. Fig. 11. The young lice are hatched in spring, and are active for a few days. They then migrate to the young shoots of the apple, and inserting their beaks into the bark, remain there for the rest of their lives. They are gradually covered with the scale from which they take their name, and which is exuded from their bodies in a soft state as they grow. Under it the eggs are laid, after which the mother insect dies.

Fig. 11.

This pernicious insect is now found injuriously abundant in every Province of the Dominion. From its insignificant appearance and small size it is frequently overlooked; but there is no doubt that it does an immense amount of injury in our apple orchards.

Remedies.—There is only one annual brood of this insect in Canada, and the young lice emerge from the protecting scale about the 1st of June. This is the time they are least protected, and the greatest efforts should be put forth to reduce their numbers. By reason of their protecting scale, they are very difficult to treat with insecticides during the greater part of the year, few substances being sufficiently penetrating to reach them beneath their scales. The most effectual remedies have been found to be

Kerosene Emulsions (as described at page 19). During the winter the trees should be examined and the scales scraped off as far as possible. Small trees may also then be sponged with the Kerosene Emulsion preparatory to spraying them at the time the young lice appear. In Saunders's "Insects Injurious to Fruits," syringing with a solution of washing-soda in water is recommended, to be applied about the time the young lice leave the scale. "This solution is made by dissolving half a pound or more of soda in a pailful of water. Painting the branches and twigs with linseed oil, has also been found successful. As a precautionary measure, every young tree should be carefully examined before being planted, and if found infested, should be thoroughly cleaned."

An interesting observation was made at New Westminster, B.C. Mr. A. J. Hill, who has kindly assisted me in collecting and giving information concerning injurious insects in his neighborhood, sent me in April last, twigs of apple trees handed in by Mr. C. G. Major, of New Westminster, which were thickly covered with this insect. Noticing an old scale of the year previous had been perforated by a parasite, I placed the twigs in a glass jar, and soon after had the great pleasure of finding large numbers of the beautiful little Chalcid (*Aphelinus mytilaspidis*, LeBaron).

Fig. 12.

This is a minute yellow fly, which is parasitic upon the scale insect, and has in some instances largely reduced its numbers. It is shown greatly enlarged at Fig. 12.

Pear-blight Beetle, "Shot-borer," "Pin-borer" (*Xyleborus dispar*, Fab).

(*Xyleborus pyri*, Peck, of American authors.)

Fig. 13.

Attack.—A small, blackish beetle boring into trunks and limbs of apple trees. In the latter case generally entering at a bud and boring right round the stem in the wood near the bark, then inside this another burrow is run, after which a short perpendicular shaft is frequently sunk. Sometimes the first burrow runs in for a short distance, and then branches irregularly in different directions.

Fig. 13 shows the female of this beetle enlarged and of the natural size.

During the last three or four years frequent complaints have been received from the Annapolis Valley, in Nova Scotia, of the depredations of a small borer which was attacking the apple trees. This, from the size of the holes whence the mature beetles have emerged, has locally been described as the "pin-borer," or "shot-borer." During the past summer, owing to the kindness of Mr. T. E. Smith, of the Nova Scotia nurseries, Cornwallis, N.S., I have been supplied with a good series of the perfect beetles, as well as much useful information concerning this and many other injurious insects. I find that the culprit is the above named insect, which is a small dark brown beetle, not more that $\frac{1}{8}$ of an inch in length, with legs and antennæ of a much lighter colour, and having the whole body covered with short hairs.

Mr. Smith says: "I think the eggs are deposited early in June, as I have seen in the same burrows, eggs, larvæ in all sizes, and the beetle. The eggs and larvæ are white. I have seen the beetles fly from tree to tree in June, and I think they only attack diseased trees. I have not tried the soap wash recommended. I have

had so few in my own nursery that I had no trouble in cutting off all the injured limbs and burning them. I have never found them trouble the pear."

From this full series of specimens the somewhat important scientific fact has been ascertained that this and the rare *X. obesa*, Lec., are the same species.

Mr. J. B. Smith, of Washington, who kindly confirmed the identification of the specimens, writes to me: "The Xyleborus is *pyri*, *i.e.*, the female is; the male is *obesa*. This proves what Mr. Schwarz has long claimed, that *obesa* was but the male of *pyri*. Both of these are equal to the European *dispar*, Fab. *Obesa* is extremely rare, only two or three specimens being known thus far."

Mr. Schwarz also called the attention of the Entomological Society of Washington to the probability of the above identity on April 1, 1886.

In Jacquelin du Val and Fairmaire's "Genera des Coléoptères d'Europe," there are beautiful enlarged figures of both the male and female under the name of *Bostrichus dispar*.

The male and female differ considerably. In the female, fig. 13, which is about $\frac{1}{8}$ of an inch in length, the thorax is large, very convex and rounded, and comprises about $\frac{1}{3}$ of the insect, it is much roughened in front with coarse protuberances, the elytra are furrowed, and each one bears about six stripes of punctures and rows of hairs. They slope off slightly behind, but not nearly so perceptibly as in many insects of the same family. Each tibia, or shank, is much widened and flattened towards the end, bearing at the extremity a spine, and on the outer margin some teeth and bristles pointing outwards. These are no doubt a great assistance to the beetles in moving about in their burrows, which the mature beetles frequent much, retiring quickly out of sight on the approach of danger. The tarsi, or feet-joints, are very slender as compared with the shanks.

The male of this beetle is much smaller than the female, seldom exceeding one-tenth of an inch in length. The thorax is quite differently formed, being much flatter and instead of being higher than the base of the elytra, slopes sharply down to the head. The tibiæ, too, are less inflated. Altogether it is quite a different looking beetle and was as above stated at one time supposed to belong to a different species.

The injuries committed by this small beetle are very great compared with its insignificant size, and I have had the statement made to me several times that it seems to poison a large area of wood around its burrows when these are in the solid wood. In the young limbs the burrows cut through their tissues so that they are completely girdled. Some specimens injured in this way which were sent to me by Mr. Smith and Mr. J. D. Ells, of Sheffield Mills, N.S., had as many as five tunnels in a length of $4\frac{1}{2}$ inches. Mr. E. E. Dickie also sends specimens from Cornwallis, N.S. He says: "It is doing much damage to our apple trees in this part of King's County; we do not know it is in the tree until the leaf begins to fade." Mr. T. E. Smith writes from the same locality: "I send by this mail specimen of apple twig borer, of which we were talking last winter. One of my neighbors says he has lost about forty fine healthy apple trees, mostly Gravenstein and King of Tompkins. They attack the butt, and in some cases well into the limbs of young and bearing trees a foot in diameter,* mostly on the north side of the tree. I recommended plugging with wooden pegs such holes as were visible, to stop their supply of air. We found this too tedious and used fine cut nails. Those that were plugged in on Saturday were coming out in other spots on Monday. We are now going to try scraping and using a thick coat of whitewash with a mixture of Paris Green. Some are trying a coating of tar, others bore a hole and fill with paraffine and fill up."

The plugging up of the holes would, of course, be useless, as discovered by Mr. Smith, and the last two remedies would be very injurious to the trees. The thick coat of whitewash with Paris Green would probably be a useful remedy. I suggested applying at once a thick soap wash to be prepared as directed on page 19 of Saunders's Insects Injurious to Fruits, and known in my correspondence as "the Saunders Wash." It is as follows:—

* Mr. Smith has since written, "I think after all they only attack diseased trees."

"Soft soap reduced to the consistence of a thick paint by the addition of a strong solution of washing soda in water is perhaps as good a formula as can be suggested; this, if applied to the bark of the tree during the morning of a warm day will dry in a few hours and form a tenacious coating not easily dissolved by rain."

Some of the fruit growers in the Annapolis valley, who have considered this matter, state that the beetle attacks perfectly sound and healthy trees.

Mr. W. H. Hartwick, of Canard Station, Nova Scotia, "found them in young and perfectly sound trees." Mr. F. C. Johnson, of Port Williams Station, gives the same testimony: "I detected them first in a sound healthy tree by seeing the sap flowing from the wound. I plugged the hole up and stopped the attack." It is probable that the beetle was here killed by the plug. Mr. J. L. Gertridge who has studied this pest closely, is positive that he has found them in both old and young trees. Now I have received specimens of this borer in its burrows from several of these localities and there is one character noticeable about most of the specimens, viz., that the bark is hardly visible on account of being covered with the Oyster-shell Bark-louse. It has therefore occurred to me that the trees which are suffering so severely from this little beetle, had already been reduced to a low state of vigour by this last named pernicious and frequently everlooked enemy.

I am advising all the Nova Scotia fruit growers to use special efforts to rid themselves of the Bark-louse, when I believe some of the other pests will be cleared out at the same time.

Prof. Saunders tells me that during a journey made through Nova Scotia last summer he had the opportunity in company with Mr. C. R. H. Starr, Secretary of the Fruit Growers Association of Nova Scotia, of examining several apple orchards in which the trees were suffering from this pest, and in no instance did they find any traces of the ravages of these beetles in healthy trees; those affected had invariably been injured by bark-lice or borers, or had become stunted and diseased from some other cause.

The tenacity of life of this beetle is remarkable. I have found them alive in their burrows out of doors, during the winter, which is not very surprising; but of the samples sent me in the beginning of June by Mr. Smith some were put on one side as museum specimens, and as the beetles were showing in the central perpendicular tunnel described above, alcohol was poured over them and they were put away as dead. To-day (Feb. 25th)* in examining them I find to my surprise some of the specimens alive. These specimens were sent upon their first appearance in June, and have been kept in a heated study every since. Amongst the sections of apple wood sent me was part of a branch 2½ inches in diameter, from which emerged not only the beetle under consideration, but several of the small and injurious Apple Bark Beetle (*Monarthrum mali*, Fitch). The habits of this last named are very similar to those of the above and the same remedies would be applicable to both. This is a very small, slender beetle about ⅛ of an inch in length. It is shown much enlarged at Fig. 14.

Fig. 14.

The Red-humped Apple-tree Caterpillar (*Œdemasia concinna*, Sm. and Abb.)

Fig. 15.

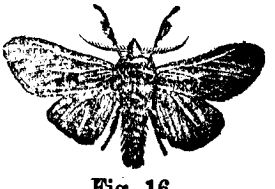


Fig. 16.

Attack.—Yellow and black caterpillars with red heads and a hump behind the

* They are still alive and active April 5th.

fourth segment, about one and a quarter inches in length when full grown. They all remain together from the time they are hatched until mature, and are very ravenous. When occurring on small trees they frequently strip every leaf before they are discovered. This is a particularly objectionable looking larva and emits a strong acid odour when touched. When full grown they fall to the ground and spin a light cocoon amongst the leaves on the ground in which they remain as larvæ until the next spring. The perfect insect appears about 1st July and is a brownish moth, expanding about an inch and bearing on each of the wings a conspicuous spot and several longitudinal streaks.

Specimens of the caterpillars have been sent to me from three or four localities, amongst others from Mr. C. A. Patriquin, of Wolfville, Nova Scotia, Mr. W. A. Macdonald, agricultural editor of the *Farmer's Advocate*, London, Ont., and Mr. A. McNeill, M. P., of Wiarton, Ont. The experience of the last named was that of all the rest, he says: "I enclose an exceedingly ugly caterpillar which has been very troublesome for a year or two among my apple trees, stripping the leaves from a young shoot, in an incredibly short time. It commences operations generally near the point of a branch, and if not observed for a few days works great mischief."

One collection of five specimens was sent in, of which all were found to be parasitised by the Ichneumon fly *Ophion purgatum*, Say, and at Ottawa several specimens of *Limneria Guignardii*, Prov., were bred from this species.

GRAPES.

The grape crop of the past season has been exceptionally good, and although a few specimens of injurious insects have been sent in, there have been no complaints of serious injury.

An interesting but severe occurrence of the "Tomato gall of the Grape" has been brought under my notice in the garden of Captain D. K. Cowley, of the Richmond Road, Ottawa. This I hope specially to investigate for a remedy next year.

The Grape-vine Leaf Hopper (*Erythroneura vitis*, Harris.)

Attack.—Small four-winged active insects one-eighth of an inch long. The upper wings striped with deep brown and yellow. Generally keeping beneath the leaves, and sucking the sap, so as to leave them white and withered. This troublesome little creature has not been so abundant on the grape during the last year or two as upon the Virginian creeper (*Ampelopsis quinquefolia*, Michx.), for which in the Ottawa district it seems to a large extent to have deserted the cultivated grapevines. It shows a marked preference for the wild grape (*Vitis riparia*, Michx.), where that species is grown.

This grape-vine leaf-hopper, with one or two other species, generally found with it attacking vines, and all known by the inaccurate name "Thrips," hibernates in the perfect state and lays its eggs on the young leaves when they first open.

Remedies.—Destroying all winter shelters, such as dead leaves and rubbish, doubtless prevents the mature insects from hibernating in close proximity to vines; as they fly easily, however, this is insufficient. Several experiments have been tried for a remedy, and the one which gives the most promise of success is a weak Kerosene Emulsion in the proprortion of 1 of kerosene to 30 of water, to be applied at the time when the young bugs have just hatched. Mr. John Lowe, the Secretary of the Department of Agriculture, tells me that he has never failed to drive these insects off his grape-vines by simply applying powdered sulphur, which, when liberally applied to the vines, gives off, on warm days, a perceptible odour of sulphurous acid gas which keeps the insects away.

The Grape-vine Looper (*Cidaria diversilineata*, Hubn.)

Fig. 17.

Fig. 18.

Attack.—Slender light-green or pinkish loopers (or measuring-worms)—Fig. 17 eating the leaves of the grape and Virginian creeper in June and July.

The moth of this caterpillar (Fig. 18) is very prettily marked with brown lines on a bright ochre ground. When at rest it much resembles a dead leaf. It has a curious habit of curving the abdomen up between the wings, which also gives it an unmothlike appearance.

Mr. T. E. Smith, writing from Cornwallis, N.S., says: "I send you some caterpillars which I have found for the last three years upon one lot of my grape-vines. I have watched and hand-picked them very carefully, but I find them increasing in numbers. While at rest they extend themselves from the edge of the leaf they are feeding on and resemble a small filament or the end of a tendril. When full-grown they attain quite a large size."

Remedies.—These caterpillars can be easily kept down by sprinkling either hellebore or a very weak mixture of Paris Green in water over the foliage.

The Beautiful Wood Nymph (*Eudryas grata*, Fab.)

Fig. 19.

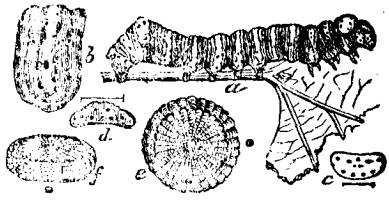


Fig. 20.

Attack.—Bright coloured, voracious caterpillars, destroying the leaves. The body is blue, crossed with broad orange bands and narrow black streaks. Head, orange. The perfect insect of this caterpillar is one of our most beautiful moths. It may be frequently found during the day time resting on the leaves of the grape, with two of its legs extended in front of it. The wings, when expanded, cover nearly two inches. The upper wings are pearly white, bordered with rich seal-brown, edged inside with green. The lower wings are orange, and have a broad, brown band along the hind margin. The body is orange, with a black stripe down the back.

These caterpillars are very voracious and have been numerous in some parts of Ontario during the past summer. Mr. Stanley Spillett, of Nantye, Ontario, says: "I take the liberty of sending you some worms which are eating the leaves of my grape vines here. If not interfered with they would destroy all the foliage. We do not know of any remedy for their destruction."

A mixture of Paris Green in water was recommended and proved quite successful. Hellebore or dry Pyrethrum powder would probably have answered as well.

Raspberries.

Raspberries suffered much from the dry weather so prevalent last season. Early in the spring the Red Spider (*Tetranychus telarius, L*) showed itself in many places, and

gave trouble all through the summer, although vigorously assailed by a small Lady-bird beetle, *Scymnus punctatus*, Melsh.

The young shoots were attacked by the larvæ of an Anthomyian fly. The eggs of which were evidently laid in the axil of a leaf, and when hatched the maggot ate its way down inside the stem, leaving a thin discoloured track for six or eight inches. When mature it turned into a brown puparium and passed the winter inside the stem (this was in the breeding jars). The mature insect which is a small black and extremely active fly about half as big as a house-fly has not yet been identified. The presence of this enemy is first shown by the tip of the young shoot fading and hanging over, much in the same way as when attacked by the Raspberry-cane borer (*Oberea bimaculata*, Oliv.) except that when stems are injured by this latter, the two rings made by the female, and between which she deposits her egg, are plainly visible. The only practicable remedy for both of these is at once to cut off the stem below the seat of injury.

The Pale Brown Byturus (*Byturus unicolor*, Say.)

Fig. 21.

Attack.—An active greyish brown beetle about one-sixth of an inch in length, which eats into the buds and destroys the flowers.

Early this spring these little beetles appeared in numbers and assailed the Raspberry bushes, doing a great deal of harm.

Remedy.—The only remedy tried was hand-picking. It is nocturnal in its habits, and in the morning each flower seemed to have its occupant. In my garden at Ottawa, all the first flowers were destroyed. The beetle seemed to be particularly attracted to a seedling bush of the White-flowered Scented-raspberry, *Rubus Nutkanus*, Mocino, flowering for the first time last year. Not a single flower of the first blossoms was perfect. As this bush was separated some distance from the rest, Pryethrum was dusted over the buds in the evening, and by this means perfect flowers were obtained. No fruit, however, was formed on this bush, but whether this was due to the insect powder keeping away bees and other insects, I am unable to say.

Red Raspberries at Ottawa were in some spots severely attacked by an aphis, by which all the young flowering shoots were thickly covered. Observing that many of the aphides showed signs of being parisitised I collected some shoots and had the pleasure of breeding many specimens of the minute Proctotrupid *Lygocerus stigmatus*, Say, and two examples of a tiny midge, *Diplosis aphidimyza*.

These parasites were kindly identified for me by Mr. W. H. Ashmead. He says: "The Diplosis is a common parasite on aphides in the old country, but not before known in this country, Osten Sacken not recording it in his recent catalogue. I have reared another species here from an aphid on hickory, *Schizoneurus caryæcola*, Ashm, and I find a record of Prof. Comstock having reared a species from a coccid in California."

Currants.

Currants of all kinds were little troubled by insects. The value of Hellebore for the Imported Currant worm (*Nematus ventricosus*, Hartig.) is now universally known. Nevertheless there is frequently considerable loss from carelessness on the part of the growers who wait until the injury is done before they procure the Hellebore. An effort was made last season with good results to prevent this loss, by writing letters to the press in the middle of May warning fruit growers to be on the alert.

My attention has been drawn by Rev. C J. Young, of Renfrew, to the fact that an erroneous idea prevailed with regard to Hellebore. He writes: "Some people here have an idea that 'Hellebore' has a deleterious effect on the bushes and prevents them from bearing, so are shy in using it; as a consequence the currant and goose berry worms are worse than ever this year and have stripped many a bush of its leaves already."

White currants were again attacked at Ottawa by the Currant Weevil (*Antho-*

nomus rubidus, Say) and in a few instances black currants were also injured. The Spiny Caterpillar of the Currant (*Grapta Progne*, Cram.) appeared abundantly but readily succumbed to a weak treatment of Paris Green.

The Currant Bark Louse (*Lecanium ribis*, Fitch).

Attack.—Brown, polished, bark-lice thickly clustered on the stems; beneath these in their early stages are small lice bearing a beak with which they suck the sap of the plant.

One of the severest attacks reported by this large scale insect, which infests the red and white currants, occurred at Ste. Anne de Beaupré, P.Q. Mr. Magloire Simard writes me that he procured a supply of young white currant bushes, and the next year they were entirely covered with these bark lice, of which he sent me some specimens. Upon the branch he sent me I was pleased to find that many of the insects had been destroyed by some small parasite, as was evidenced by the perforated scales.

Remedy.—Sponging or spraying the bushes before the leaves expand with a strong soap or alkaline wash, or with a kerosene emulsion (1 of kerosene to 15 of water), would be the best way to clear them of these pests.

STRAWBERRIES.

The only serious injury reported by insects to strawberries was from Cowansville, P.Q., and was referred to me by Mr. L. A. Woolverton, the editor of the *Canadian Horticulturist*, in the beginning of June.

The Strawberry Weevil (*Anthonomus musculus*, Say).

Attack.—Very small brown beetles, $\frac{1}{12}$ inch in length, with a black blotch, bordered with white, in the centre of each wing-case. The head extended into a beak, which is slightly curved and nearly half as long as the body. These beetles bite off the buds and flowers of strawberries, or injure them so much by puncturing the stems that they dry up.

Remedies.—Very little is known of the life history of this insect, so preventive remedies only were suggested. These were the Kerosene Emulsion (see page 19), and the Carbolic Wash (see page 23).

FOREST AND SHADE TREES.

HARDWOODS—MAPLES, OAKS, ETC.

One of the most remarkable visitations of the year was the appearance in enormous numbers of the Tent Caterpillars, already alluded to on a previous page. In the immediate neighborhood of Ottawa the forest presented a most peculiar aspect. The leaves were riddled and cut up so that on some trees there could not have been more than half the amount of green vegetation to perform the functions of the foliage. This was particularly the case on the Quebec side of the river and along the river banks. Considerable alarm was expressed by farmers who did not understand the habits of these insects, lest when they had consumed all the foliage of the maples, oaks, aspens, &c., they should destroy the grain crops. This was probably due to the fact that they were incorrectly spoken of as the "Army Worm." The idea, however, took such hold in the district that some of the farmers proposed burning their fences

to kill the caterpillars and to remove their means of migrating from the woods to the fields, and I found it necessary to write to one of the leading farmers living in the district infested, to ask him to explain the nature of the insect and prevent such absurd destruction.

The colony of the Maple-Leaf Cutter (*Incurvaria acerifoliella*, Pack.) mentioned in my last report as present at Ottawa, still continues to increase to an alarming extent No parasites have as yet been observed.

CONIFERÆ.

PINES.

As a consequence of the hot dry summer, bush-fires have been very prevalent throughout the timber districts, and there is such anxiety amongst lumbermen that it is proposed, as soon as possible, to prepare a bulletin treating specially of the insects injurious to Pine timber. In this will be collected together as much as is known, or can be ascertained, as to the lives of the insects, and the most successful methods adopted by lumbermen to protect their property. Extensive correspondence is now being carried on, and it is hoped that before very long some useful information will be ready for distribution. The two insects which probably commit the most serious ravages on felled pine timber, or upon standing pine trees when they have been injured by fire, are the two Long-horned beetles known as *Monohammus confusor*, Kirby, and *M. scutellatus*, Say, the first is grey mottled with darker tufts of hair, and the latter is black with white marks. The life of these insects is briefly as follows: The egg is laid in a crevice or hole in the bark; when it hatches the grub eats its way into the cambium layer of the sap wood, and here spends the greater part of the first year. As winter approaches it penetrates into the solid wood. In the spring of the next year it eats further into the solid wood, and probably turns to the pupa or third stage the next spring and emerges as a perfect beetle in the summer of the third year.* Directly a fire passes through a forest the trees are brought into a condition suitable as food for these beetles, and it is marvellous how soon they discover them and begin to deposit their eggs.

The important point to discover then is how late in the year do these beetles lay their eggs, because when a fire occurrs after the period during which eggs are laid, the trees will not receive injury from the borers until the next year. Owing to the prevalence of early fires this year lumbermen are forced to employ many more men in the shanties to prevent their logs being destroyed.

There seems to be conclusive evidence that logs kept shaded during the summer are very much protected against the borers. In a recent visit to Lindsay and Fenelon Falls, Ont., through the kindness of Mr. J. A. Barron, M.P., I was enabled to meet several of the lumbermen and foremen of that locality, and obtained much valuable and practical information. I found that they had no confidence in the operation known as "rossing," which consist of cutting a groove along the top of the log as they say "to let the rain in," but all seemed to agree that keeping the rays of the sun off the logs, by covering them with boughs of Balsam Fir, as explained by Mr. W. G. Perley, M.P., of Ottawa, before the Select Committee on Agriculture and Colonization last year, does decidedly protect against wood-boring beetles.

* NOTE.—Since writing the above, I have had an opportunity of examining standing pine injured by fire last spring, Larvæ of all sizes were found from half an inch to one and three-quarters in length. These latter, I should suppose, must be almost full-grown. Where they had been at work beneath the bark was plainly visible. After entering the solid wood they had penetrated to distances varying from one to ten inches. From the above observations it is now uncertain whether, under favourable circumstances, these large borers may not possibly pass through all their stages in one year Arrangements have been made for a further study of this matter during the ensuing season. My thanks are due to Mr Berkeley Powell (of the firm of Perley & Pattee) and Mr. W. R. Thistle, lumbermen of the Ottawa district, who have rendered me much assistance in this investigation. They themselves accompanied me to Pembroke and drove me through portions of their extensive limits which had been burnt at different times during the last year. By their kindness in placing horses and men at my disposal, I was enabled to visit distant points, and, when necessary, to fell trees for examination.

Any good effects which have been derived from "rossing," I am of the opinion are from the bark separating from the tree, and by the consequent drying up of the cambium layer, upon which the young and tender grub feeds.

The Red-Pine Gall-Weevil (*Podapion gallicola*, Riley.)

An interesting discovery was made at Aylmer, P.Q., last summer, upon the occasion of a visit paid to that locality with Mr. W. H. Harrington.

Upon the twigs of the Red Pine, we found large numbers of oval galls about 1 inch in length, in which upon examination we discovered specimens of this weevil, and I have since found that instead of being, as generally supposed, a very rare species, it is extremely abundant throughout the Pine forests in the County of Renfrew, Ont. In no instance could I find a tree of the Red-Pine which had not most of its small branchlets distorted by the swellings caused by this insect, and there was abundant evidence of its operations in former years. In the young cones of the trees at Aylmer were also found numerous examples of the small Scolytid, *Dryocœtes affaber*, Mann, which had destroyed probably two-thirds of the cones. This species also bores in the terminal shoots of the White Pine.

SPRUCE.

From British Columbia I have received some larvæ which have produced the moth known as *Halisidota sobrina*, Stretch, a pretty brown moth spotted with silvery white spots on the upper wings and with under wings almost wholly white. These larvæ were sent by Rev. George W. Taylor as committing great depredations on the spruces there. In the box with these caterpillars were twigs of the Douglas fir. I found, however, that they fed with perfect indifference upon either Canada balsam fir or white spruce, and all came to maturity except two specimens, which were parasitised. This will doubtless be treated of in full in Mr. Taylor's forthcoming report as Provincial Entomologist.

From the Province of Quebec comes a woeful tale of the destruction of the spruce forests.

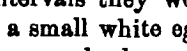
The Spruce Bark Beetle (*Dendroctonus rufipennis*, Kirby).

Attack.—A small cylindrical beetle, with deep-brown wing cases and head and thorax almost black, which bores a hole through the bark of a healthy spruce tree, until it reaches the sap wood, here it runs a tunnel about two or three inches in length beneath the bark, and lays at short and regular intervals eggs which hatch into white grubs. These eat out channels at right angles to the primary tunnel, so as to destroy the sap-wood beneath a large square of bark.

I have received several letters on this subject, and have also had specimens sent me which, through the courtesy of Mr. Schwarz, of Washington, have been identified as the above named beetle.

The attack appears to be most prevalent in the townships of Orford, Newport and Eaton, and Windsor, Dudswell, &c., in the Eastern Townships. It is also most probably the same insect as is complained of in New Brunswick, and which was mentioned at page 30 of my last report. The following interesting letter, giving original observations, has been received from Mr. Joseph Andrews, of Windsor Mills, P.Q.:—

"I will give you the result of my observations for the last eleven years. In the month of June, 1875, I cut a spruce tree on my farm for the purpose of making shingle, and when I came to remove the bark I found the white or pulpy part of it one mass of white maggots, about ¼ of an inch in length. As the tree, to judge from

the outside, was perfectly healthy, I was surprised to find such an amount of corruption inside, so I began to investigate, and in every part of the tree I found a great number of small beetles or borers still at work. Their manner of proceeding was this. They would bore through the bark until they came to the soft pulpy part of the new annular growth of new wood just forming and bore a tunnel from 1 to 3½ inches. At very short intervals they would form a little cell on each side of the main passage and deposit a small white egg (in this way ), and do it with wonderful precision, and where tens of thousands of these borers would attack a tree you may be assured they made short work of it; but still there are some parts of the country that do not seem to suit them. I have noticed that in some parts where there is a deep, dry, light, loamy soil, every spruce tree of any size is totally destroyed, whilst on the other hand, where you find a wet, gravelly bottom, you will rarely find a spruce tree affected.

"I would also mention that although the borer works up to the tops of the trees, it is not the young shoots which are first attacked, but they begin near the ground first and work up."

The only remedy which can be suggested as yet for this evil is prompt cutting of the timber as soon as the injury is observed.

AMERICAN LARCH, OR TAMARAC.

The Larch Saw-fly (*Nematus Erichsonii*, Hartig.)

This insect is still found in large numbers in the Provinces of Quebec and New Brunswick; but the reports which come in appear to me to be satisfactory. It is true it is widening its area of destruction; but there are many places where two or three years ago it was plentiful in which it does not now occur.

In the Ottawa district last spring the perfect fly was very abundant, but although the larvæ were looked for very closely, few could be found, and efforts to secure a supply for study were unsuccessful, even in an isolated grove where the females had been seen ovipositing. The egg-bearing twigs, in the summer, after the time the eggs should have hatched, showed very few cases of defoliation. All reports, however, were not of this nature. Prof. Saunders observed them as "very abundant in parts of Nova Scotia, especially in the County of Cumberland where the trees in many localities were almost entirely denuded of their foliage." Mr. G. U. Hay writes: "I am not so sure that the ravages of the worm which infests the larch tree are less this year in some parts of New Brunswick than in previous seasons. During a recent visit I made to Miscou and Shippegan, I observed a very large proportion of the trees wholly or partly defoliated. This also was the case along the Intercolonial Railway from Bathurst to St. John. At Norton, about 25 miles from St. John, many trees were wholly defoliated.

As an off-set against this intelligence I found, during the past summer, that a tamarac swamp at Dalhousie, N.B., which, in 1884, was almost defoliated, was entirely free of these larvæ.

BIRCH.

The Birch Saw-fly (*Hylotoma dulciaria*, Say).

Attack.—Yellow false caterpillars with orange heads and 6 rows of black spots down the back, and a short black oblique dash above each leg along the sides.

These larvæ were first observed in injurious numbers at Quebec in 1885 by Rev. T. W. Fyles, of South Quebec. During the past season Mr. H. M. Ami, of the Geological and Natural History Survey Staff, sent me specimens in September from Quebec, with the intelligence that they were taken at Chaudière Railway Bridge, seven miles from Quebec, where, as in Eastern Quebec, they were in myriads."

REPORT OF THE CHEMIST.

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

OTTAWA, 10th February, 1888.

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

SIR,—I have the honour to submit to you my report on the character and extent of the work done by me since my appointment to the office of Chemist to the Experimental Farms of the Dominion in August last.

On 10th August, 1887, at the request of the Minister of Agriculture, I accompanied you on a short tour through the Eastern States, with a view to the inspection of the laboratories, both as to fittings and the latest forms of apparatus, of the more principal agricultural stations and universities; the object of gaining such information being that we might be able the better to equip our permanent laboratory (not yet built) with the most modern improvements for analytical work and work of research in all the branches of agricultural chemistry.

Proceeding first to New York, I was extremely gratified to find that the American Association for the Advancement of Science was holding its annual session. During my two days' stay in that city I was therefore enabled to hear read and discussed many valuable papers by some of the foremost men in science in the United States, and also to meet personally many of the chemists engaged in agricultural work in various parts of the country, many of whom very courteously invited me to inspect their laboratories and gave me every information in their power. My subsequent travels proved their kindness to be of great benefit to me in this respect, and to these gentlemen I would tender my thanks.

As emphasizing what I have just said with regard to the value of hearing read and discussed scientific papers upon subjects of almost universal interest and importance, and as this city has lately been visited with a severe epidemic of typhoid fever, I think it may not be out of place here to refer to a paper read on The Causes of Typhoid Fever, and the means of eliminating such causes, by Dr. Albert R. Leeds, of New Jersey. He instanced many cases of typhoid fever in various towns which he had traced to an impure and contaminated water supply. He clearly showed that in such cases as he had examined, the investigation proved that the water used by persons suffering from this disease was contaminated by the excreta of other victims of typhoid. In some instances the source of the trouble was many miles distant from its direful effects.

The cause of typhoid fever is generally believed to be due to a bacillus, of which usually there is a large number in water infected, and probably the most practical portion of this paper was the means proposed by the author to rid the water of these bacteria, rendering it fit and wholesome for drinking purposes. The process consists simply in adding half a grain of alum to each gallon of the water to be used. By this process all the peaty matter is precipitated along with the Bacteria, leaving a water brilliant and limpid, and better than distilled water. The alumina is all taken out by the precipitation, and chemical tests failed to reveal its presence in the supernatant liquid. A contaminated water from Mount Holly examined by the author containing 8,000 bacteria per cubic centimetre showed after this treatment only 8 bacteria per c. c., this water then passed through two sterilized filter-papers was rendered *entirely free* from bacterial life. Many other interesting and instructive papers and discussions were listened to, but the time at our disposal was altogether

too short to reap such benefit as is obtainable by attending the full session of such an important scientific society.

Whilst in New York I visited the Chemical and Mineralogical Laboratories of the Columbia Schools of Mines, and found them admirably adapted and fitted up for work in all the branches of these sciences. It is here desirable to point out that necessarily, there is a difference in the appointment of those laboratories intended for teaching purposes only and those in which analytical work purely is carried on, remembering of course that in *many* features *all* laboratories must be similar both in arrangement and forms of apparatus. As of special interest in the laboratory just named, I would mention as worthy of notice a water-bath, about ten feet in length, which could be heated as ordinarily by Bunsen burners, or more quickly by a steam coil connected with the heating apparatus of the building. In less than two minutes after the steam was turned on, the water in this bath would be raised to the boiling point, thus saving a great expenditure of time and economizing fuel. Another feature was the slate-covered benches, which resisting the action of acids and alkalies, always preserve an even and untarnished surface, a condition very desirable but impossible to keep when the working benches are simply of wood. When, as here, there is a strong up-draft in the flue, an open draught cupboard can be used. This is very desirable, as when the front of the cupboard is enclosed with doors, the operator is always more or less hampered in his manipulations.

The Connecticut Agricultural Experimental Station at New Haven was next visited. The chemical laboratory here is about 36 feet by 29 feet with working benches on two of the sides and in the centre. As there were several chemists working in this laboratory the tables in the middle of the room made it much too cramped for comfortable work. Iron sinks were situated at the ends of the two central tables, from which the waste water was conducted to a cesspool and from thence over the land. A special room for the balances is here dispensed with, each chemist having his balance on the portion of the bench or table allotted to him. This arrangement although economizing time is not to be commendably endorsed, as a delicate balance must in a short time be seriously injured by the fumes necessarily present where a number of analysts are working.

Our next visit was to the Experimental Station at Amherst, Mass. Here a building has recently been erected which is entirely devoted to the chemical work of the station. The two laboratories are fitted up with all modern improvements, both as to apparatus and fittings. The larger laboratory is 19 by 16 feet, the smaller 17 by 12 feet. Wherever possible the arrangement of having two laboratories in the place of one, is most desirable, for many analytical operations cannot be conducted with success where other chemical work is being carried on. This is particularly necessary, for instance, in water analysis, which requires an atmosphere free from ammonia and hydrochloric acid, necessarily present in the air of a general working laboratory. A feature of special interest here was that the ceilings were lined with wood. The plan of lining both the walls and ceiling of our new laboratories with wood is one I would strongly recommend for the reason that plaster ceilings and walls are attacked by acid fumes, soon becoming dirty in appearance and small pieces of the surface whitewash scaling off may spoil an analysis by falling into vessels which are being used, a catastrophe which can be seen is not easily preventable where such ceilings are used. The gas in this laboratory, both for heating and illuminating purposes, is made from gasoline (light petroleum) on the premises. The plant is extremely simple and very nearly automatic. Air is drawn over the surface of gasoline which is placed in a tank sunk some feet below the surface of the ground at suitable distance from the building. The resulting mixture of air and gasoline vapour forms the illuminating gas. In order that such gas can be used economically as a fuel the carbon should be completely burnt, and a further supply of air is required to bring about a total combustion. In the Amherst apparatus the same arrangement which draws the air over the gasoline supplies an extra blast of air to the burners. Dr. Goessman, the director, assured us that the process had now been in operation for over a year and had given excellent satisfaction. Gas by this method costs about $1.00 to $1.25

per 1,000 feet, according to the price of gasoline. I have dwelt somewhat at length upon this method of manufacturing gas, as it does not seem improbable but that we shall have to adopt some such system for the laboratories of the farm.

The laboratory of the Bussey Institute, near Boston, is of good size, about 27 by 40 feet, and is furnished with a large fume cupboard of good width, the floor of which is of brick and the front enclosed with sliding glass doors.

It was thought desirable whilst in Boston to see the laboratories of the Institute of Technology. In all the branches of Applied Science this institution was found to be very well equipped as to apparatus, appliances and models. The laboratories intended for pupils are very large and capable of accommodating over one hundred students at once. There was no shelving for bottles upon the tables; the students keeping apparatus and chemicals in the drawers and cupboard assigned to each of them. The waste water, containing as a matter of course, often large quantities of corrosive chemicals, is conducted by means of an open pitched gutter, which can be examined at any time by removing certain of the floor boards. This arrangement obviates the expense of removing the pipes from time to time and has some features to recommend it where students are engaged in studying chemistry practically, but on the other hand it is to be noted that there would be a great likeliness of foul odours arising into the laboratory unless a large flow of water was continually kept running.

The question of the purity of the water supplied to our Canadian cities and towns I deem of such importance that I venture to bring before the Government, through you, the work of Mrs. Ellen H. Richards, who, at the time of our visit, was engaged in the laboratories of the above institution upon the analysis of a large number of the waters of the state, under the direction of the State Board of Health. This work is of a most useful and important character, and it can hardly be too strongly emphasized that such an investigation into the condition of our water supplies should be commenced and systematically carried on from time to time. In this connection I would also refer to the work in water analysis inaugurated some years ago, and since carried on, by the members of the Society of Public Analysts in England. The result of their labours has been to bring about greater uniformity in methods of water analysis, and with greater uniformity in methods has come greater uniformity and reliability in the interpretation of the results of such examinations. Standards of purity by which waters may be judged have been proposed in England and are satisfactory for English waters; but these can scarcely be applied with accuracy to a large number of Canadian waters, owing to the different character of the source of the supply, and before we can make and adopt standards for ourselves more data are required.

As pure water is an indispensable article of diet, without which health cannot be preserved, and as impure and contaminated water has been proven to be the source of so many diseases, it becomes a matter of the greatest importance that all public water supplies should be examined and reported upon by competent chemists, and that farmers and others not drawing from such supplies should have an opportunity offered them—perhaps at a small cost—of having their water examined. That wells in the country should be examined may, by some, be thought to be unnecessary, but I am convinced that there is much impure water drunk in the country, owing to the ignorance of many digging their wells in the barnyard or in close proximity to a source of contamination. In many instances where the soil is sandy the wells often act as a cesspool for draining a large adjacent area, and if in such area excreta or urine are allowed to lie, the consequence is that the water is but a more or less diluted sewage.

From Boston I went to Washington in order to see the laboratories of the Bureau of Agriculture, as well as to attend the Fourth Annual Convention of the Association of Official Agricultural Chemists. This association, as its name implies, consists of analytical chemists connected with the United States Department of Agriculture, or any State Experimental Station or educational institution having official control over fertilizers, and who are engaged in analytical work and research

upon soils, cattle foods, dairy products, and other materials of agricultural industry. However, other chemists are welcomed to the meeting, and discussion invited from all who may be present. The result of these annual conventions and the publication of the proceedings has been fraught with much good; greater accuracy and uniformity in the processes and results of analyses has been brought about, and thus much benefit bestowed upon the agricultural population. Interesting and valuable reports were read by the chairmen of the several committees appointed at the annual meeting last year. These reports were on the analysis of cattle foods, fertilizers and dairy products.

Dr. W. H. Wiley, Chemist to the United States Department of Agriculture, very courteously conducted me through the laboratories, which are in the basement of the building and are now much too small for the number of chemists working and the amount of analytical work in progress. The tables ranging round the sides were amply supplied with water and gas, and being covered with white tiles about 6 inches square, presented a very clean and nice appearance. A central table, with a large sink in the centre, is furnished with filter-pumps of an improved kind to the number of ten, thus allowing the prosecution at the same time of a large number of analyses which require this useful and indeed indispensable adjunct. Special places were set apart for apparatus for the determination of nitrogen by Kjeldahl's method and Soxhlet's extraction apparatus. This method, where space allows, of setting up pieces of apparatus in a permanent manner saves very much of the analyst's time.

There were special rooms for photography, storing of chemicals, apparatus, &c. Distilled water is here continuously made in connection with the steam heating apparatus.

A short visit was paid to the Laboratories of the famous John Hopkins' University, Baltimore, but as they are intended and fitted up for students' work, I shall not go into details. There are here also special rooms for photography, gas analysis and combustion work—the latter supplied with large hoods over the furnaces to carry off the gaseous products of combustion.

On returning to Ottawa I elaborated plans as to the size and arrangements of our laboratories, and submitted them to you. They are now with the Government Architect. It was thought most desirable to have two laboratories—a large and a smaller, and in connection with them a balance room which could also be used as an office for the Chemist.

As the building of these could not be begun last autumn, it was deemed advisable to procure temporary accommodation for laboratory purposes in the city of Ottawa. A suitable room, though small, was obtained in the Russell House Block, the necessary gas and water fixtures were put in, and a certain quantity of chemicals and apparatus procured.

Besides the work incumbent upon one in superintending the fitting up and arranging of the new laboratory, I have been enabled to make the following reports —which will indicate the nature of the chemical work upon which I have been engaged.

REPORT No. 1.

OTTAWA, 31st October, 1887.

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

DEAR SIR,—As requested by you, I have made a careful analysis of the marl sent in for examination by Mr. Holland, of Ottawa, and find its composition as follows:—

Calcium carbonate (carbonate of lime)	60·00
Organic matter	25·42
Sand and silicia	6·55
Alumina and oxide of iron	3·33
Moisture	4·55
Magnesia, &c	·15
	100·00

No phosphoric acid could be detected, and only traces of the alkalies were present.

The specimen, about 6 or 8 inches in size, is one of shell marl, showing a large number of small shells and also at one side a considerable amount of peat. The whole was fairly sampled and the analysis made on the quantity so obtained.

In commenting upon its value as manure, I would say that as a rule the fertilizing power of a marl depends, to a large extent, upon the amount of carbonate of lime it contains, although the value of those marls which contain phosphoric acid and potash would be enhanced thereby. The application of such marl as the one analyzed would be of especial benefit to a peaty soil which is deficient in lime.

Besides acting as a manure, marl is often useful in altering the mechanical condition of the soil. The addition of marl to a sandy soil has the effect of making the soil heavier and better adapted for holding manure and moisture, and conversely its action on clay is to produce a more pliable and easily worked soil. As carbonate of lime is not at all caustic, its application, even in excess of the amount needed, cannot result in any injury to vegetation.

I remain, Sir,
Yours very truly,

FRANK T. SHUTT, M.A., F.C.S.,
Chemist, Dom. Exp. Farms.

REPORT No. 2.

OTTAWA, 1st November, 1887.

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

DEAR SIR,—As instructed by you, I have made an analysis of the alkaline water sent by Miller Christie, Esq., of Manitoba, for examination, and find as follows:—

Solid matter per Imperial gallon, 465·22 grains, the percentage composition of which is tabulated below:

Lime (CaO)	10·55
Magnesia (MgO)	7·25
Soda (Na_2O)	25·56
Sulphuric acid (SO_3)	22·15
Chlorine	28·08
Alumina and oxide of iron	·52
Water of hydration, small quantities of carbonic acid and organic matter undetermined	5·89
	100·00

Examination with the spectroscope showed sodium to be the only alkali present.

Calculating from these figures on the supposition that the chlorine is combined with the sodium, and the magnesia with the sulphuric acid, we arrive at the following:—

	Per cent.
Sodium chloride (common salt)	46·27
Magnesium sulphate	21·75

The other constituents would then be—calcium sulphate, calcium hydrate and sodium hydrate.

The water was slightly akaline to test paper, and on standing the supernatant liquid becomes quite clear, leaving a calcareous deposit at the bottom of the jar. This deposit effervesces strongly on addition of an acid.

Owing to the fact that lime had been added to this water, the composition of its saline matter has been altered from its original condition. The above figures, therefore, do not represent accurately either the actual compounds existing in the water in its natural state or in their true proportions.

In all probability the alkali exists to a large extent as carbonate, and the effect of adding lime to such water would be to produce carbonate of lime and caustic soda, thus rendering the water much more akaline than before the treatment.

With regard to the elimination of the akali, whether it exists as hydrate, carbonate or chloride, from the water, it may be pointed out that owing to the great solubility of the salts of the alkali metals, it is impossible to suggest any practical or economic method whereby the alkali may be got rid of by precipitation.

The addition of an acid would not be efficaceous in the removal of the alkali.

The only method for rendering the water free from this saline matter and consequently fit and wholesome for use, is, I believe, distillation.

In districts where such alkaline water only is obtainable, a small distillation apparatus might be kept constantly at work. This apparatus, if attached to the ordinary cooking stove in the kitchen, would entail but little extra expense. It might be of the simplest character, consisting of a vessel of tinned or galvanized iron. This vessel would be furnished with a lid, tightly fitting and large enough to allow the vessel to be easily cleaned when necessary. A suitable tube and condenser for the condensation of the steam, could be easily attached to this boiler. The water so obtained, while entirely free from saline matter, would taste rather flat, owing to the fact that it would have parted with its dissolved oxygen during the process.

I am, Sir,
Yours very truly,

FRANK T. SHUTT, M.A., F.C.S.,
Chemist, Dom. Exp. Farms.

REPORT No. 3.

REPORT ON THE ANALYSIS OF THE WATER SUPPLY OF THE CITY OF OTTAWA.

OTTAWA, 12th January, 1888.

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

SIR,—At your request I have made an analysis of the water supplied to the city of Ottawa by the Waterworks, and have the honour to present you herewith my report thereon.

The samples were taken by Mr. Surtees, the City Engineer, and myself, on the 22nd December, as follows:

A.—From east side of slide channel, between 200 and 300 feet above mouth of aqueduct and about 600 feet from the north branch of the Rochester Creek, taken at a depth of about 5 feet below the surface.

B.—From mouth of clear water pine or inlet, in front of screen, at a depth of 10 feet below the surface.

C.—From the tap in pumping-house.

D.—From the tap in basement of City Hall.

CHEMICAL ANALYSIS.

The following table shows the results of the chemical analysis:

	Grains per Gallon.				Parts per Million.			
	A	B	C	D	A	B	C	D
Colour in 2-foot tube	Dark yellow.				Dark yellow.			
Smell at 100° F	Slightly peaty.				Slightly peaty.			
Chlorine	·035	·035	·035	·035	·5	·5	·5	·5
Phosphoric acid	None.				None.			
Nitrogen in nitrates and nitrites	·0080	·0103	·0126	·0109	·1152	·1482	·1811	.1564
Free ammonia	·0014	·0014	·0007	·0007	·01	·02	·01	·01
Albuminoid ammonia	·0091	·0084	·0084	·0084	·13	·12	·12	·12
Oxygen absorbed in 15 minutes	·1912	·1610	·1708	·1629	2·731	2·372	2·430	2·327
Oxygen absorbed in 4 hours	·3519	·3507	·3507	·3507	5·028	5·010	5 010	5·010
Solids	3·80	3·70	3·92	3·92	54·0	53·0	56·0	56·0
Hardness as $CaCO_3$	1·64	1·40	1·55	1·55	23·4	20 0	22 1	22·1

The first conclusion to be drawn from these results is that all the above samples are very similar as to their quality, that from the slide channel being somewhat the worst, owing no doubt to its containing a slightly larger quantity of suspended matter. The other three may, for all practical purposes, be considered identical.

Colour in the 2-foot Tube.—By this test pure water is colourless. The presence or organic matter, especially of a vegetable origin, in solution renders the appearance, under these circumstances, of a green, yellow or brown tint, varying in depth according to the amount of such matter contained.

Smell at 100° F.—The result of this examination may reveal the presence of an injurious quantity of organic matter, but on the other hand a very bad water may not have any objectionable odour. This test is only of importance as a supplementary one.

Chlorine in Chlorides.—The presence of chlorine in considerable quantities indicates the existence of sodium chloride derived either from this salt naturally present in the soil through which the water passes, or from contamination with sewage. The small amount found shows that all these samples of water are free from sewage pollution.

Phosphoric Acid.—Phosphoric acid, except in very slight traces, would indicate contamination with sewage. My results in this particular confirm the opinion as to the absence of sewage expressed in the preceding paragraph.

Nitrogen in Nitrates and Nitrites.—Oxidized nitrogen as nitrates or nitrites in a water points as a rule to contamination with animal organic matter or sewage. The abundance of vegetable life, however, may decompose and assimilate these salts, and hence the absence of such nitrogen cannot be considered as negative evidence as to such pollution. Analysts differ as to the value to be assigned to this datum in forming an opinion on the quality of a water, but the small quantity evinced by the

analysis taken in conjunction with the other results adds an additional proof with regard to the absence of sewage pollution.

Free Ammonia.—A large quantity of ammonia, except in water from deep wells, would probably indicate the recent contamination with sewage. The exceedingly small amount present again shows this water to be free from pollution of this sort.

Albuminoid Ammonia—Oxygen absorbed in 15 minutes and 4 hours at 80° F.—By both of these determinations we are enabled to infer the relative quantity of organic matter present in the sample of water under examination. To estimate the exact amount of organic matter in a water or to ascertain with certainty what part of such is of animal or vegetable origin, is not only difficult, but impossible.* Organic matter of an animal origin is generally conceded to be more dangerous in a water than that derived from vegetable growth; yet that decomposing vegetable matter has a toxic effect has repeatedly been shown It is as yet an undecided question if decomposing organic matter, whether animal or vegetable, is of itself poisonous apart from those low forms of life which cause such decomposition, and which are held by many to be the direct cause of disease. Bacteria require organic matter for their growth and development, therefore we may argue that water containing a large quantity of such matter is likely to contain a greater number of these micro-organisms, than water possessing but traces of organic matter.

This so-called albuminoid ammonia is evolved when a water containing organic matter is boiled with an alkaline solution of potassium permanganate, and hence the quantity found is a measure of the organic matter present. Much albuminoid ammonia from a water giving but little free ammonia points strongly to the excess of vegetable organic matter. Many waters contain less than ·05 parts per million, and ·1 part per million causes a water to be looked upon with grave suspicion, while ·15 p. p. m. would, according to Wanklyn (the deviser of the process), condemn a water for drinking purposes. In applying this standard of purity to a water we must, however, take into consideration its source, and therefore we should not be justified in condemning the Ottawa water without additional data, because it yields ·13 parts of albuminoid ammonia per million, though we must judge it impure in this respect.

The amount of oxygen absorbed during a stated interval at a stated temperature from a given amount of an acid solution of pot. permanganate again gives us a measure of the organic matter present. The more oxygen absorbed the greater the quantity of the decompositing organic matter. The excessive amount of oxygen so absorbed by this water emphasizes in a most unmistakable manner the conclusion arrived at in the preceding paragraph.

Drs. Tidy and Frankland have suggested the following scale for classifying upland surface waters from results obtained by this method:

Section 1—Upland surface water:

Class—Water of great organic purity, absorbing from permanganate of potash not more than 1 part of oxygen per million parts of water.

Class 2—Water of medium purity, absorbing from 1 to 3 parts of oxygen per million parts of water.

Class 3—Water of doubtful purity, absorbing from 3 to 4 parts of oxygen per million parts of water.

Class 4—Impure water, absorbing more than 4 parts of oxygen per million parts of water.

Section 2 is a classification for waters other than upland surface. The limit of the amount of oxygen absorbed is exactly one-half of that in the corresponding class in Section 1.

Judged by this standard it is obvious that the Ottawa water in its present condition is unfit for drinking purposes owing to the large excess of dissolved vegetable organic matter.

That the organic matter is vegetable in its origin is borne out by the fact that the ratio of the amount of oxygen absorbed in fifteen minutes to that absorbed in

*Nichols' "Water Supply," page 36.

four hours is nearly as 1 : 2, whereas if the matter were of animal origin the ratio would approach 1 : 15.

Although vegetable organic matter, as before stated, cannot be considered as injurious as that of animal origin, yet the excessive quantity here found is quite sufficient to render highly necessary a purification of the water before being used for drinking purposes.

The absence of organic matter as derived from sewage may or may not be attributable to the fact that for several days previous to the 22nd of December the day upon which the samples were taken, the temperature was considerably below the freezing point, and consequently the water of the Rochester Creek had ceased to flow. If previously the city water was polluted from sewage matter brought down by this creek the larger volume of water, together with the swift current of the river would easily account for the absence of such contamination at this date.

We shall now apply the standard of purity proposed by Drs. Muter and Wigner, celebrated English analysts, in order to ascertain the relative degrees of purity of the Ottawa water.

Dr. Muter's scheme takes into consideration and assigns values to the amounts of free ammonia, albuminoid ammonia, and the oxygen absorbed in 15 minutes and four hours. He proposes that the following limits, "supposing no other consideration intervenes to modify the analyst's opinion of the sample," should be observed:

First-class water	up to ·25 degrees
Second class water	up to ·40 do
Undrinkable water	over ·40 do

By this classification the Ottawa water would rank as undrinkable, its value being 1·61.

Mr. Wigner's scale includes a value for each of the determinations enumerated in the table of results. The limits by this scheme are as follows:

Extremely pure water	15
First-class water	40
Second-class water	65
Third-class water beyond	65

The Ottawa water, according to this scale, gives a valuation of 134·5, being entirely condemned for drinking purposes.

We must, however, remember that those standards were proposed for English waters, the sources of which are altogether different from many of our Canadian waters, and therefore great care should be used in interpreting the results of an analysis by these standards. But even considering the source of the Ottawa supply we must look upon it with grave suspicion and strongly deprecate its use as a potable water without previous purification.

It may not be uninteresting to compare this water with that supplied to Toronto. Dr. W. Hodgson Ellis, Professor of Applied Chemistry and Public Analyst, Toronto, has for some time past made thorough analyses of the Toronto water, and in an exhaustive report to the Toronto City Council last June proposes for the comparison of waters a scale to illustrate the "average degree of impurity." Applying this scale to the results of his analyses, Dr. Ellis tabulates as follows:

	Average degree of organic impurity.
Bell buoy (Lake Ontario)	22
Pumping well	22
Reservoir	21
Hydrant	22
Eastern gap (Toronto Bay)	39

By this scale the Ottawa water would equal 188.

BIOLOGICAL EXAMINATION.

A microscopical examination of the deposit of this water, which has been allowed to settle in a suitable vessel, reveals the presence of vegetable débris, algae, diatoms and infusoria, but not insufficient quantities to condemn the water from this cause alone.

It has been before observed that the organic matter of a water serves as food for bacteria, and consequently the number of these organisms in water gives a measure of the organic purity of a water. For the purpose of this report we may classify bacteria into pathogenic and non-pathogenic forms. To distinguish between these is a matter of great difficulty and often requiring some months of arduous work. The number of bacteria, apart from their nature, in a given volume, is, however, of much value, as will be seen from the results of Prof. R. Ramsay Wright's investigation on the water of the Toronto supply. Some of his results are tabulated below.

Number of Bacteria per Cubic Centimetre.

No. 1—Bell buoy (Lake Ontario, mouth of inlet pipe).....	0
No. 2—Eastern gap (Toronto Bay).....	5,000
No. 3—Reservoir.....	10
No. 4—Tap in School of Science	17

From these figures he draws, among others, the conclusions that the water No. 2 is unfit for drinking purposes; that the water at the Bell buoy is pure from bacterial life and sewage contamination; at the time of examination that the tap water in this respect compares very favourably with that of New York, London, Berlin and other cities.

I have subjected to such an examination the four waters enumerated above, the samples being taken on the 5th inst., with the following result.

	Bacteria per c. c.
A.....	135
B.....	100
C.....	96
D.....	145

From these numbers I am unable to make any distinction between these waters as to their degree of organic purity.

Those who have made such investigations the object of research give it as their opinion that water containing but 50 micro-organisms per c. c. would be ranked as very pure, while a water containing 1,000 per c. c. should be subjected to some cleansing operation before use for drinking purposes.

The present analysis shows that the Ottawa water is surcharged to a dangerous extent with vegetable organic matter. Whether this is temporary or not it is impossible to say from one analysis. It is very reasonable to suppose that the character of the water has been affected by the long continued drought of the past summer, and we may expect therefore that the water may improve rather than deteriorate, I would suggest that analyses be made of the water at regular intervals, in order to gain information on this most important point.

As the majority of the citizens have but the city water to draw from, it may not be out of place to suggest some means whereby they may render the water comparatively free from any noxious principle it may contain.

By far the greater number of bacteria in fluids are killed below the temperature of boiling water, and especially is this true of most of the pathogenic forms. Their spores, as a rule, are capable of sustaining their vitality at temperatures which are fatal to the parent forms, yet, if the water is boiled for a few minutes, from 2 to 15, we may insure the death of nearly or quite all of these micro-organisms. This boiling, however, will not remove the dissolved organic matter. Effective filtration not

only abstracts suspended matter, but removes by adhesion and oxidation much of this dissolved organic matter. Sand filtration on the large scale lessens the amount of organic matter in solution according to the thickness of the filtering medium, and the rate at which the water passes through the medium.

Some of the best filtering materials for domestic purposes are animal charcoal and spongy iron, which latter Bischop has shown to be capable of destroying bacterial life.

Dr. Albert R. Leeds, of New Jersey, in a paper before the American Association for the Advancement of Science, at its last session, upon the causes of typhoid fever, and the means of eliminating such causes, proposes a method to rid water containing the typhoid bacillus by adding one-half grain of alum to each gallon of the water to be used. By this method, he says, all the peaty matter is precipitated along with the bacteria, leaving a water brilliant and limpid. The alumina is all taken out by the precipitation, and chemical tests failed to reveal its presence in the supernatant liquid. In a contaminated water containing 8,000 bacteria per c. c., the author showed that after this treatment the water only contained 8 bacteria per cubic centimetre.

Respectfully submitted.

FRANK T. SHUTT, M.A., F.C.S.,
Chemist Dom. Exp. Farms.

REPORT No. 4.

CENTRAL EXPERIMENTAL FARM LABORATORY,
OTTAWA, 4th February, 1888.

"Saline water from boring 170 feet deep on base line in Section 31, Township 4, Range 1, west, Manitoba. Strong spring in abundant supply." Sent by Mr. John Lowe, Acting Deputy Minister, Department of Agriculture.

Prof. WM. SAUNDERS,
Director Dominion Experimental Farms.

SIR,—As the result of my analysis of the above saline water, I have the honour to report as follows:—

Constituents expressed in parts per 1,000 of the water—

Sodium (Na.)	6·573
Magnesium (Mg.)	·577
Calcium (Ca.)	1·180
Iron and Aluminium (Fe. & Al.), (traces).	
Silicon (Si.), (slight traces).	
Chlorine	10·785
Sulphuric Acid (SO_4)	2·122
Carbonic Acid (CO_3), (traces).	
	21·237
Total solid contents by direct experiment, dried at 180° c.	21·198

From the above it may be deduced that the principal compound is common salt, amounting to 17·153 parts per 1000, or 1200·71 grains per gallon. The remaining solid compounds consist of magnesium and calcium sulphates and chlorides, with small quantities of carbonates of these metals, the latter (carbonates) being held in solution as the more soluble bicarbonates.

The water is but faintly alkaline to test papers. Experiment shows no volatile alkali to be present.

To the query as to whether "if condensed, would products be useful as a fertilizer?"—I must answer that as a direct fertilizer, salt is not considered to be of any value. Most plants differ from animals in not requiring salt as an essential constituent of their food. On certain soils, however, salt is beneficial to some extent as an indirect fertizer, liberating lime and potash—essentials for plant growth. This, however, may be more economically brought about, in the majority of cases, by other compounds, *e. g.*, gypsum. Salt again is sometimes used to arrest rank growth in soils too rich in nitrogenous matter. To the second part of the question I would reply that as a source for obtaining common salt this water would not be of any commercial value.

With regard to the third question proposed, "could the salt be neutralized by any chemical substance?" my reply must again be in the negative. Salt is itself a neutral body; and being an exceedingly soluble one cannot by any chemical means be precipitated in order to render the water fit for drinking purposes.

The only method to obtain from this saline water a potable one would be by distillation—such as I suggested in my last report on saline water—the condensed product being free from all dissolved solid matter.

Respectfully submitted.

FRANK T. SHUTT, M.A., F.C.S.,
Chemist, Dom. Exp. Farms.

I am now conducting a series of analyses with a view of ascertaining the relative qualities of certain wheats, and also, if possible, to find out what effect, if any, climatic influences, variety of soil, &c., have upon the constitution or composition of the same wheat. The results of these analyses will also show the comparative values of the Red Fyfe wheat, as grown in our North-West, and the newly imported Ladoga (Russian) wheat, as grown in Russia and the several Provinces of our Dominion.

All of which is respectfully submitted.

FRANK T. SHUTT, M.A., F.C.S.,
Chemist, Dom. Exp. Farms.

REPORT OF THE HORTICULTURIST.

(W. W. Hilborn.)

Prof. Wm. Saunders,
Director Dominion Experimental Farms,
Ottawa.

Sir,—I have the honour to submit herewith a report relating to the progress made under your direction in the Horticultural Department of the Central Experimental Farm.

The cultivation of fruit, still in its infancy, is becoming of great importance in the Dominion.

The great variation in soil and climate in different parts permits of the growth of a very large number of varieties to great perfection. While we cannot grow the more tender sorts of trees in the colder portions of Canada, many of the small fruits can be grown profitably, and it is hoped that the limits within which large fruits can be grown will shortly be extended much further north and west.

With that end in view a large number of Russian fruits have been secured for trial at the Central Experimental Farm. A collection is also being made of hardy western and native seedling fruits, to which will be added a great number of seedlings originated on the grounds, many of them from seeds which have ripened as far north as such can be obtained. These added will make a collection of which much may be expected.

Possession of the farm was obtained so late in the autumn of 1886 that there was no time to prepare land for orchard planting, and being unwilling to lose one season's growth a very large and valuable collection was ordered of apple, pear, plum, cherry and other fruit trees, which were received in the spring and planted in nursery rows in suitable soil. There they received suitable cultivation, and notwithstanding the severe drought which prevailed during the whole season, the trees made a satisfactory growth and formed such a mass of fibrous roots that the transplanting of them to the orchards can be done with little or no risk, and with but slight check to their growth.

APPLES.

Canadian apples command the highest prices in foreign markets and are not surpassed in any part of the world for flavour, colour, keeping and shipping qualities, we need not, therefore, be afraid of successful competition.

The demand for the apples of this country for export is increasing much more rapidly than the supply, and will, it is believed, continue to do so as the knowledge of their superior qualities becomes better known; more attention should therefore be given to this fruit in those localities where it grows to such perfection.

The collection at the Experimental Farm already consists of 903 apple trees, 297 varieties, of which 174 are from Russia and other parts of Northern Europe. Of these trees 216 were planted out in orchard last autumn to test the relative merits of fall as compared with spring planting.

A fine piece of sandy loam was selected for the orchard; it was manured early in the season, well ploughed and the soil got into good condition for planting. This plantation will be extended early in the coming spring. Those which were put out last autumn were planted thirty feet apart each way, the trunks loosely wrapped in tarred paper and earth drawn up around the base of each tree to the height of from twelve to fifteen inches.

CRAB APPLES.

Of this fruit the collection contains 26 trees, of 12 varieties, chiefly of American origin, most of which should succeed in this locality.

PEARS.

Pears cannot be grown over as large a portion of the Dominion as apples, yet there are many localities where they can be produced in great perfection. The attempts at their cultivation in the Ottawa valley has not yet been attended with much success.

In order that a thorough test of them may be made on the Experimental Farm a collection has been secured consisting of 298 trees of 101 varieties, 45 of which are from Northern Europe. Further additions will be made to this list in the way of seedlings and supposed hardy sorts, and it is hoped that some at least will be found which will endure the severe winter weather in this locality and prove valuable not only here but also in other colder portions of the Dominion.

PLUMS.

Large crops of wild plums are grown in this vicinity; they succeed very well indeed, but to what extent the improved varieties in cultivation will prove hardy is yet an experiment.

The experience of fruit growers here would indicate that as far as tested there are none of the improved sorts that will endure more than a few years at most. In the course of the farm work that, however, will not be taken for granted, but specimens of many of the leading varieties have been obtained for trial and comparison with the native seedlings.

The collection at present consists of 197 trees of 72 varieties, 32 of which are from Russia and other parts of Northern Europe.

No pains will be spared in making a collection of native seedlings and in the endeavour to raise the standard of that fruit much above its present level.

CHERRIES.

Cherries have not been planted very extensively around Ottawa. Greater interest will, therefore, be felt in our collection of 155 trees of 71 varieties, 54 of which are from Russia and other parts of Northern Europe, among which are some very hardy and valuable sorts of the Ostheim and Vladimir families.

PEACHES.

It is not expected that peach trees will endure the severe winter climate in this locality, hence the number of trees planted of that fruit is small, 25 in all, of 11 American varieties.

APRICOTS.

Of this fruit seven trees only have been obtained consisting of four varieties, two Chinese and two European.

This completes the list of large fruits obtained in the spring of 1887. Most of the trees are large enough to plant in the orchards, which will be done in the coming spring.

A careful record will be kept of every tree, and such information as is gained which promises to be useful will be reported on from time to time.

SMALL FRUITS.

These can be grown over a much greater area than large fruits, in fact, wherever wheat or other grain will succeed many small fruits can be grown very successfully.

In the great North-West of Canada these desirable fruits should be tried extensively and may be planted in every settlement with good prospects of success.

GRAPES.

Grapes succeed remarkably well in the Ottawa Valley, although the seasons are somewhat shorter than in Western Ontario they appear to ripen earlier and are of the best quality.

All varieties must be laid down and protected during winter; in this way even the more tender sorts can be successfully grown.

The collection at the farm contains 891 vines of 127 varieties. The greater portion of them have been planted ten feet apart each way to be trained on trellis, a number have been planted to be trained in another form, and another lot in rows four feet apart and two to three feet apart in the row after the French system, these will be tied to short stakes, well pruned back so that the fruit spurs may be near the ground. A fine location has been selected for the vineyard on a high piece of sandy loam sloping to the south.

CURRANTS.

The currants are planted in rows six feet apart and four feet apart in the rows.

All of the leading varieties have been obtained in large enough quantities to test their value for market purposes. The collection consists of 865 bushes of 20 varieties of the standard named sorts of red, black and white, to which may be added nearly 100 new seedlings, some of which are very promising.

GOOSEBERRIES.

The plantation of this fruit contains 251 bushes of 30 named varieties and about 50 most interesting unnamed seedlings, many of which are of Canadian origin.

RASPBERRIES.

The raspberries were all planted in rows six feet apart and from two to four feet apart in the rows. 50 to 100 plants each of all the leading varieties were obtained to test their market value. A special plantation was also made to grow young plants from for future planting. In all 3,650 plants have been secured, containing 38 named varieties, and about 200 unnamed seedlings, most of which have been originated by Prof. Wm. Saunders, and among them are many hybrids between the black and red varieties.

Quite a number of these bushes produced fruit last season of a very large size and fine quality, showing also great productiveness. There was one worthy of special attention. The fruit was large, salmon yellow, of very fine quality and wonderfully productive. Should the plant retain these qualities on further trial, and prove to be healthy and hardy, it will deserve to stand high on the list of yellow raspberries. There are also some very interesting hybrids between the raspberry and blackberry in this collection, but none of them have yet fruited.

BLACKBERRIES.

Until recently there were no blackberries in cultivation hardy enough to prove valuable except in the most favourite localities. Among the newer introductions there are several hardy sorts that promise to succeed wherever raspberries can be grown.

The collection on the farm contains more than 500 plants of 20 named sorts; these were planted in rows six feet apart and from three to four feet apart in the rows.

All of the above small fruits except the grapes have been allowed full possession of the land to the exclusion of any other crop. The land occupied by them is a fine sandy loam, but was not in good condition, and was very weedy at the time of planting with a large number of Canada thistles. The one-horse cultivator was freely used between the rows and all weeds cut out with hoes from between the plants until the end of August, which had the effect of thoroughly destroying the weeds, and also caused the soil to retain moisture enough to keep the plants growing nicely; after this cultivation was discontinued to give the new wood time to ripen up in order to enable the plants to stand the cold and trying winter. For further protection the soil was ploughed up toward the rows of plants which will be worked down again in spring.

STRAWBERRIES.

The plantation of strawberries consists of 90 named varieties and about 50 unnamed seedlings. There are 20,900 plants in all. These have been planted in rows three and a half feet apart and one foot apart in the rows. Most of the blossoms and all runners that first made their appearance were cut off. When the plants gained sufficient vigor to send out several runners at once those were allowed to grow and form plants thus making the rows about one foot in width at the end of the growing season.

The weather was very dry and hot during the period of their growth, but the frequent cultivation they received enabled them to withstand the drought and make very satisfactory progress.

Late in the autumn after the ground had frozen to the depth of two or three inches they were mulched with coarse manure and straw, most of which was put between the rows with just enough over the plants to nearly cover them from sight.

Many varieties were planted in sufficient quantities to test their value for market purposes. They are in a favourable condition to give a full crop of fruit in 1883, when they will be watched with much interest, as a large number of the varieties have never fruited before in this vicinity.

W. W. HILBORN,

Horticulturist.