TWENTY-FOURTH ANNUAL REPORT

OF THE

ONTARIO AGRICULTURAL COLLEGE

AND

EXPERIMENTAL FARM

1898.

(PUBLISHED BY THE ONTARIO DEPARTMENT OF AGRICULTURE.)

PRINTED BY ORDER OF

THE LEGISLATIVE ASSEMBLY OF ONTARIO.

TORONTO:
WARWICK BRO'S & RUTTER, PRINTERS, ETC., 68 AND 70 FRONT STREET WEST.
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TWENTY-FOURTH ANNUAL REPORT

OF THE

ONTARIO AGRICULTURAL COLLEGE

AND

EXPERIMENTAL FARM

FOR THE YEAR 1898.

GUELPH, January 2nd, 1899.

To the Honorable JOHN DRYDEN,
Minister of Agriculture:

SIR,—I have the honor to transmit herewith the Twenty-fourth Annual Report of the Ontario Agricultural College and Experimental Farm.

In this report. the work of the year 1898 has been briefly reviewed under the following heads:

PART I. REPORT OF PRESIDENT.
PART II. REPORT OF PROFESSOR OF PHYSICS AND LECTURER IN ENGLISH.
PART III. REPORT OF PROFESSOR OF BIOLOGY AND GEOLOGY.
PART IV. REPORT OF PROFESSOR OF CHEMISTRY.
PART V. REPORT OF PROFESSOR OF VETERINARY SCIENCE.
PART VI. REPORT OF PROFESSOR OF DAIRYING.
PART VII. REPORT OF PROFESSOR OF AGRICULTURE.
PART VIII. REPORT OF PROFESSOR OF HORTICULTURE.
PART IX. REPORT OF PROFESSOR OF BACTERIOLOGY.
PART X. REPORT OF EXPERIMENTALIST.
PART XI. REPORT OF FARM SUPERINTENDENT.
PART XII. REPORT OF MANAGER OF POULTRY DEPARTMENT.
PART XIII. REPORT OF APICULTURIST.
PART XIV. REPORT OF PHYSICIAN.

I have the honor to be, Sir,
Your obedient servant,

JAMES MILLS,
President.

THE ONTARIO AGRICULTURAL COLLEGE

AND

EXPERIMENTAL FARM, GUELPH, ONT.

HON. JOHN DRYDEN, Toronto, Ont.,
Minister of Agriculture.

JAMES MILLS, M.A., LL.D	President
A. E. SHUTTLEWORTH, B.A.Sc., Ph.D.	Professor of Chemistry
H. H. DEAN, B.S.A.	Professor of Dairy Husbandry
J. HUGO REED, V.S.	Professor of Veterinary Science
J. B. REYNOLDS, B.A.	Professor of Physics and Lecturer in English
WM. RENNIE	Farm Superintendent
C. A. ZAVITZ., B.S.A.	Experimentalist
WM. LOCHHEAD, B.A., M.S.	Professor of Biology and Geology
G. E. DAY, B.S.A.	Professor of Agriculture
H. L. HUTT, B.S.A.	Professor of Horticulture
F. C. HARRISON, B.S.A. (who has charge of Library)	Professor of Bacteriology
R. HARCOURT, B.S.A.	Assistant Chemist
M. W. DOHERTY, B.S.A., M.A.	Assistant in Biology
I. N. BECKSTEDT	Assistant Resident Master
W. MCCALLUM, B.S.A.	Fellow in Biology
A. T. WIANCKO, B.S.A.	Assistant Librarian
L. G. JARVIS	Manager and Directer in Poultry Department
R. F. HOLTERMANN	Lecturer in Apiculture
CAPTAIN WALTER CLARKE	Instructor in Drill and Gymnastics
W. O. STEWART, M.D	Physician
G. A. PUTNAM	Stenographer
A. MCCALLUM	Bursar

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PART I.

REPORT OF THE PRESIDENT.

The Ontario Agricultural College and Experimental Farm reports another prosperous session. The work of the year just ended has been done without a jar, and substantial progress has been made in the different departments. It may be said, in a word, that the institution is gaining the confidence of the farming community, and doing much valuable work for the Province as a whole—stemming the tide from country to city; preparing young men for agricultural pursuits; conducting experiments for farmers, fruit growers, and dairymen; publishing the results of work done from year to year; assisting at Farmers' Institutes and other public meetings; and contributing in various ways, directly and indirectly, to the dignity and success of farming as an occupation.

Attendance of Students.

The attendance of students during the past year has been the largest in the history of the College. Every bed has been occupied, and several students have had to lodge outside. The total number on the roll in 1898 was 333—223 in the regular course and 110 in the dairy course. Of these in the regular course, 87 per cent. are from Ontario, 7¼ per cent. from other provinces of the Dominion, and 5¾ per cent. from other countries.

Ages and Religious Denominations.

The ages of students in the regular course last year varied from sixteen to thirty-one years, averaging twenty years. The dairy students were somewhat older.

The religious denominations were as follows: In the regular course,—76 Methodists, 75 Presbyterians, 39 Episcopalians, 14 Baptists, 6 Roman Catholics, 3 Friends, 3 Brethren, 2 Congregationalists, 2 Christadelphians, 1 Lutheran, and 1 Christian Church; and in the dairy course,—41 Presbyterians, 37 Methodists, 18 Episcopalians, 10 Baptists, 3 Roman Catholics, and 1 Congregationalist.

Counties Represented.

The students at the College in 1898 represented 41 counties and 4 districts,—18 from the county of Wellington, 9 from Simcoe, 8 from Huron, 7 each from Dundas, Lincoln, Middlesex, Wentworth, and York, 6 each from Lambton, Northumberland, and Oxford, and smaller numbers from other counties.

Analysis of College Roll (*General Course*).

(1) From Ontario.

Algoma	1	Middlesex	7
Brant	4	Norfolk	2
Bruce	1	Northumberland	6
Carleton	4	Ontario	5
Dufferin	3	Oxford	6
Dundas	7	Parry Sound	3
Durham	2	Peel	1
Elgin	2	Perth	5
Frontenac	3	Peterboro'	4
Glengarry	2	Prescott	

ANALYSIS OF COLLEGE ROLL.—*Continued.*

Grenville	1	Prince Edward	3
Grey	3	Renfrew	1
Haldimand	4	Russell	3
Halton	3	Simcoe	8
Hastings	4	Stormont	2
Huron	8	Victoria	3
Kent	2	Waterloo	5
Lambton	6	Welland	5
Lanark	2	Wellington	18
Leeds	3	Wentworth	7
Lennox	2	York	7
Lincoln	7	Toronto	13
Manitoulin Island	2		194
Muskoka	1		

(2) FROM OTHER PROVINCES OF THE DOMINION.

Manitoba	2	Prince Edward Island	1
Northwest Territories	1	Quebec	6
New Brunswick	2		16
Nova Scotia	4		

(3) FROM OTHER COUNTRIES.

Bermuda	1	Jamaica	1
England	8	Asia Minor	1
Scotland	1		13
United States	1		
Total in general course	223		

COUNTY STUDENTS.

By an Act of the Legislature, each county council in the Province has power to send one student free of tuition. Of those on the roll in 1898, 61 were nominated by county councils, and as a consequence were exempted from the payment of tuition fees. The counties and districts which exercised the power of nomination last year (42 in number) were the following: Algoma, Brant, Bruce, Carleton, Dufferin, Dundas, Durham, Elgin, Glengarry, Grenville, Grey, Haldimand, Halton, Hastings, Huron, Kent, Lambton, Lanark, Leeds, Lennox, Lincoln, Middlesex, Muskoka, Norfolk, Northumberland, Ontario, Oxford, Parry Sound, Peterboro, Peel, Perth, Prescott, Prince Edward, Renfrew, Simcoe, Stormont, Victoria, Waterloo, Welland, Wellington, Wentworth, and York.

MORE ROOM NEEDED

Increase in dormitory accommodation is needed, and should be provided as soon as the Government can spare the money required for certain alterations and the erection of two new buildings, one for a physical laboratory and the other to embrace the library, the reading-room, and a medium-sized hall for the weekly meetings of the College Literary Society and the annual meetings of the Experimental Union, which of late years has met in the Experimental Museum, but cannot do so hereafter, because the new cases for exhibiting the best varieties of grain, corn, grasses, etc., will henceforth occupy all the available space in said museum.

If a new library building were erected outside, and a wing 40 by 47 extended back from the south end of the main College building, sufficient increase in dormitory accommodation could be provided. That portion of the main building now occupied by the library could be changed into dormitories, and the two upper stories of the proposed addition could be used for the same purpose, the lower storey being required for a Physical Laboratory for practical work in general and soil physics.

Soil Physics.

When so much depends upon the crops grown from year to year, there can be no question as to the importance of a very thorough and persistent study of the soil in its relation to heat, moisture, and fertility, as affected by humus, tillage operations, etc. It used to be thought that a chemical analysis of a soil, showing its various constituents, was all that was necessary; but it was at length shown by experiment that land might contain all the constituents of plant food in due proportion, and still be unproductive, owing to a lack of moisture, or a sodden condition due to a deficiency of vegetable matter in the soil, or the fact that the ingredients of the soil had not been worked over and exposed to the frost and atmosphere in such a way as to make them available for plant food. Hence the importance of studying the physical condition of the soil—the results of underdraining, the effects of various tillage operations on the retention of moisture for the use of plants, and the power which humus, or vegetable matter, has to retain heat and water in the soil. These and many other important problems come under the head of Soil Physics.

Our Professor of Physics, J. B. Reynolds, B.A., has commenced a series of investigations under this head, and will push the work along as fast as he can, consistently with the large amount of teaching which is required of him. Last year he found by actual tests on plots in the College Experimental Grounds, that soil which was kept open by stirring the surface as often as was necessary to prevent a crust from forming, contained 37 per cent. more moisture in the first two feet, measured from the surface, during the month of July, than the same kind of soil in an adjoining plot, the surface of which was not disturbed. Hence the value of stirring the earth around trees and shrubs in dry weather, and the need for frequent cultivation of corn, roots, potatoes, etc., during the summer months.

Biology and Geology.

After twenty years of faithful service in the College, J. Hoyes Panton, M.A., F.G.S., Professor of Biology and Geology, died on the 2nd February last. No one could serve an institution more faithfully and conscientiously than Professor Panton served the Ontario Agricultural College. He was a man of rare integrity and devotion to duty —a good scholar, a hard-worker, a clear and impressive lecturer; and he possessed exceptional skill in simplifying and popularizing the facts and teachings of science for farmers and others who had not received a scientific training. His death was a great loss to the College.

As Professor Panton's illness began in August, 1897, we had to arrange as best we could for the work of the department from October, 1897, to June, 1898. Most of the advanced work was done by F. C. Harrison, Bacteriologist; the entomology was taken by H. L. Hutt, Horticulturist; some classes in botany and zoology were taught by J. C. Macdonald, Fellow in Biology; and most of the practical work in zoology was done by Dr. John McCrae, of the General Hospital, Toronto.

On the 15th September, Wm. Lochhead, B.A., M.S., of the London Collegiate Institute, a teacher well and favorably known throughout the Province, was appointed Professor of Biology and Geology, and M. W. Doherty, B.S.A., a graduate who took a post-graduate course and the degree of M.A. in Cornell University, was appointed Assistant in Biology.

The department is fairly well equipped, and good work is expected both for the students in attendance and for farmers and others who may want information about noxious weeds or troublsome insects.

Chemistry.

A. E Shuttleworth, B.A.Sc, Ph.D., Professor of Chemistry, has been in Germany for a year and seven months (May 15, 1897, to December 13, 1898), most of the time at Göttingen University, studying and doing laboratory work in agricultural chemistry,

and one or two kindred branches. During his absence, he not only completed the work for a degree at Göttingen, but took a course of lectures at Halle, spent a short time in the University of Berlin, and visited the principal agricultural experiment stations in the German Empire. He sat under some of the ablest professors of chemistry in Europe, observed the latest methods of research and instruction, and is now qualified for first-class work in the Department of Chemistry.

During Dr. Shuttleworth's absence, R. Harcourt, B.S.A., Assistant Chemist, took charge of the work and proved himself a good executive officer and a very acceptable lecturer and demonstrator in chemistry. W. A. Kennedy, B.S.A., (employed and paid by Professor Shuttleworth), did most of the analytic work in the Station Laboratory, including the analysis of a large number of samples of butter and whey, a series of digestion experiments with Lucerne cut at different stages of growth, and a considerable amount of research to determine the manure value of the root residue of Lucerne and three varieties of clover,—Common Red, Mammoth Red, and Alsike Clover.

Veterinary Science.

The live stock of the institution suffered very little from disease last year. Hence there is not much of special interest to report under that head. The lectures and practical demonstrations in the Department of Veterinary Science were thorough and practical as usual.

Dairying.

The Dairy School opened on the fourth January and continued in session for three months. The number in attendance was 110, and the work of the session was quite satisfactory. A considerable proportion wrote for certificates; and most of those who did so were successful. Many of the best cheese-makers and butter-makers in the Province have taken a course at the school, and the demand for graduates is rapidly increasing.

During the remaining nine months of the year—April to December inclusive—the attention of the department was devoted to experimental work,—T. O. Rogers, instructor in butter-making, having been employed in the butter room, and R. W. Stratton, assistant instructor in cheese-making, in the cheese room. These men, under the supervision of Prof. Dean, did a large amount of work, with a view to answering some of the many questions which arise in the home dairies and factories of the Province.

One result of these experiments may be mentioned in passing, viz., that which relates to the methods of paying for milk at cheese factories. Three methods are followed in the factories of the Province: the quantity method (the weight of the milk alone being considered); the fat method; and the fat-and-casein method. The final result of a long and elaborate series of experiments carried on for a number of years at the College, is that *the fat-and-casein method*, or payment on the basis of the percentage of fat in the milk plus two per cent. for the casein, is the fairest; next to it is the fat method, based on the percentage of fat in the milk; and the most unfair of all is the quantity method, based on the weight of the milk. This last method is far from just. It takes large sums of money from patrons who furnish rich milk and gives it to those who furnish poor milk. A single example will show how unfair this method is: 300 lbs. of milk containg 4.2 per cent. of fat made 35 lbs. of cheese, while 300 lbs. of milk containing 3.2 per cent. of fat, or one per cent. less, made only 26½ lbs. of cheese, or a difference of 8½ lbs. of cheese on 300 lbs of milk. The difference on a season's make would be a very considerable sum. This method puts a large premium on poor milk, and cheats the man who sends good milk; and the better the milk, the more the sender is cheated.

For a full account of experiments in the Dairy Department, see Prof. Dean's report in Part VI. of this volume.

Experimental Feeding.

Stock-feeding is a very important branch of farming in this Province. Hence Mr. G. E. Day, our Professor of Agriculture, has been conducting experiments in the feeding of cattle, sheep, and swine. In cattle-feeding, he has been determining and comparing the net results from heavy, medium, and light rations of meal, fed with bulky food, such as cut hay and roots; and in all cases so far—in tests extending over two years—the heavy ration of meal has proved the least profitable. In pig-feeding, he has been comparing the different breeds, judged by the requirements of the export bacon trade, and has been working along several lines to ascertain the cause or causes of softness in meat. He has already obtained results which involve suggestions as to what the causes are; but these results will have to be verified by further experiments, which are now in progress.

For an account of the experiments under this head, see Prof. Day's report in Part VII. of this volume.

Horticulture.

Of late years, more attention has been given to horticulture at the College than formerly. The orchard has been considerably enlarged, the small fruit plantation has been increased in size, and a great number of variety tests have been made. Last year, tests were made with 219 varieties of strawberries, fifteen of red raspberries, fifteen of black raspberries, nine of blackberries, thirteen of currants, thirteen of gooseberries, eleven of tomatoes, 270 of geraniums, and thirty of coleus. A faithful comparison of variety with variety was made by the head of the department, Mr. H. L. Hutt, Professor of Horticulture; and many valuable items of information were obtained.

A full account of the instruction and experiments in this department will be found in Prof. Hutt's report, Part VIII. of this volume.

Bacteriology.

Bacteriology, including the manufacture of tuberculin for distribution throughout the Province, has become a strong department of College work; and there seems to be practically no limit to the useful and interesting fields of investigation which open before the student in this comparatively new branch of scientific research. Last year, the demands for tuberculin were considerable, and the appeals for laboratory investigation on several lines were urgent; but the addition of a large part of Prof. Panton's work in botany and histology (animal and vegetable), to the regular class-room duties and laboratory demonstrations with students in the department, left the Bacteriologist very little time for original work.

An account of the work and instruction in this department will be found in Prof. Harrison's report, Part IX. of this volume.

Field Experiments.

The work of field experiments is enthusiastically carried on by C. A. Zavitz, the College Experimentalist: and, as regards the selection of seed; dates and methods of seeding; the growing of mixtures of grain; and the testing of varieties of cereals, potatoes, roots, clovers, grasses, etc.,—there is no place on this continent or in Europe where better, more extensive, or more valuable work is done than on the Experimental Grounds at the Ontario Agricultural College. The ordinary reader or observer does not realize the magnitude or importance of the work. In my last report, I stated that "in oats and barley alone, the varieties introduced and distributed by our experiment station have, within the past four or five years, paid to the Province a good deal more than the entire cost of the College for the last ten years;" and having since gone into the facts and figures, I do not hesitate to say that my statement was correct. We sent out cards of inquiry and received many replies, declaring that the *Siberian oats* and

Mandscheuri barley, for instance, (introduced and distributed by our Experimental Department), have benefited the farmers to the amount of thousands of dollars in neighborhood after neighborhood.

For a full account of the work under this head, see Mr. Zavitz's report, Part X. of this volume.

Farm Proper.

The work in the Farm Department has been carried on with the same vigor and success as for several years past. The methods, especially in the cultivation of the soil and the growing of crops, are such as we can commend to our students, and the results are very satisfactory. The stock kept on the farm is about the same as for some years past, while the average annual expenditure for feed purchased—bran, etc.—for the maintenance of stock in the three years, 1896-1898, is just one third of what it was from 1890 to 1892 inclusive, both being considered in relation to the average annual revenue of the farm for the periods mentioned; and the average net annual expenditure, after making due allowance for stock imported in '91 and '92, is about one-third in the three years ending 1898, of what it was in the three years ending 1892.

The chief point of interest in the Farm Department last year was the feeding of steers tied up in the usual way *versus* steers loose in box stalls. The lots were carefully selected, so as not to give one method any manifest advantage over the other. The food for both lots was the same, and the general treatment in every respect the same. The lot in the box-stalls did considerably better than those which were tied up; and two other lots fed about the end of the year gave similar results.

A brief account of last year's work in the department will be found in Mr. Rennie's Report, Part XI. of this volume.

Other Departments.

In the other departments, there is nothing of special interest to report. Mr. L. G. Jarvis, manager of the Poultry Department, conducted some experiments in cross-breeding and made a few tests with water-glass and other mixtures used for preserving eggs. Mr. R. F. Holtermann, Apriculturist, gave the first and second year students a course of lectures as usual, and did some experimental work in his apiary at Brantford. Accounts of the work done in these departments will be found in reports by Mr. Jarvis and Mr. Holtermann, Parts XII. and XIII. of this volume.

Governor-General's Prize.

We do not devote much time to military drill; but our students, under the direction of Captain Clarke, do well whatever they undertake in this line. Hence they have often won the cup offered by the Governor General for competition among the batteries of the Dominion. Last year they carried off the Earl of Aberdeen's prize with a lead of 40 points.

Excursionists to the College.

Of late years, a great number of farmers visit the College in the month of June. They come to inspect the different departments of the Institution, especially the experimental grounds, and, if possible, to learn something which will be of use to them on their own farms. The number which came last year was about 30,100.

Class-Room Work.

The class room work in the different departments has gone on as usual. Thirteen candidates wrote for the B.S.A. degree in the University of Toronto, and eleven of them were successful. A fair proportion of first and second year students gained a respectable

standing in our College examinations; but the percentage of failures is still very large, resulting in some cases from idleness, but in most instances from a lack of early training in the elementary branches of an English education.

Examiners.

The third year examinations were conducted as usual, by examiners appointed by the Senate of the University; and those of the first and second years by the professors and instructors of the College, with the assistance of Wm. Tytler, B.A., of Guelph.

Bachelors of the Science of Agriculture.

The examinations for the degree of B.S.A. were held in the month of May, and the successful candidates received their degrees at the commencement exercises of the University in June. The list is as follows:

Beam, E	Black Creek, Welland, Ont.
Butler, W. E	Dereham Centre, Oxford, Ont.
Clark, G. H	Cainsville, Brant, Ont.
Craig, R. D	Guelph, Wellington, Ont.
Davis, A. N	Cayuga, Haldimand, Ont.
Elliott, W. J	Seaforth, Huron, Ont.
McCalla, G. B	St. Catharines, Lincoln, Ont.
Ross, H. R	Gilead, Hastings, Ont.
Ross, M. N	Warrington, England.
Ross, N. M	" "
Summerby, W. L	Russell, Russell, Ont.

Recipients of Associate Diplomas

Deike, H. V	Guelph, Wellington, Ont.
Grisdale, J. H	Russell, Russell, Ont.
Hammell, W. H	Beeton, Simcoe, Ont.
Harris, C. H	Rockwood, Wellington, Ont.
Hawke, A. H	Winnipeg, Manitoba.
Hollis, J. H	Shelby Bay, Bermuda.
Hopkins, A. G	Highfield, York, Ont.
Hume, H. H	Marvelville, Russell, Ont.
Hutt, W. N	Southend, Welland, Ont.
Jarvis, C	Guelph, Wellington, Ont.
Jarvis, T	" "
Kennedy, W. J	Vernon, Carleton, Ont.
Livingstone, J. M	Sarnia, Lambton, Ont.
*McLaurin, J. D	Vankleek Hill, Glengarry, Ont.
Mallory, F. R	Frankford, Hastings, Ont.
Marshall, F. R	Westbrook, Frontenac, Ont.
Murdoch, G. H	Bobcaygeon, Victoria, Ont.
Price, W. J	Marsville, Dufferin, Ont.
Raynor, M	Rose Hall, Prince Edward, Ont.
Robertson, M	Meaford, Grey, On.
Ross, D. A	Martintown, Glengarry, Ont.
Scott, W. C	Kingston, Frontenac, Ont.
Snider, C. H	Attercliffe, Lincoln, Ont.
Taylor, G. R	Harley, Brant, Ont.
Thomson, G. T	Blenheim, Kent, Ont.
†Tozeland, J. H	Killarney, Manitoba.
Wagg, A. J	Mindemoya, Manitoulin Island, Ont.
Westgate, H. P	Watford, Lambton, Ont.
Wilson, E. S	Dundas, Wentworth, Ont.
Zavitz, H. V	Coldstream, Middlesex, Ont.

* To take supplemental examination in Literature.
† " " Bee-Keeping.

First-Class Men.

The work of the College is divided into five departments; and all candidates who get an aggregate of seventy-five per cent. of the marks allotted to the subjects in any

department, are ranked as first-class men in that department. The following list contains the names of those who gained a first-class rank in the different departments at the examinations in 1897, arranged alphabetically:

First Year.

1. Goble, F. W., Woodstock, Ont., in one department: Mathematics.
2. Linklater, Wm., Stratford, Ont., in four departments: Agriculture, Natural Science, Veterinary Science, and Mathematics.
3. Mortureux, C. E. M., Quebec, P.Q., in two departments: Natural Science and English.
4. McMillan, E. J., New Haven, P.E.I., in four departments: Agriculture, Natural Science, Veterinary Science, and Mathematics.
5. Robertson, J. A., Blantyre, Ont., in one department: Agriculture.

Second Year.

1. Grisdale, J. H., Russell, Ont., in five departments. Agriculture, Natural Science, Veterinary Science, English, and Mathematics.
2. Hopkins, A. G., V.S., Highfield, Ont., in two departments: Veterinary Science and Mathematics.
3. Hume, H. H., Russell, Ont., in four departments: Agriculture, Natural Science, English, and Mathematics.
4. Hutt, W. N., Southend, Ont., in one department: Natural Science.
5. Kennedy, W. J., Vernon, Ont., in three departments: Agriculture, Natural Science, and Veterinary Science.
6. Price, W. J., Marsville Ont., in two departments: English and Mathematics.

Expense of the Institution.

The people of this country have become accustomed to large expenditures of money for the education of a small fraction of the population for the various professions. They think it is quite right to spend $100,000 to $150,000 a year in a university to fit young men for law, medicine, teaching, and preaching, but a great mistake to spend half that amount in an institution to fit equally able and intelligent young men for the public and private duties required of them in general farming, fruit growing, dairying, stock raising, etc., and to qualify some of them for teaching these subjects and the various sciences related thereto. Indeed, very few have anything like an adequate conception of what is meant by a properly equipped agricultural college. Most people think of it as merely a farm, which should be managed so as to pay all expenses.

The facts are, that a strong and efficient agricultural college is like an arts college or university, except in one or two particulars:

(1) The agricultural college in a province like Ontario is working for the education of that section of the community which represents about seven-tenths of the population, while the arts colleges are all working for the education of another section, which represents about one-tenth of the population.

(2) The Agricultural College has several heavy items of expense, in addition to all or nearly all the outlay necessary in an arts college—such, for instance, as a farm, buildings, implements, and live stock for practical instruction in agriculture; buildings, dairy cattle, and expensive appliances for instruction in milk-testing, butter-making, and cheese-making; orchard, garden, greenhouses, and special laboratory for instruction in horticulture; men, horses, and implements for field experiments; buildings, men, and animals for experiments in stock feeding, etc.,—all this in addition to the buildings, class-rooms, and laboratories required in an Arts College.

From this it is manifest that an ordinary Arts College or University should not cost the country so much as an equally well equipped Agricultural College.

The people of the United States, taking a broad, statesmanlike view of this question, are spending quite as much on their agricultural institutions as on their arts colleges and universities. Take the following as fair samples:

Agricultural College for the State of Wisconsin—

Annual expenditure, apart from erection of buildings.....$60,000
Amount of salaries paid annually..... 28,000

Instruction in English, mathamatics, and sciences being furnished free by the State University at the same place.

Agricultural and Mechanical College for the State of Iowa—

Annual expenditure, apart from buildings.....100,000
Annual salary bill..... 50,000
Four of the principal buildings cost as follows: Main Building, 80,000; Agricultural College Hall, $45,000; Morrill Hall, $38,000; and Margaret Hall, $50,000—nearly all paid for by direct taxation.

Agricultural and Mechanical College for the State of Michigan—

Annual expenditure, apart from buildings.....$108,812
Annual salary bill..... 42,426

This Institution has a large number of very expensive buildings.

Dean Henry, of the Wisconsin Agricultural College, writes that, "An Agricultural College, when properly run, is the most expensive of any kind of school that can be imagined. There must be plants and animals for illustrative purposes, and these are expensive to procure and expensive to care for and soon pass away. There is also a large amount of machinery and other illustrative material. I hope our legislators will soon see that Agricultural Colleges are expensive and that this expense must be provided for; or else take the opposite course and abolish them altogether. We had better have good Institutions or none at all. The last three biennial legislatures of Minnesota have given their Agricultural College $150,000 for buildings; and Bills are now in the legislature of that state providing $80,000 more for buildings and equipment for their Agricultural College,"—all this for an institution which was fairly well equipped eight or ten years ago.

I have honestly endeavored to keep down the expenses of the Ontario Agricultural College in every department, and have been altogether too illiberal in the matter of salaries. Our expenditure is only about half that of American agricultural colleges for similar work. Yet some stand aloof and say that the College costs too much. To all such, I would say that a good college cannot be maintained for less. In fact, we should have an immediate outlay of about $20,000 for buildings and an addition of nearly $3,000 to our annual maintenance expenditure.

Personally, I very much prefer to work in a strong, well-equipped, and well-manned college, and I am inclined to think that the Province of Ontario cannot afford to have an inferior institution to represent the great industry of agriculture in its various branches.

JAMES MILLS,
President.

O. A. C., Jan. 2, 1899.

FINANCIAL STATEMENT FOR 1898.

I. College Expenditure.

(a) *College Maintenance.*

1. *Salaries and wages*		$19,860 18
2. *Food*—		
Meat, fish, and fowl		4,834 03
Bread and biscuit		1,200 07
Groceries butter, and fruit		4,890 01
3. *Household expenses*—		
Laundry, soap, and cleaning		86 90
Women servants' wages		1,943 53
4. *Business Department*—		
Advertising, printing, postage, and stationery		1,071 05
5. *Miscellaneous*—		
Maintenance of chemical laboratory		494 86
" physical laboratory		204 20
" biological laboratory		240 58
" bacteriological laboratory		297 90
Library and reading-room—books, papers, and periodicals		742 69
Medals		64 50
School assessment		132 00
Unenumerated		601 74
		$36,664 24

(b) *Maintenance and Repairs of Government Buildings.*

Furniture and furnishings	$584 05	
Repairs and alterations	1,314 91	
Fuel	3,364 75	
Light	1,074 25	
Water	12 50	
Sewage disposal	381 26	
		6,731 72
		$43,395 96

College Revenue.

Fees	$2,106 95	
Balances on board accounts	6,048 93	
Gas used by students	47 00	
Chemicals	3 86	
Supplemental examinations	10 00	
Sale of tuberculin	45 68	
Sale of oil to other departments	24 00	
Sundries—bones, old iron, etc.	14 55	
Paid by F. C. Harrison for time of engineer and assistant fitting pipes at his house	21 30	
Contingencies—fines, breakage, etc.	149 01	
		8,471 28
		$34,924 68

II. Farm Expenditure.

(a) *Farm Proper.*

1. *Permanent improvements*—		
Fencing, new cement silo, etc		$609 29
2. *Farm maintenance*—		
Salary of Superintendent	$1,200 00	
Wages of foreman and men	2,930 25	
Purchase of live stock for feeding, etc	2,196 67	
Maintenance of stock	585 82	
Seed	130 06	
Binding twine	14 00	
Repairs and alterations (including blacksmithing)	373 28	
Furniture and furnishings	274 54	
Tools and implements	250 46	
Advertising, printing, postage, and stationery	147 48	
Fuel and light	4 32	
Contingencies	106 27	
		8,213 10
		$8,822 39

Cash Revenue of Farm Proper.

Sales of cattle—21 steers, 32,185 lbs., at $4.65	$1,496 60	
" " 15 steers, 20,800 lbs., at $4.90	1,019 20	
" " 1 bull	60 00	
" " 8 cows, $26 to $59 each	287 00	
" " 3 grade calves, $3 to $5 each	12 00	
" " 10 pure bred calves, sold by auction	560 45	
" pigs—3 pigs, 1,170 lbs., at $3.00	35 10	
" " 4 " 700 " $4.00	28 00	
" " 8 " 1,488 " $4.60	68 44	
" " 11 " 2,284 " $4.75	108 50	
" " 8 " 1,423 " $4.80	68 30	
" " 6 " 900 " $5.10	45 90	
" " 15 " 2,360 " $5 75	135 70	
" " 67 sold by auction	825 80	
" sheep—31 sheep, $5 to $15	318 30	
" wheat—277.40 bushels at 73c	202 69	
" " 218.33 " $1.00, and 66 bags at 25c., and 28 at 10c.	234 55	
" " 12 " $1.25	15 00	
" barley— 15 " 60c	9 00	
" " 209.36 " 65c.; 40 bags at 20c., and 38 at 10c.	148 09	
" " 2⅔ " 75c , and 1 bag at 20c	2 07	
" oats— 210 " 55c.; 39 bags at 20c., and 43 at 10c	122 68	
" peas— 195.15 " 80c.; 42 bags at 20c., and 15 at 10c	165 30	
" potatoes—18 " 30c.	5 40	
" milk—660 lbs., at 80c. per 100	5 28	
" " 1,104½ quarts at 4c	44 18	
" wool—261 lbs., (unwashed) at 13c	33 93	
" " 202 " " 12c	24 24	
" hide and skins—4 sheepskins	3 70	
" screenings—815 lbs., at $1.00 per 100	8 15	
Services of animals	207 50	
Sundries	44 55	
		6,345 60
Net expenditure of farm proper		$2,476 79

(b) *Experimental Plots and Feeding.*

1. *Permanent improvements*—Alterations in buildings, &c		$32 60
2. *Maintenance*—		
Salary of experimentalist	$1,500 00	
Foreman	386 68	
Teamsters	588 00	
Experimental feeder	360 00	
Wages of laborers	1,837 11	
		$4,671 79
Seeds	$356 56	
Manure and special fertilizers	149 80	
Stock for feeding	1,082 15	
Furnishing and repairs (including blacksmithing)	393 98	
Printing, postage, and stationery	99 83	
Tools and implements	183 95	
Feed and fodder	506 90	
Contingencies	159 04	
		$2,932 11
		$7,636 50

REVENUE.

Sales of sheep—2 sheep						$17 87	
" " 17 "	2,265 lbs.	@	5c			113 25	
" cattle—10 steers,	13,965 lbs.	@	$4.25			593 50	
" " 1 steer,	1,300 lbs.	@	$4.00			52 00	
" " 1 "						39 50	
" pigs—14 pigs,	2,142 lbs.	@	$3.85			82 45	
" " 19 "	3,000 "		$4.00			120 00	
" " 59 "	8,998½ "		$4.25			382 43	
" " 2 "	279 "		$4.50			12 55	
" " 4 "	686 "		$4.90			33 60	
" " 1 "	185 "		$5.00			9 25	
" " 9 "	1,517 "		$5.35			81 15	
							1,537 55
Net expenditure under this head							$6,098 95

III. DAIRY DEPARTMENT.

(a) *Experimental Dairy.*

Salary of buttermaker and instructor, nine months	$487 50
" cheesemaker, nine months	500 00
" engineer and assistant in experimental work	276 00
" cattleman and assistance in milking	465 40
Temporary assistance	50 77
Purchase of milk for experimental work	947 23
Purchase of cows	383 72
Feed and fodder	408 62
Furniture, furnishings, and repairs	1,015 68
Advertising, printing, postage, and stationery	63 54
Laboratory expenses—gas, chemicals, etc	71 83
Fuel and light	373 71
Contingencies	112 55
	$5,156 55

REVENUE.

Sales of butter,—	3,875 lbs.	@	20c			$775 00	
" " 46 "			16c			7 36	
" " 115 "			15c			17 25	
" cheese,—	270½ "		6c			16 29	
" " 913 "			7c			63 91	
" "	1,349½ "		7½c			101 21	
" "	4,180 "		8c			334 40	
" " 874 "			8⅛c			71 01	
" " 25 "			8¼c			2 14	
" "	2,088½ "		8⅜c			177 52	
" "	1,139½ "		9c			102 55	
" milk,—	5,610 lbs.	@	80c per 100			44 88	
" "	7,292 "		74c "			53 95	
" "	6 823 "		72c "			49 12	
" "	1,615 quarts	@	4c			64 60	
" skim and buttermilk,—	1,800 lbs.	@	10c per 100			1 80	
" "	7.050 "		15c "			10 57	
"	56 gals. buttermilk	at	5c			2 80	
" cream,—	167 quarts	@	15c			25 05	
" " 21 "			20c			4 20	
" cattle,—	5 cows, 1 @ $25 00 and 4 @ $30.00					145 00	
" "	4 grade calves @ $1.50 to $9.00					17 00	
" "	5 pure bred calves @ $11.00 to $24.00					91 55	
Sundries						10 08	
							2,189 24
Net expenditure of Experimental Dairy							$2,967 31

(b) *Dairy School.*

Wages of instructors for 3 mos.	1,602 48
Engineer, for 3 mos	105 00
General helper	79 98
Services of boy and board of engineer	24 00
Cleaning, etc	16 00
Purchase of milk for use in School	4,420 00
Dairy appliances	448 27
Expenses of cheese and butter judges	2 35
" inspecting factories	18 75
Advertising, printing, postage, and stationery	160 60
Fuel and light	135 08
	7,012 51

REVENUE.

Sales of butter—11,883 lbs. at 18½c. to 21c	2,369 19	
" cheese—16,927¾ lbs. at 6c. to 9c	1,323 34	
" skim milk—3,180 lbs. at 15c. per 100	4 75	
" whey—season's make	25 00	
" cream—3½ quarts at 20c	70	
" sundries	5 00	
Registration fees	102 00	
		3,827 98
Net expenditure of Dairy School		$3,184 53

IV.—POULTRY DEPARTMENT.

Salary of manager		700 00
Temporary assistance		40 70
Purchase of stock		25 00
Feed, etc		168 24
Furnishings and repairs		191 90
Fuel and light		58 29
		1,184 13

REVENUE.

Sales of poultry—118 birds @ 25c. to $12.00 each	159 65	
" " 29½ pairs dressed @ 60c to $1.00	21 62	
" eggs for setting—44⅓ settings @ $1.00 to $1.50	62 68	
" " for domestic use—330½ doz. @ 10c. to 25c	49 41	
		293 36
Net expenditure of Poultry Department		$890 77

V.—HORTICULTURAL DEPARTMENT.

1. *Permanent Improvements*—Paving drives, etc		97 85
2. *Maintenance*—		
Salary of foreman and head gardener	650 00	
" assistant gardener	528 00	
" assistant in greenhouses	380 00	
Wages of teamster and laborers	1,826 10	
Manure	105 01	
Trees, plants, bulbs, and seeds	302 31	
Tools, implements, furnishings, and repairs	394 37	
Fuel and light	605 05	
Contingencies	282 69	
		5,073 53
		5,171 38

REVENUE.

Sale of berries—914½ boxes @ 4c.	36 58	
" potatoes—20 bush. @ 25c.	5 00	
" tomatoes—2 " @ 50c.	1 00	
" " 2 " @ 45c.	1 35	
Sundries—Old iron, etc	4 86	
Paid by F. C. Harrison, for time of men and team grading piece of ground near his house	24 29	
		70 83
Net expenditure of Horticultural Department		5,096 55

NOTE.—The produce of the Horticultural Department is used in the College. We are not allowed to sell anything from the department, except a little now and then to officers of the Institution.

VI.—MECHANICAL DEPARTMENT.

Salary of foreman		700 00
" extra carpenter for erection of buildings, etc		700 00
Tools, etc		82 49
Fuel and light		11 10
		1,493 59

REVENUE.

Paid by F. C. Harrison for time of carpenter working on his house	172 13
Net expenditure of Mechanical Department	1,321 46

SUMMARY.

Total net expenditure in all departments.—College, Farm, etc. :—

I.	College and Government Buildings	$34,924 68
II.	Farm—	
	1. Farm proper	2,476 79
	2. Experimental plots and feeding	6,098 95
III.	Dairy Department—	
	1. Experimental Dairy	2,967 31
	2. Dairy school	3,184 53
IV.	Poultry Department	890 77
V.	Horticultural Department—Garden, greenhouses, lawn, orchard, small-fruit and forest tree plantations, etc	5,096 55
VI.	Mechanical Department	1,321 46
		$56,961 04

Unexpended balance on the year's operations in all departments, $1,912.96.

JAMES MILLS,
President.

ARM.

$34,924 68
2,476 79
6,098 95
2,967 31
3,184 53
890 77
5,096 55
1,321 46
$56,961 04

esident.

PART II.

REPORT OF THE LECTURER IN

ENGLISH LITERATURE AND PHYSICS.

To the President of the Ontario Agricultural College :

SIR,—I have the honor to present herewith my report of the departments of English and Physics.

ENGLISH. The study of English literature has been continued under much the same conditions as formerly. The students who attend this College do not by any means lack in appreciation of literature. I do not find any difficulty in arousing interest in class-work in English Literature, or in inducing a close study of the authors prescribed. The works of the best English authors are well appreciated, and, in class and out, sometimes justly criticized. So far, matters are encouraging to the teacher. But the great weakness of many of the students is in composition. The cause is, undoubtedly, lack of practice and of proper instruction. In spelling, punctuation, vocabulary, and rules of grammar, many are very deficient. Within the short time at our disposal during the course here, it is impossible to give them the requisite knowledge and skill in the use of language; so some of them receive their diplomas with very meagre attainments in that most essential branch, English composition. It would perhaps seem an injustice to a good student, who has acquired considerable knowledge in the practical and scientific studies, to withhold from him a diploma from an Agricultural College on account of deficiency in English; but there is no doubt that many pass out from this College, accredited associates and graduates, who have no confidence in their own ability to write a passable article for an Agricultural journal. This is not as it should be, and I am doing my best to reduce this undesirable condition of things to a minimum. For the Preparatory and First Years, your assistant in the Residence is responsible in the matter of composition. I sometimes assign subjects for these classes, and require papers to be handed in or to be read in class; but it is with the second and third years that I have mainly to do. With the Second Year I follow the plan of weekly essays, on subjects assigned by myself, or occasionally left to themselves to choose. These essays are read carefully and marked closely during the week; then they are handed back and the errors discussed in a part of the lecture period. With the present second year I am able already to report a very noticeable advance in the general style and appearance of the weekly essays. For the present I have assigned a subject to cover three weeks; they are to write on either "The Fat Stock Show," or "The Experimental Union," both of which are soon to take place. The Third Year have considerable practice in Seminary work, writing of essays on subjects connected with their special departments. Besides this, in the English department they are

assigned subjects for a small number of essays, with a month in which to prepare. The first essay for this year was on one of the following subjects: England in Egypt, the Chinese Question, and Cuba. These essays have been handed in, and a new subject assigned, namely, Elizabethan Literature. This amount of work is all that time, either of students or of teacher, will allow.

The additions to the Library in the department of English Literature have been judiciously selected. A very creditable collection of commentaries is now on hand. Shakespeare and Tennyson are especially well represented. These commentaries are of great value in teaching, and are extensively referred to by all the classes of students.

PHYSICS. The department of instruction in Physics continues to advance. We have now, I think, a good course in Mechanics, both in lectures and laboratory work. This is taken during the Fall Term, and includes a practical study of different systems of pulleys, the lever in various forms, the tread-power, a study of friction, and other questions in Statics and Mechanics. In outside work, measuring areas with the chain, and determining levels for draining and grading. A broad course in Soil Physics is given in the Winter Term, with laboratory work.

To the Third Year work a short course of lectures and observations in Meteorology has been added. This includes readings of the humidity, temperature, and barometric pressure at different periods of the day; changes in temperature that different soils undergo during the day when exposed to the sun's rays; a comparison of the ranges of temperature of air, water, and soils wet and dry, dark and light; and observations of weather, with a systematic method of taking notes upon the phenomena observed.

METEOROLOGY. Early in the summer I began making systematic observations in Meteorology. These observations have been carried on since about June the first. This Autumn I arranged with the Observatory at Toronto to keep the meteorological records at this station, and the Observatory sent some instruments to assist in these records. We have now a raingauge, maximum and minimum thermometers, wet and dry-bulb thermometers, and a hair hygrometer. The barmometer belonging to the department has recently been repaired and adjusted, and is now in first-class condition. At present, observations are taken three times a day, and recorded in a book kept for that purpose, monthly records being sent to the Observatory. Part of this work has been done by the specialists in the Third Year; and I intend them to continue the same until they have become sufficiently expert and accurate in taking observations. In addition to reading the instruments, observations of the weather are taken, such as the amount of blue or of cloud in the sky, mist, haze, time of rain or snow, and other weather phenomena. This course is useful, not only in establishing habits of observing those indications and changes in the weather, but also in making them familiar with the correct terms and methods of expressing the phenomena observed.

Below will be found the Humidity and Dew-point records for the five months, June to October, inclusive. It would perhaps not be amiss to explain these terms briefly. When the air is saturated with moisture, as during a rain or a mist, the humidity registers 100. The figures of the humidity column give the amount of vapor present in the air compared with the maximum amount at saturation. A reading of 50 means that the air contains only 50 per cent of its greatest possible vapor content. The dew-point is the temperature at which dew would deposit if the temperature were to fall to that point; that is, if the temperature at any time were 60, and the dew-point 46, then if the temperature should fall to 46, as it likely would before midnight, the air would be saturated with vapor, and some of the vapor would condense and be deposited as dew. The determination of due point may safely be used to forcast frosts, since the temperature seldom falls below the dew-point. When the dew-point is reached on any night, the condensation of vapor results in the liberation of large quantities of heat, thus keeping the temperature up so long as dew continues to fall. But if the dew-point at six o'clock, say, were 32, there is danger of frost, since the freezing point is reached before heat can be liberated by the condensation of water-vapor. There are various ways of determining

the dew-point. A simple method is as follows: A bright tin or silver cup, a thermometer, and some ice and water, are required. After nearly filling the cup with water, ice should be added slowly, until the outside of the cup becomes clouded. The water inside the cup is then at the temperature of dew-point.

		Dew-point.			Humidity.			h
		9 a.m.	2 p.m.	5 p.m.	9 a.m.	2 p.m.	5 p.m.	
		°	°	°	%	%	%	
June	Av.	47.5	47.5	49.	73.8		4.7	
	Max.	69.5	69.5	66.7	91.		99.	
	Min.	37.2	38.2	39.	49.		40.	3.36 inches.
July	Av.	55.	61.	57.	64.	49.7	52.	
	Max.	71.5	71.	71.	86.	89.	91.	
	Min	38.5	41.2	35.5	41.	26.	32.	1.33 inches.
August	Av.	60.1	55.6	55.	85.8	57.3	56.5	
	Max.	68.5	69.	67.	100.	84.	100.	
	Min.	54.	47.	43.	77.	32.	36.	1.99 inches.
September	Av.	59.	64.5	60.	83.5	63.5	71.7	
	Max.	73.	73.	73.	100.	100.	100.	
	Min	36.	39.	35.	59.	38.	36.	2.61 inches.
October	Av.	48.1	48.7	45.8	92.3	79.6	76.2	
	Max.	70.	72.	71.	100.	100.	100.	
	Min.	25.5	21.	21.5	70.	49	41.	4.18 inches.

In the above table, the average of the dew-point and humidity readings is given for each month, at three periods of the day, 9 a.m., 2 p.m., and 5 p.m. The maximum and minimum dew-point and humidity for each month, at each of the hours, are also given. On studying these figures, the following facts will be observed:

1. The dew-point, on the average, varies but little throughout the day, but is generally slightly higher at 2 p.m. If the actual amount of moisture in the air remained the same, the dew-point would also be stationary. Any changes, therefore, will be explained in the next note, on humidity.

2. Generally, the humidity is lower at two p. m., that is, when the temperature for the day is highest. There are three causes affecting humidity, namely, evaporation of moisture from the surface of the ground, which takes place during the heat of the day, and of course increases the humidity; secondly, heating the air, by increasing the capacity of air for moisture, lowers the relative humidity; thirdly, some of the vapor present in the air, being lighter than the air itself, rises into the higher regions of the atmosphere, and thus lowers the humidity. Hence, there are two causes operating to lower the humidity of the air, and one to raise it; and as these forces are seldom, if ever, perfectly balanced, it will be seen that the humidity is constantly changing. Also, according as the evaporation of moisture from the ground is more or less rapid than the rising of the vapor into the higher regions, will the dew point rise or fall.

8. The average humidity for the month varies directly with the amount of rainfall, and inversely with the temperature. September and October being colder months, the air is more moist.

Determination of Soil Moisture.

Last year we began some experiments in the determination of soil moisture. This year, with better equipment, our work has been much more extended. To begin with, it was necessary to procure some convenient instrument for taking samples of soil from the field. A spade will do the work, but it has its disadvantages. After some inquiry among investigators along the same line, we adapted an instrument used at some of the

American Experiment Stations by the addition of a little invention of our own. The sampler we have used this season consists of a seamless brass tube one foot in length, and three quarters of an inch in diameter, with a female thread cut at one end. To fit this, an iron shank about three feet long, with a similar thread outside was made. Through the top of the shank a wooden handle two feet long passed to serve as a lever in turning the instrument and boring into the soil. Into the other extremity of the brass tube were fixed two closely-fitting knives, about half an inch long, made of the hardest steel, and slightly curved so as to cut out a tube of soil somewhat smaller than the brass tube through which the soil passes. The instrument is forced into the earth by a combination of boring and downward pressure.

With this borer we can take samples to the depth of three feet or more. After boring to the depth of one foot, the borer is withdrawn, the brass tube with the moist soil is unscrewed from the shank and slipped into a tin case, which is labelled and immediately closed with a cork to prevent evaporation. Then a second brass tube is fitted to the shank, the instrument is shoved down the hole previously made and another foot of the soil below the former is sampled. It has been our practice this season to sample three depths of soil, extending to one foot, from one to two feet, and from two to three feet in depth, respectively. After all the samples for the day have been taken, they are carried to the laboratory, the soil removed from the tubes, weighed, dried, weighed again; and by taking the difference of the two weighings the amount of water contained by the soil is determined. The percentage is reckoned by comparing this difference with the weight of the soil as it came from the field.

Samples were taken at intervals varying with the weather. When the weather remained uniformly fine, once in three days was found to be often enough. A sample was taken as soon as possible after a rain, and again in twenty-four hours, so as to determine the rates of percolation, transpiration and evaporation.

The Effect of Surface Cultivation on the Moisture of the Soil.

The experiments under this head were conducted on plots one rod square, situated side by side, under conditions exactly similar, with the exception of the difference in the surfaces. The surface of one was kept loose and fine,* while the other was not interfered with. Neither of them bore any crop, so that any difference must be due to the treatment of the surfaces. The experiment was carried on for three months, May, June and July. In May seventeen samples were taken, in June thirteen, and in July nine. In July the continued dry weather made it unnecessary to sample so often.

Below is a table giving the average per cent. of moisture for each of the three months.

—	May.			June.			July.		
Average temperature ..	54.3			60.			69.		
Total rainfall	2.02 inches			3.36 inches			1.33 inches		
Per cent. of moisture in the soil:	1st ft.	2nd ft.	3rd ft.	1st ft.	2nd ft.	3rd ft.	1st ft.	2nd ft.	3rd ft.
Plot "A" (loose) ...	18 6	19.9	17.7	18.3	20.1	17.4	16.7	18 8	17.4
Plot "B" (compact).	17.8	17.5	18.1	17.9	18.4	18.0	16.1	16.9	17.7

*Note.—As the plot was only one rod square, it was cultivated with a hoe and rake—cut to a depth of about two inches with the hoe and then pulverized and loosened with the rake. On large areas, the work can be equally well done with a scuffler or cultivator.

By comparing plot A with plot B, the following differences may be noticed: Throughout the whole three months, the upper two feet below the mulched surface contained more water than that below the compact surface. For May, plot A contains in the upper two feet eighty-seven gallons of water per square rod more than plot B; that is, an equivalent for a rainfall of six-tenths of an inch, or three-tenths of the total rainfall for the month. For June a difference is observed, in favor again of plot A, of fifty-seven gallons per square rod, or an equivalent for four-tenths of an inch of rainfall, or about one-eighth of the total rainfall for the month. For July, there is a difference of sixty-eight gallons per square rod, which is three-eighths of the total rainfall, or about half an inch. These results are presented in brief form in table below.

—	May.	June.	July.
Per cent. of total rainfall	2.02 inches	3.36 inches	1.33 inches
Per cent. of total rainfall saved by surface cultivation.	$\frac{3}{10}$ or 30%	$\frac{1}{8}$ or 12½%	$\frac{3}{8}$ or 37½%

Hence we observe: The drier the weather, the greater is the beneficial effect of surface cultivation. This conclusion should not be overlooked. It declares that, in a comparatively wet month, such as June of this year, surface cultivation has less effect on the saving of moisture. The farmer need not be alarmed about this, since at such a time there is enough and to spare of moisture in the soil. The most important problem in cultivation is how to keep enough moisture during a dry season. The above results show plainly that in a dry season, surface cultivation can easily make all the difference between failure and a good crop. The right time to practice mulching, then, is particularly during a dry season, and, to repeat, the drier the weather the greater is the relative effect of this kind of labor.

A second point of importance in these results may be seen by comparing the figures in the first table. It will be observed that, while the two surface layers of the soil have more water when mulched, the third foot, without exception, has less. This shows that the excess of moisture in the upper two feet is due not only to the prevention of evaporation from the surface, but partly to another cause, namely, that the mulching of the surface, by keeping the soil under the mulch more moist, preserves its capillary power. It is well known that a dry and hard soil loses its capillary power, and it appears from these figures that the unmulched soil is less able to bring the water from below.

To sum up our results, the thirty-nine observations, extending over a period of three months, declare the following:

1. Surface cultivation conserves moisture; and the drier the weather, the greater is the relative effect.

2. Surface cultivation keeps the ground in better condition for lifting the water from below to the roots of plants.

Some Investigations in Dairy Physics.

Last year during the session of the Dairy School, my attention was called to some peculiarities in the theory of the separation of the cream from the serum by the deep-setting system. In order to arrive at some facts upon which to found correct explanations, I began some physical investigations with butter, cream, whole milk, and skim milk, with a view to determining two things, namely, the expansibility of the different constituents, and their relative rates of cooling and heating.

TABLE 1.—Showing the Rate of Expansion.

Temperature: C. F.	10°—20° 50°—68°	20°— 40° 68°—104°	10°— 40° 50°—104°
Water	.000152	.000297	.....
Skim-milk	.000175	.000286	.000231
Whole milk	.000260	.000367	.000313
Cream	.000582	.000628	000605

The expansion co-efficients of the different products are given in Table 1. Taking the first reading of skim-milk, .000175 means that one cubic centimetre of milk at 10°C., if heated to 20°, would occupy 1.00175c.c., that is, $1+(000175\times10)$. Some curious results are stated in this table. First, it is evident that the greater the amount of butter fat or other solids in the milk, the more uniform is the expansion. Cream has nearly the same rate of expansion at all temperatures. Pure water increases its rate of expansion quite rapidly with increase of temperature. A second and more important point in the results is in their relation to the separation of cream by the deep-setting system. The rate of expansion or of contraction between the limits 68° to 50°F. is, for serum, .000175; for cream, 000582. The cream therefore contracts about three and a half times as fast as the serum within the limits of temperature usual for the deep-setting method. Hence, while the serum is always heavier than the cream, the latter very rapidly approaches the specific gravity of the former as they cool. They are therefore becoming more and more nearly equal in weight; so that whatever is the cause of the more rapid separation by the cooling system, it cannot be due to an increase in the difference of specific gravity, since the opposite is the case. I am well aware that there is nothing new in this statement, since the usual explanations of the process of separation by cooling recognize the facts contained in the foregoing table. It may, however, be an advantage to those who are teaching the subject to have definite figures to use; and I have not seen in the standard works on dairying any exact information on this point.

TABLE 2.—Showing the Rate of Cooling.

Excess of temperature.	54°C.	44°C.	34°C.	24°C.	14°C.
Butter	3.67	2.92	2.14	1.41	.87
Skim-milk	2.59	1.98	1.47	.905	.443
Cream	2 50	1.994	1.47	.95	.446
Whole milk	2.34	1.81	1.32	.890	.462

TABLE 3 —Showing Specific Heat.

Butter	.531
Cream	.841
Whole milk	.932
Skim-milk	.956

Table 2 and 3 deal with the specific heat of the same products, with the addition of pure butter fat. This specific heat was determined by two methods; first, by cooling. A test tube full of milk, cream, or butter, as the case might be, was heated to a high temperature, and then suspended in the air to cool, with a thermometer in it. The rate of cooling was observed, the time required to fall 10 degrees in temperature being chosen as the standard. In table 2, the upper horizontal line of figures denotes the differences between the temperature of the cooling body and that of the surrounding air, at the different stages of the experiment. The second horizontal line denotes the rate, that is, the number of degrees per minute, at which butter cools. At a difference of 54° C. between the butter and the surrounding air, butter cools at the rate of 3.67 degrees per minute.

Table 3 contains similar results, obtained by a different method, namely the method of mixtures. This consists simply in heating the substance under experiment, and then mixing with water. The weights and temperatures of all being observed, the specific heat of the substance can be calculated, water being taken as the standard. The two tables then should indicate the same results. A rapid rate of cooling is identical with a low specific heat, and *vice versa*. Both tables agree in stating that butter fat cools much more rapidly than serum, when they are separate from one another. This contradicts many of the text-books on the subject. But it is altogether likely that the theories put forth in text-books on Dairying are not always based on exact physical experiments, but are deduced from the obvious phenomena that present themselves frequently in dairy operations.

But while both methods agree so far as butter and serum are concerned, when considered separately, they do not agree in the case of the whole milk and cream. According to table 3, the specific heat is greater, the less is the amount of butter fat contained; but in table 2 whole milk and cream do not fall into their respective places. There is an anomaly here. What the explanation is, I cannot say. I simply present the facts. There is apparently something in the surroundings of the fat before it is separated from the serum which interferes with its heating and cooling, and prevents it from following the regular law of cooling which controls it when separated into the pure butter fat. To account for this anomaly, the theory of "envelopes" may have to be revived.

Needs of the Department.

Agricultural Physics has given evidence that it affords a fruitful ground for experimental research, without requiring previously an extensive scientific training. The difficulty of the Third Year thesis work hitherto has been, that it is impossible to give to the students of the Second Year the necessary knowledge required for original research. Fortunately I do not meet with that difficulty in the department of Physics. So far, I have been able to give in the Second Year a preliminary training quite sufficient for carrying on the thesis work of the Third Year. This year out of six students following the Agriculture specialty, three are doing their thesis work entirely in my department and under my direction, and a fourth has chosen a subject that requires to be done partly in this department. At present, our quarters are far too narrow to allow this work to be done to the best advantage. The department of Physics stands greatly in need of larger accommodation. There is required: 1. A laboratory for instruction and practical work in Mechanics and general Physics for the Second and Third Years. 2. A room for the analysis and examination of soils, and for Station work. 3. A room for experiments in Soil Moisture, Temperature, and Humidity, in relation to plant growth. 4. A larger class-room. The present room accommodates only forty students, while there are nearly sixty in the present First Year.

Up to the present, I have had recourse to assistance from students with occasional help from other sources. For the past season, Mr. Roland Craig proved to be a painstaking and capable assistant. I hope that, for the coming year, you will be able to

establish a Fellowship in Physics. A Fellow, if appointed, would be engaged as follows: During vacation, assisting in station work and co-operative experiments; during the College session, assisting in laboratory instruction, carrying on such original work as is required of the department, and correcting essays and papers. It is well-known that too much of the last cannot be done.

Allow me to express my gratitude to you for your encouragement and co-operation in providing for the department under my charge. I hope that you will be enabled to make further provision as outlined above. So much has the scope of the department widened during the last two years, that the increased accommodation and the assistance are both essential to good work for the future.

Respectfully submitted,

J. B. REYNOLDS,
Lecturer in English and Physics.

GUELPH, Dec. 31st, 1898.

PART III.

REPORT OF THE

PROFESSOR OF BIOLOGY AND GEOLOGY.

To the President of the Ontario Agricultural College:

SIR,—Herewith is submitted for your consideration my first report as head of the department of Biology and Geology.

This report, in view of the circumstances of my appointment, must necessarily deal more with plans for the future than with work actually accomplished. The Assistant Biologist, M. W. Doherty, began his duties here simultaneously with my own, on September 1st; and since that time our attention has been chiefly given to preparation for the work of instruction. Flowering plants, insects, and fungi had to be procured for demonstration work in class, so that either Mr. Doherty or myself was almost constantly occupied during September in the work of collection.

Part of my time during September and October was devoted to correspondence relating to insects and plants, and although the number of correspondents is not so large as it was before the death of the late Prof. Panton, yet about a hundred letters were sent out during the year, many of which required considerable time for their preparation, owing to the large amount of information asked for. It is quite conceivable that the correspondence will resume its normal volume during the coming year, and require my attention at a time when my teaching duties will be sadly interfered with. I refer to the opening of spring, which is a very busy season for class-work.

INSTRUCTION. With reference to the instruction given the different years, in a general way the plan of previous years had been followed:—

Fall Term.....	*First Year.*—Botany. *Second Year.*—Botany and Entomology. *Third Year.*—Botany and Geology.
Winter Term	*First Year.*—Zoology and Geology. *Second Year.*—Biology. *Third Year.*—Botany and Geology (part of time).

The aim of the instruction given is to impart a good practical knowledge of the Elementary science subjects; hence laboratory work has been strongly emphasized, and is introduced at every stage of the work. Purely formal lectures have been almost done away with in the first two years, and but seldom given in the advanced work of the third year, then only in summarizing the knowledge which has been already obtained by the student in his practical work. Students trained to observe carefully and draw proper conclusions are in a good position to carry on life's work in any sphere in which they may be placed. The process of observation includes the three-fold processes of comparison, relation, and judgment, and these are virtually the requisites of the successful farmer, merchant, or statesman.

Besides the training of the observational powers of the students by this close contact with natural objects, whether they be flowering plant, fungus, insect, or rock structure, much attention is paid to their economic aspects.

At the conclusion of the two-year course the students will be in a position to identify correctly the common weeds, and to put into operation the best methods for their eradication; to determine the weed seeds which are commonly found in samples of clover, timothy, and other grains; to recognize the noxious insects which infest the farm, orchard, and garden, and to apply the proper remedies for their destruction.

The two objects always kept in mind in all Natural Science work at this College are (1) the training of the power of observation, and (2) by means of this trained observational power so to control the amount of damage on a farm that the money value of the crops will be largely increased.

Plant Physiology and Pathology. The study of plant physiology has been made quite prominent. The principles governing the behaviour of plants under the influences of external stimuli, and their relation to soil, moisture, heat, light, and other conditions which are generally known as environment, are explained clearly to the second-year students, while the subject is given a wide range in the third year, when the student determines these principles and relations for himself in the laboratory and greenhouse.

Very satisfactory progress has been made in this direction, and it is to be hoped that every facility will be offered for the thorough study of problems relating to plant life, for a study of the normal life processes is the foundation for proper work on the treatment of plant diseases. I would suggest that an effort be made to introduce laboratory work in plant physiology in the Second Year. For this purpose an appropriation of $50 a year for two or three years for apparatus would be sufficient.

In the Third Year, plant pathology is studied after the course in physiology. Here the worker must not only study the effects of disease, but the causes which lead to the diseased condition. These causes are most frequently of a fungous nature, but sometimes purely physiological. These subjects are all so important that to give them due attention the time of a separate instructor would be required.

Entomology. This year a course in elementary Entomology was given to the Second Year, and a more advanced course to the Third-Year students. These were practical courses, consisting almost entirely of laboratory work and demonstrations in class-room by means of the electric lantern. The material at our disposal for this work is far too meagre for satisfactory work, but an effort will be made during the coming year to enlarge greatly the collection of eggs, larvæ, adults, and specimens of work done by the insects.

For another year it will be impossible to increase the courses in Entomology for want of time, but as soon as the Fourth Year is added several additional courses can, with advantage, be taken by the specialists in this line. The importance of Entomology is recognized now by nearly everybody; and in order to make the study of it of the greatest value, an insectary course should be organized, when the life-histories of the various pests can be worked out and remedies applied for their control.

Laboratory Accommodation. The laboratory is neither convenient nor large enough. The class-room is not suited for demonstration work, as there is not sufficient light to enable the students to see minute parts distinctly. No doubt the proposed change will lighten the room and improve the conditions materially, yet the fact remains that more laboratory accommodation is urgently needed in the interests of biology. The annex is a very pleasant room, and is quite suitable for small divisions, and for histological and pathological work of the Third Year. The remainder of the present laboratory is very inconvenient as well as too small. An instructor ought to be able to see all his students at a glance, but in this case it is quite impossible to do so. A suggestion has been offered that the southern portion of the flat be extended even with the present annex—that the present south wall be torn down so as to form a large, commodious room directly south of the office and to the east of the present annex. Some such plan as this I urgently recommend for your consideration.

The recent additions to the equipment of the office and annex are much appreciated. The herbarium is very complete with 135 sliding shelves; already the many specimens which had been packed away in odd corners are being placed in their proper shelves and made accessible to the student who may wish to consult and study plants. The new

book-case is large enough to hold all the reference books belonging to the department. An insect cupboard for the reception of insect cases is now in course of preparation, and an effort will be made to secure a good systematic and economic collection of insects for both elementary and advanced work in Entomology.

HISTOLOGY. The department will be in a position next September to give instruction in the histology of both vegetable and animal tissues. It was not prepared to do the work this year, as you desired, for want of material, paraffine ovens, and other appliances, and Mr. Harrison kindly consented to continue the work of instruction for another year. In a department where histological methods are used in nearly all investigations it becomes a matter of importance that the investigators should be as familiar as possible with the best methods of histological research, and this can best be acquired by giving practical instruction to classes. The department will, therefore, make full arrangements during the coming summer to put up material in paraffin and collodion for class-work.

TEACHERS' BULLETINS. Many eminent agriculturists have the conviction that the best way to awaken a real interest in farm life is to instruct the children by means of natural objects. An attempt has been made by Cornell University to introduce nature study into the rural schools of New York State, and the result has been very gratifying to the teachers, pupils, and parents.

"So far as the present outlook is concerned, it is, perhaps, not too much to say that many believe that the movement directed toward the young people of the rural communities, is the most important one which has developed in agriculture since the consummation of the Experimental Station idea." (Year Book, U. S. Dept. Ag., 1897, p. 284.)

The present drawback to the adoption of such a plan in Ontario lies in the fact that the majority of teachers in rural schools are not sufficiently equipped for the work of instruction. To overcome this difficulty, leaflets might be prepared by this department, and issued to teachers to show how nature study may be presented to the pupils. These leaflets need not affect Agriculture directly, but topics might be dealt with which would vitally affect Agriculture indirectly. In a few years the teachers themselves would become, I venture to think, the most potent advocates of nature study, because their labors would be more pleasant. What pupils would not become interested in the observation of insects and plants under the direction of an enthusiastic teacher?

A FEW OF THE MOST NOXIOUS INSECTS, WEEDS, AND FUNGI.

Turnip Louse. Many enquiries have reached this department with regard to the Turnip Louse or Aphis (*Aphis brassicae*). This small insect was extremely troublesome this last fall on turnips and rape, and many complaints were made. The aphids are generally found in clusters on the lower surfaces of the leaves, but sometimes the upper surfaces are also attacked. On close observation many will be seen to be winged, especially in the autumn.

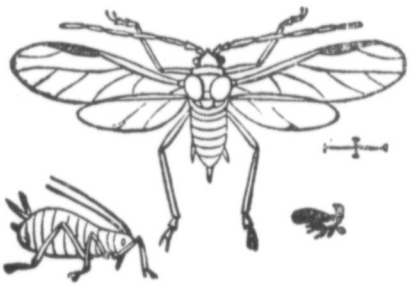
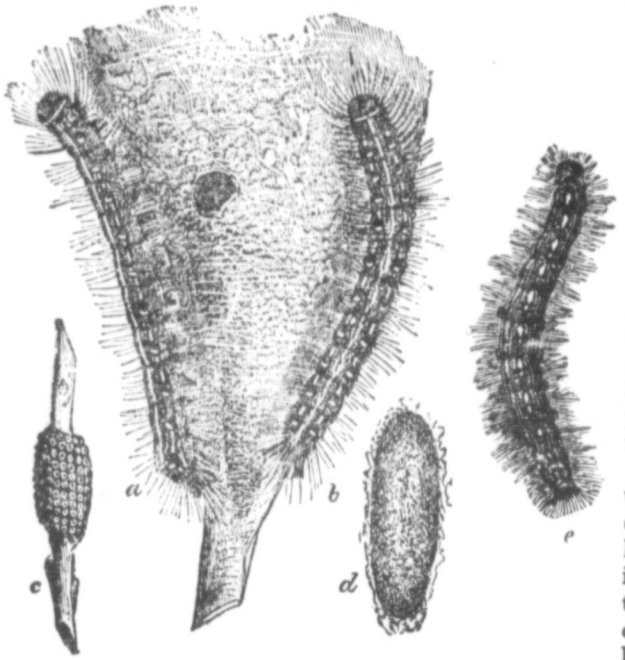


Fig. 1. Turnip Lice—Females wingless and male winged.

A powdery secretion covers the whole cluster of lice, as if dust had been sprinkled upon them. The lice are not easily disturbed, but move about very lazily when touched. They have no biting mouth parts, but are provided with sucking beaks which they insert into the green tissues of the leaf and suck up the nourishment.

Treatment for these lice over large fields is very difficult, from the fact that the pests are usually hidden on the under surface of the leaves. Kerosene emulsion has proved successful in small fields of cabbage and turnips. Much success has attended the method of late sowing and high manuring, so that growth is healthy and rapid. Aphids will usually have very little effect upon such healthy, vigorous plants.

Tent Caterpillars. The two Tent Caterpillars (*Clisiocampa Americana and C. disstria*) must be ranked among our most destructive insect pests. These are readily recognized by their peculiar egg clusters, and their tents, constructed in the forks of branches of the apple, cherry, and some forest trees. The eggs are laid in early summer, in ring-like clusters on twigs, and remain in that position for the rest of the summer and winter. The larvæ, or caterpillars, appear early in spring, and attack the young buds and newly opened leaves. About June the larvæ leave the trees and build cocoons in sheltered places where they remain about three weeks.



The best way to combat these Tent Caterpillars is to destroy their tents when the larvæ are inside in early morning, and to crush the egg clusters during the winter. Of course Paris Green spray will kill the larvæ.

FIG. 2. Tent Caterpillar, showing rings of eggs at (*a*); caterpillars at (*b*); and cocoon at (*d*). (*c*) Forest Tent Caterpillar.

Larch Saw Fly. The Larch Saw Fly (*Nematus Erichsonii*) still continues its devastations in our tamarac forests. Unfortunately very little aid can be extended to the infested regions, but in small areas the use of Paris Green spray has been beneficial.

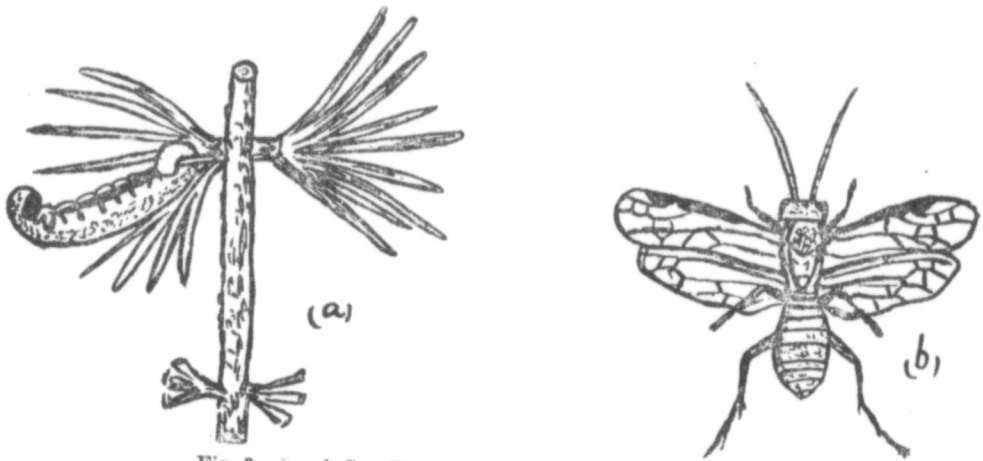


Fig. 3. Larch Saw-Fly—(*a*) Caterpillar; (*b*) Adult Saw-Fly.

Jarring young shade trees has had good results, as the larvæ cannot climb trees. Probably parasites are our best friends, and we must look to them to keep the Saw Fly in check in our great swamps. Another favorable feature is the great vitality of the tamarac, which often quickly revives after complete defoliation.

Lecanium. In some districts the locust hedges have been severely attacked by a scale insect, a species of Lecanium, which is an oval, brown insect about one-fifth of an inch long, and one-eighth of an inch broad. The scale is the body of the insect itself, in this respect differing from the San José, the Oyster Shell, or the Scurfy Bark Lice, which protect their bodies with an armor or scale. The old, dead, brown scales remain on the branches during fall and winter, and are quite conspicuous objects. When broken into nothing but dust-like remains of egg-shells can be seen. The young escape from the eggs about July and make their way to the leaves, where their small size and color render them very inconspicuous. They secrete honey-dew which forms a suitable medium for the growth of a sooty-black fungus. In late summer or early autumn the immature forms migrate to the branches before the leaves fall, where they hibernate. In spring their growth is very rapid, so that they are mature in May, when the females are as large as the old scales, but are soft and yellowish. The eggs are laid under the body of the female, and there is but one brood each year. The adult males are winged, and appear in June, their scales being much smaller and flatter than those of the female. Prof. Slingerland, State Entomologist of New York State, recommends that infested trees or shrubs be sprayed with Kerosene Emulsion once after the leaves fall in the autumn, and at least twice in the spring before the buds open.

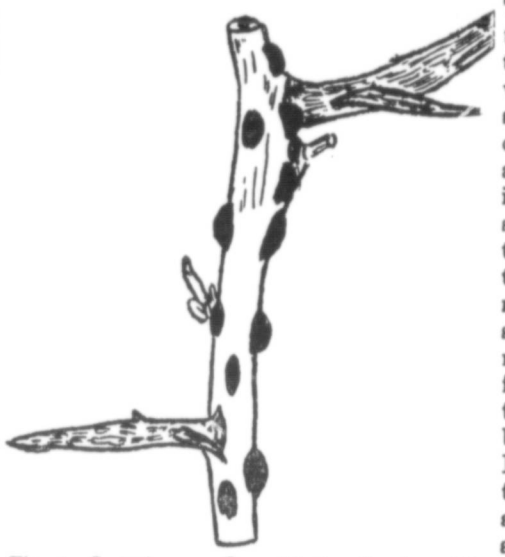


Fig. 4. Lecanium on Locust-hedge showing old, mature scales of Females.

Bindweed. Another bad weed is the Bindweed (*Convolvulus Arvensis*) which is spreading rapidly wherever it has obtained a foothold. It resembles a morning-glory in habit, and may either run or climb. The flowers are not numerous, but are quite large, being over an inch in diameter. The roots are perennial, composed of long, white threads, small portions of which are capable of budding and reproducing the plant, so that careless cultivation only tends to spread the pest. The chief methods of propagation are the dispersal of seeds in hay and other crops, the breaking off of roots by the plow and carrying these to different parts of the field. Many methods have been tried to eradicate this pest, but with little success. Coutinuous shallow surface cultivation, it is contended by some, will eventually stamp it out. Some recommend the application of dilute sulphuric acid, or coal oil, or carbolic acid, while others maintain that thick seeding crops, which tend to smother it, will keep it in check.

Fig. 5. Bindweed—Showing leaves and flowers.

Rib-Grass. One of the worst weeds of the past season was Rib Grass, sometimes known as Ripple Grass, or Black Plantain, or English Plantain (*Plantago Lanceolata*). This weed has evidently been introduced into Canada from Europe in grass or clover seed.

It has a perennial root and consequently is hard to deal with. Grass lawns are suffering heavily, and as soon as dry weather sets in, the Rib-Grass forges ahead of the grasses. It is a stemless weed, very conspicuous during July and August in dry lawns which are not mown frequently.

Fig. 6. Rib-Grass—(*a*) Showing lanceolate leaves and spikes of flowers; (*b*) A single flower from spike.

The time of flowering ranges from June to October; the flowers are small and whitish, arranged in a spike which rises to a height of ten or twelve inches. The only methods for controlling this weed are constant spudding in lawns, and the use of clean clover and grass seeds.

Fungi. Mr. Doherty has, at my request, prepared the following notes on the Apple Scab and the Peach Leaf Curl, both of which were very destructive during the past season:

APPLE SCAB (*Fusicladium dendriticum*)—FCKL.

This fungus attacks the fruit and leaves of the apple, and is the cause of the black or blackish scabby appearance so familiar to orchardists. It first makes its appearance upon the apple as small olive-green patches, which later become black and spread until a number run into one another to form a large disfigurement. The side of the apple most seriously affected fails to develop fully as a result of the fungus appropriating its nourishment. In this manner a large percentage of the apples are rendered unsaleable, or at least of little market value. The annual loss sustained by the farmers and fruit growers of the Province is difficult to compute, but it is safe to say that 30 per cent. of the apple

and pear crops are destroyed by this fungus and a closely related species *Fusicladium pyrinum*, or Pear Scab. Some varieties appear to be more susceptible to injury from the scab than others. The Fameuse, or Snow Apple, for instance, is as a rule seriously injured, while the Rhode Island Greening is comparatively free from attacks of this fungus. Of pears, the Flemish Beauty appears to be the most susceptible.

The same parasite that causes the scab on the fruit also affects the leaves and new growth of the tree. Diseased leaves are unable to perform their normal functions, assimilation is restricted, and the vitality of the whole tree is impaired, thus not only diminishing the present crop but injuring the prospect for future ones as well.

The life history of the fungus has not been well determined, but it is now believed that infection takes place much earlier in the season than was formerly supposed; it is probable that the disease obtains a foothold before the petals fall from the tree.

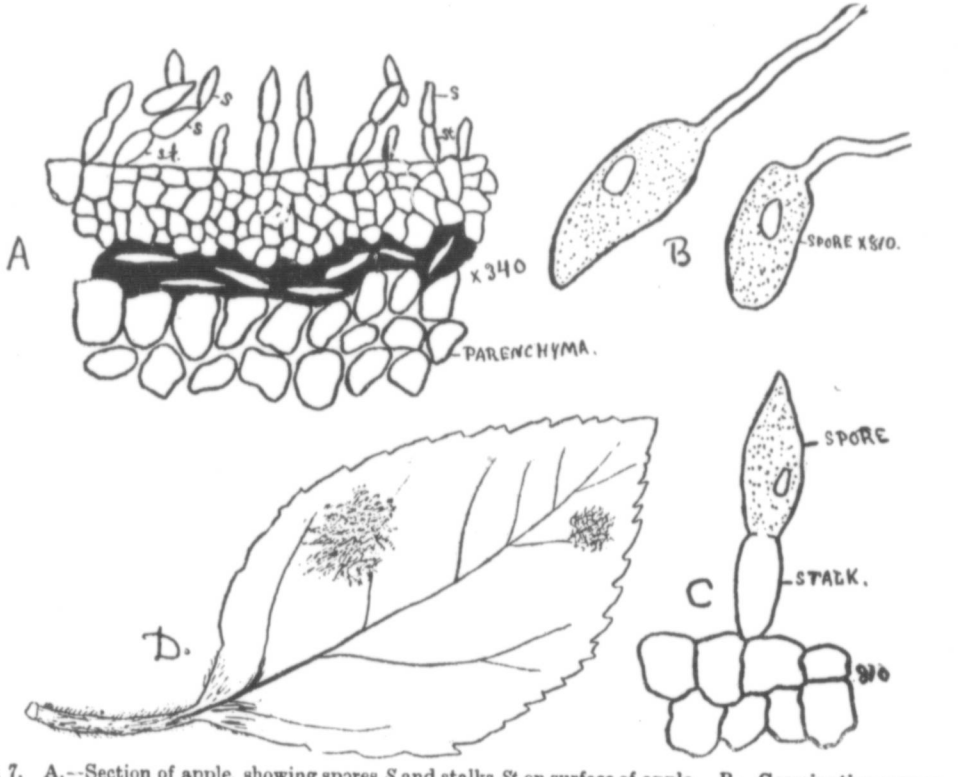


Fig. 7. A.—Section of apple, showing spores *S* and stalks *St* on surface of apple. B.—Germinating spores. D.—Leaf affected with apple scab.

Under the microscope, sections of the fruit or leaves show that the dark velvety growth on the surface is the fruiting part of the fungus, the vegetative portion of which is more deeply seated. The spores are variable in size and form, being sometimes almost perfectly egg shaped, and sometimes larger toward the free end than below. (See Fig. 7-A). In the most characteristic form they are nearly oval in general outline, but rather pointed at the free end. Nearly all are one-celled, but occasionally one is found with a cross partition, making it two-celled.

They germinate by sending out a slender tube (Fig. 7-B). The manner in which this tube gains entrance into the tissues of the fruit is not known. When this is found out, the great susceptibility of certain varieties to attacks of this disease may be explained. The vegetative mycelium, or thread-like tubes of the fungus does not penetrate the tissues of the fruit to any great extent, but forms a layer of pseudo-parenchyma ex-

ternal to the soft cells (parenchyma) of the apple. This pseudo-parenchyma bears the stalks (conidiophores) and the spores. (See Fig. 7-A). These spores become detached from the stalks on which they are borne and, if circumstances prove favorable, propagate the disease throughout the year. Winter spores are produced on the fallen leaves in perithecia. The perithecia contain asci, each of which contains eight spores.

Treatment. The treatment is preventive, and in cases where the fungus has once penetrated the plant tissues, there is no efficient remedy for it. The application of a fungicide as soon as the flowers open is perhaps the most effective application of the entire treatment and should receive careful attention.

It is usually advisable to spray an insecticide along with the fungicide in order to reduce the expense and labor. As soon as the fruit is formed, the codling moth lays its eggs in the calyx end of the apple. The worms which develop from these eggs eat their way into the apple and make it wormy. As soon as the fruit begins to hang down, little benefit can result from the application of Paris Green. So Paris Green should be sprayed with the second application of the Bordeaux mixture.

Experiments conducted under the direction of the Minister of Agriculture throughout this province during the past two or three years prove conclusively that it is possible, by the application of fungicides, to keep this disease well under control, and in some cases to cause its almost total disappearance. Of the various fungicides two will here receive consideration, viz. Bordeaux mixture and carbonate of copper solution. Although the latter has probably given better results in experiments, the former is more popular with fruit growers in general.

Carbonate of Copper Solution. A solution according to the following formula is found convenient and effective: One ounce of carbonate of copper dissolved in one quart of aqua-ammonia (strength 22 Baumè), diluted with twenty-five gallons of water. A large tree will need about two gallons for a thorough spraying, and a smaller one one and one-half gallons.

Preparation. Keep the ammonia in a glass vessel tightly corked. In buying carbonate of copper, order the precipitated form. Add the carbonate of copper to the ammonia at the rate of one ounce to a quart of ammonia. When ready to spray, add this solution to water at the rate of one quart to twenty-five gallons. At least three applicantions should be made, and some recommend as many as seven if the season is unusually wet. The first should be made as soon as the trees are in bloom, the second when the fruit is well formed, and the third ten days after the second.

Never add Paris Green or London Purple when spraying with carbonate of copper as injury to the foliage is sure to follow. If it is desired to spray with Paris Green for the codling moth, do so the day following the second application of the fungicide.

Bordeaux Mixture. On many grounds this is preferable to the carbonate of copper; it is somewhat cheaper, does not injure the foliage when applied with Paris Green, and is not so easily washed off.

Preparation. Dissolve five pounds of the copper sulphate crystals in four or five gallons of warm water in a clean tub or barrel; slake four pounds of lime and add water until a thin white wash is produced. Strain this into the copper solution and add water up to forty gallons. For the Scale, spray at least three times, as with carbonate of copper. With the second application, Paris Green for the Codling moth may be added at the rate of one pound to forty gallons of the fungicide.—M. W. D.

Peach Leaf Curl. (*Exoascus deformans*).

This fungous disease, which attacks the twigs and leaves of the peach, is commonly spoken of as the "leaf curl." It affects the leaves more than the twigs. It causes only a slight enlargement of the twig, while it involves the leaf in a series of irregular folds with

the edges drawn toward each other. The affected portions of the leaf become pale green, parts being more or less strongly tinted with red and yellow. Fig. 8 represents the leaves of the peach as they appear when diseased by Exoascus. Fig. 9 A. young twig, *b*, Leaf diseased—exact size. The parenchymatous, or soft tissue of the affected leaves, is stimulated to an abnormal growth, causing the leaf to bulge out on one side. The first crop of leaves usually falls, and is generally followed by a second. Frequently the tree fails to develop a crop of fruit. In cases where the fruit falls after setting, the cause is to be found, not in the direct attack of the fungus, but in a lack of nourishment due to the fall of the leaves and to the diseased tissues of the twigs. The "Curl" is most troublesome in seasons when the weather, during the two or three weeks following the putting out of the leaves, is cold and wet. After the disease has run its course, and new

FIG. 8.

leaves have developed, there is seldom any further attack, provided the weather is dry and warm. But the second growth of leaves so exhausts the tree that the succeeding year's crop is light, if any. The mycelium is perennial. It passes the winter months in the tissue of the leaf buds, and in the spring grows out with the developing leaves. In this way the disease is perpetuated from year to year.

The disease spreads, no doubt, chiefly through the agency of affected buds used in "budding" young seedlings in the nursery. Spores are developed in asci on both surfaces of the leaves. The number of spores in each ascus varies from four to eight.

Remedies. To secure good results from any treatment, it is well to head back the branches in the spring, carefully removing any that were injured by the "curl" the previous year, lest the mycelium, which is perennial, might spread in the new leaves when they appear.

FIG. 9

With proper pruning and spraying of fungicides it is possible to hold this disease in check. Apply Bordeaux mixture—the first application just before the buds, the second as soon as the trees are out of bloom, and the third, about ten days or two weeks after the second. With each application of the Bordeaux mixture Paris green should be used for the curculio, at the rate of one pound to 300 gallons of the mixture. If the weather is wet, a more frequent use of the fungicide may be necessary, and an additional application can often be made with profit.—M. W. D.

All of which is respectfully submitted.

WILLIAM LOCHHEAD,

Professor of Biology and Geology.

GUELPH, Dec. 31, 1898.

PART IV.

THE REPORT OF

THE DEPARTMENT OF CHEMISTRY.

To the President of the Ontorio Agricultural College :

SIR,—Owing to Prof. Shuttleworth's continued absence in Germany, it again becomes my duty to report upon the work of the Chemical Department.

Besides the regular class-room and laboratory work with the students of the College, we have, during the summer, devoted considerable time to the study of the composition and digestibility of lucerne as affected by maturity. This work was commenced two years ago and partially reported upon last year. We feel that we have now reached some definite conclusions regarding the feeding value of this fodder. In co-operation with the Experimental Department a commencement has been made in an endeavor to determine the comparative manurial value of the crop residues of several varieties of clover and lucerne. In addition to this, a great deal of miscellaneous work has been done for other departments of the institution and for farmers throughout the country. In all this work, W. A. Kennedy, B.S.A., who has been assisting with the work of the department in Prof. Shuttleworth's absence, has heartily co-operated. Most of the analytical work herein reported has been done by him.

TEACHING. As the number of students increases, and the various courses of study are extended, the teaching both in the class-room and in the laboratories becomes heavier. Last year, in addition to the work of former years, the first year men were given lectures in Chemistry until the middle of June instead of only till Easter as formerly. The third year specialists in Agriculture and Horticulture received a short course of lectures dealing with the chemistry of the various insecticides and fungicides in use, together with practical work in their preparation in the laboratory. The specialists in Dairying were given lectures on the chemistry of milk and its products. In the laboratory they received instructions in methods of analysis of milk, butter and cheese, and spent considerable time in practising the detection of adulterations in milk and its various products.

WORK FOR OTHER DEPARTMENTS.

Dairy Department. Last year, at Prof. Dean's request, we analyzed a number of samples of whey with a view to determining at what stage in the process of the manufacture of cheese the casein is lost; also, whether more casein is lost in whey from rich milk than in that from poor milk, and at what stage or stages it is lost. This work was continued during the summer of 1898, the casein in twenty samples of whey being determined at four different stages in the process of the manufacture of the cheese, viz., before dipping, after dipping, after milling, and after salting. The Dairy Department was also carrying on some experiments to test the effect of different methods of churning and salting butter. Co-operating with them in this work, we made a complete analysis of seventy-four samples of butter, the results of which, together with those of the whey, will be found in the report of the Professor of Dairying.

Apiarian Department. For sometime past, the bee-keepers have been agitating for the exclusion of thin and unripe honey from the market. Mr. Holtermann, director of the committee on co-operative experiments in apiculture of the Experimental Union, has

been endeavoring to arrive at some standard of quality. At his request we determined the specific gravity of forty odd samples of honey, the results of which will appear in Mr. Holtermann's section of the report of the Experimental Union.

Experimental Department. Under the direction of Mr. Zavitz, Director of Co-operative Experiments in Agriculture, in connection with the Experimental Union of this College, there is made annually an experiment to test the value of nitrate of soda, superphosphate, and potash on certain crops; and, at Mr. Zavitz's request, we analyzed samples of the three different manures sent out this spring with the following results:

Sodium Nitrate.....	Moisture	1.86	per cent.
	Ammonia (NH_3)	18.60	"
Muriate of Potash....	Moisture	1.36	"
	Potash (K_2O)	49.68	"
Superphosphate	Moisture	2.28	"
	Total Phosphoric Acid (P_2O_5)..	35.19	"
	Water Soluble (P_2O_5).....	30.34	"

For a number of years, Mr. Zavitz has been experimenting with nitrate of soda, potash, superphosphate, various mixtures of these, wood ashes, and farmyard manure on the potato crop. For six years in succession, two mixed fertilizers have given the best average results. These we have found to have the following composition:

Percentage composition of the two fertilizers giving the best results on potatoes.

——	Moisture.	Ammonia. NH_3	Potash. K_2O	Total Phosphoric Acid P_2O_5	Water Soluble Phosphoric Acid P_2O_5
No. I.....	15.22	4.05	5.05	12.65	9.37
No. II.....	7.78	4.89	5.83	12.51	8.37

Of these two fertilizers No. I. has given the best average results.

In determining the relative amount of hull on different varieties of oats, the experimentalist had the hulls removed from one hundred grains of each of ninty-one varieties; and at his request we analyzed the mixture of hulls; also the mixture of grains from which the hulls had been removed. The results are as given below:

Percentage composition of hulls and hulless grains of oats figured to dry matter.

——	Crude Protein.	Crude Fat.	Nitrogen Free Extract.	Crude Fibre.	Ash.
Hulls.....	2.318	.200	56.400	36.253	4.829
Hulless grains.....	16.643	6.125	72.193	2.769	2.269

During the past summer the Experimental Department has done considerable work in determining the relative amounts of the crop residue of three varieties of clover and lucerne. The roots, as taken from the soil, were handed over to the Chemical Department for analysis. After it had been dried, and the soil clinging to the small roots had been removed as completely as possible, a sample was taken for the determination of nitrogen, and the remainder was burned to an ash. The following table gives the percentages of potash, phosphoric acid, and lime in the ash; also the percentages of these constituents and nitrogen in the dry roots and tops. For the weights of the various crop residues, and for particulars regarding the date and manner of digging the roots, see the report of the Experimentalist.

Percentage composition of the ash of common red, mammoth red, and alsike clover and lucerne; also, per cent. of nitrogen and ash constituents in the dry roots and tops.

Dug from date of seeding.	In the ash.			In the dry roots and tops.			
	Potash. K_2O.	Phosphoric Acid. P_2O_5.	Lime. CaO.	Nitrogen. N.	Potash. K_2O.	Phosphoric Acid. P_2O_5.	Lime. CaO.
Two months.							
Red clover (whole plant)	5.41	2.53	7.53	2.25	.88	.41	1.22
Mammoth red "	4.18	3.27	12.77	2.79	.73	.57	2.24
Alsike "	4.24	2.26	7.40	3.16	1.32	.71	2.31
Lucerne "	11.80	4.08	12.35	2.82	3.08	1.06	3.22
Five months.							
Red clover tops	5.16	3.12	13.41	3.09	1.01	.61	2.65
" roots, 1st 6 inches	4.90	3.78	6.07	2.33	.94	.72	1.17
" " 2nd "	3.13	3.61	4.66	2.01	.53	.61	.79
Mammoth red tops	6.73	3.88	20.59	2.71	.57	.63	3.22
" roots, 1st 6 inches	3.93	3.08	5.43	2.42	.81	.63	1.12
" " 2nd "	2.84	2.32	5.70	1.90	.57	.47	1.15
Alsike tops	2.99	1.94	6.52	3.38	.79	.51	1.72
" roots, 1st 6 inches	3.68	2.84	4.50	2.68	.89	.69	1.09
" " 2nd "	1.49	1.38	3.60	1.78	.47	.45	1.14
Lucerne tops	7.74	3.47	17.81	3.12	.91	.41	2.10
" roots, 1st 6 inches	6.91	2.02	6.42	2.33	.70	.20	.65
" " 2nd "	6.77	3.66	5.50	2.17	.59	.32	.48
Fourteen months.							
Red clover tops	10.56	4.20	21.88	1.51	.98	.39	2.03
" roots, 1st 6 inches	3.43	2.06	7.16	2.22	.92	.55	1.91
Mammoth red tops	9.33	4.52	18.48	1.67	.70	.34	1.39
" roots, 1st 6 inches	8.19	2.14	8.35	1.87	1.14	.30	1.17
Alsike tops	11.60	4.42	18.03	1.93	1.20	.46	1.86
" roots, 1st 6 inches	2.99	2.01	5.65	2.07	.61	.41	1.16
Lucerne tops	14.24	5.43	19.03	2.41	1.45	.55	1.94
" roots, 1st 6 inches	8.19	5.64	8.66	2.38	.74	.51	.79
" " 2nd "	3.73	3.80	3.49	1.91	.39	.59	.36
Seventeen months.							
Red clover tops	4.56	2.58	12.15	2.59	.42	.21	1.69
" roots, 1st 6 inches	3.97	2.59	6.58	2.32	.70	.45	1.15
" " 2nd "	2.88	2.25	5.40	2.08	.47	.37	.89
Mammoth tops	7.62	2.58	14.48	2.48	1.07	.36	1.92
" roots, 1st 6 inches	3.29	1.32	3.33	2.27	1.04	.41	1.05
" " 2nd "	4.09	2.48	4.21	1.63	.56	.34	.58
Alsike tops	5.33	3.44	15.15	3.18	1.03	.66	2.92
" roots, 1st 6 inches	5.04	4.72	5.93	2.74	.51	.47	.60
" " 2nd "	* No sample.			1.98	No sample.		
Lucerne tops	10.36	4.00	15.64	2.78	1.07	.41	1.61
" roots, 1st 6 inches	7.99	6.66	7.14	1.64	.66	.55	.59
" " 2nd "	7.22	9.67	6.72	1.58	.41	.55	.38
" " 3rd "	4.05	4.74	4.58	1.59	.43	.51	.48
" " 4th "	2.75	3.14	4.86	1.58	.42	.48	.75

* The sample was too small to obtain enough ashes for analysis.

Water Analysis.

During this last summer there has been an increased demand for the analysis of water used for household purposes. It appears that there is great need for work of this nature; for, out of the thirteen samples analyzed, only one could be called a good drinking water. In most cases, there was evidence of sewage contamination, caused, no doubt, by soakage from the barnyard or from privies, which are too frequently found close to the wells. Recognizing the importance of good, pure water to the individual and the

fact that, in many cases, farmers and others are using water wholly unfit for drinking purposes, we wish to announce that we will examine, both bacteriologically and chemically, waters sent us, provided the following conditions are complied with. The sender must pay all express charges and must take the sample according to the directions given below; for unless great care is taken in the sampling of the water, no faith can be placed in the results of the examination.

Mr. Harrison, bacteriologist, will make the bacteriological examination, and we jointly give the following directions for the taking of the sample:

Container. A bottle of not less than one-half gallon capacity is to be used, preferably one with a glass stopper. If there is no glass stopper, the bottle must be fitted with a *new* cork.

Preparation. The bottle must be thoroughly cleaned, all foreign substances removed, and scalded out with boiling hot water and then allowed to drain until cool.

Taking of Sample. If the sample is to be taken from a well, the water must be pumped out for about five minutes, or long enough to empty all pump connections before the sample is taken; if, from a tap, the water must be allowed to run to waste for ten minutes, or long enough to empty all local laterals, before sampling. Water standing in the pipes in a house is under very favorable conditions for the multiplication of bacteria. If, therefore, the precaution of running off the water be not taken, a very erroneous conclusion as to the number of bacteria present, may be drawn. If the sample is to be taken from a lake or stream, it must be taken some distance from shore, the sampling vessel being plunged a foot and a half below the surface, to avoid the surface scum. Samples are not to be taken immediately after a storm. From wherever the sample is taken, the bottle must be rinsed out several times with the water to be analyzed. The bottle must not be filled quite full, a small space must be left for the expansion of the water. Cork, and tie a piece of cloth over the neck to keep the cork in place. Do not use sealing wax.

Packing. If the weather is warm, pack the bottle in ice. During the winter, sawdust may be used. The water should arrive at the laboratory at, as nearly as possible, the same temperature as when the sample was taken.

Notification. Send notice by mail stating by what express company you are sending the water, and the date of the shipment. Also give as fully as possible the history of the well or source of the water, and remarks on the sanitary surroundings.

Note. On application a suitable bottle, properly prepared, will be sent to the applicant.

Fertilizing Constituents in Sludge.

In July we analyzed two samples of sludge from the Sewage Interception Works, Hamilton. The sludge from which the samples were taken had been prepared somewhat differently, both in the precipitation and in the drying. In one case, the drying was done by evaporation and in the other by means of pressure; both were comparatively free from odor. Farmers in the neighborhood were beginning to use the sludge as a manure and were desirous of knowing its true manurial value. The following is the percentage composition of the samples sent to us:

Name of sample.	Moisture.	Phosphoric Acid P_2O_5.	Potash K_2O.	Ammonia $N.H_3$.	Ammonia figured as sodium nitrate.
Per Cent.					
Evaporated	3.78	.22	.16	1.28	6.40
Compressed	5.05	.95	.86	1.00	5.00
Pounds per ton of substance.					
Evaporated	.....	4.4	3.2	25.6	128.0
Compressed	.....	19.0	17.2	20.0	100.0

Later a sample was sent which contained nitrogen equivalent to 15 per cent. of sodium nitrate.

Samples of sugar beets were sent in for analysis by the Owen Sound Sugar Manufacturing Co., The Bothwell Dairy Co., and by Dr. Comfort, North Pelham. The eight lots received from the Owen Sound Sugar Manufacturing Co. were made up of beets of about a pound to a pound and a half in weight, grown well in the ground. They were very similar in composition to those analyzed for the same company last year; the average per cent. of sugar in this year's lot being 14.5, while that of last year was 14.8. Some of the other samples sent showed a fair per cent. of sugar, but in most cases the beets were too large and were grown with a half or more of the beet out of the ground, consequently the per cent. of sugar was very low.

A few samples of marl were examined; and one sample of a peculiar soil was analyzed, which, however, is not of sufficient importance to report here.

Composition of Lucerne as Affected by Maturity.

Last year we commenced a study of the composition of lucerne as affected by maturity. The object of the work was to determine at what stage in its growth lucerne should be cut to yield the maximum amount of digestible food. Following very closely the plan as outlined in last year's report, this work has been continued throughout the past season. The first and second crops of this year's growth were cut at three different stages of maturity, which, although a little earlier, corresponded very closely with those of last year. The first cuttings were made when the buds were well formed; the second, two weeks later, when the blossoms were about one-third out; and, the third, another two weeks later, when the plant had passed the full blooming stage. The three cuttings of each crop were from the same plot as those of last year, but they were made from a larger area, each cutting being from one-thirtieth of an acre. The treatment of these different cuttings was exactly similar to that of last year. The following table gives the weight of the various cuttings of the second crop of 1897 and of the first and second crops of 1898, calculated to the yield per acre:

Yield per acre in green state, as hay, and figured to dry matter.

——	Green state.	As hay.	Dry matter.
Second crop, 1897.	lbs.	lbs.	lbs.
First cutting	17,100	3,761	3,197
Second "	15,400	4,493	3,819
Third "	11,500	3,902	3,317
First crop, 1898.			
First cutting	18,000	3,582	3,045
Second "	19,050	5,001	4,251
Third "	17,550	4,581	3,894
Second crop, 1898.			
First cutting	7,125	2,234	1,899
Second "	9,090	2,947	2,505
Third "	8,040	2,604	2,214

Very little rain fell during the growing period of the second crop of 1898, which, no doubt, accounts for the much smaller yield than that obtained from the second crop of 1897. In every case but one, the largest yield in green state, as hay, and as dry matter, was obtained from the second cutting, which, it will be noticed, was made when the plants were about one-third in blossom. It is quite possible that the weight of the crop would have increased for a few days longer; but it is evident that by the time the plant

reaches full bloom or a little beyond, there is a marked decrease, which can be at least partially accounted for by the large number of leaves which had fallen off previous to the third cutting. Not only was the yield less in the third cutting, but the percentages of the most valuable food constituents had also decreased. This is shown in the following table:

Percentage composition of lucerne harvested at different dates.

	In fresh material.							In water-free material.					
	Water.	Ash.	Crude protein.	Crude fibre.	Nitrogen-free extract.	Crude fat.	Amides.	Ash.	Crude protein.	Crude fibre.	Nitrogen-free extract.	Crude fat.	Amides.
Second crop, 1897.													
First cutting ..	81.31	1.60	3.76	5.32	7.08	0.93	0.70	8.54	20.12	28.47	37.88	4.99	3.73
Second " ..	75.20	1.75	3.86	7.83	10.64	0.72	1.12	7.09	15.54	31.57	42.90	2.89	4.52
Third " ..	71.17	1.79	3.97	11.67	10.83	0.57	0.83	6.23	13.79	40.46	37.54	1.99	2.88
First crop, 1898.													
First cutting ..	83.08	1.65	3.46	5.07	6.07	0.67	0.84	9.73	20.45	29.98	35.90	3.93	4.94
Second " ..	77.68	1.52	3.24	7.29	9.30	0.96	0.79	6.92	14.72	33.16	40.84	4.26	3.59
Third " ..	77.81	1.58	3.01	8.15	8.75	0.70	0.78	7.12	13.59	36.75	39.44	3.15	3.53
Second crop, 1898.													
First cutting ..	73.68	1.98	4.41	6.87	12.07	0.99	1.15	7.52	16.77	26 10	45.84	3.77	4.39
Second " ..	72.43	2.13	4.50	8.67	11.36	0.90	1.26	7.73	16.32	31.46	41.21	3.28	4.62
Third " ..	72.40	2.12	3.95	9.88	10.91	0.74	0.98	7.68	14.30	35.81	39.52	2.69	3.56
Average of above.													
First cutting ..	79.36	1.74	3.88	5.75	8.41	0 86	0.90	8.59	19.11	28.18	38.89	4.23	4 35
Second " ..	75.10	1.80	3.86	7.93	10.45	0.86	1.06	7.24	15 52	32.06	41.67	3.51	4.24
Third " ..	73.79	1.83	3.64	9.90	10.17	0.67	0.86	7.01	13.89	37.67	38.82	2.61	3.32
Averages of some American analyses of first and second crops cut at similar stages of maturity.													
Buds forming ..	81.53	2.15	3.41	5.09	7.27	0.57	0.75	11.63	18.46	27.56	39 36	3.06	4.09
Medium bloom .	78.48	2.06	3.32	7.23	8.41	0 52	0.48	9.60	15.44	33.58	39.08	2.40	2.23
Full bloom	74.50	2.12	3.35	9.60	10.03	0.49	0.47	8.35	13.12	37.64	39.36	1.94	1.86

Explanation of terms: *Ash* is the part of the fodder which remains unconsumed by burning to whiteness at the lowest possible red heat. It is essential to the formation of bone. *Crude protein* is the muscle-formers collectively, which includes both the albuminoids and amides. As protein is the most expensive part of a cattle food, a large amount of it in a fodder is desirable. *Amides* appear to be an immature form of albuminoids, and are not capable of performing all the functions of the latter. As a plant matures they are converted into albuminoids. *Crude fat* is that part which is soluble in ether, and consists of a mixture of oils, wax, coloring matters, etc. Linseed oil is a common constituent. *Crude fibre* is the woody portion of a fodder; it is the part that is the most indigestible and therefore of the least value. *Nitrogen-free extract* is a mixture of substances commonly called carbohydrates. Starch and sugar are good examples.

It will be noticed that there is a marked similarity in the composition of the various cuttings of the different crops. The second crop of this season contained much less moisture than either of the other two crops reported, which accounts for the higher percentages of the various constituents in the fresh material. This is especially true of the first cutting. As stated before, the crop was grown during very dry weather. The average composition of the various cuttings of all the different crops used in work will be found in the table; also, the averages of some American analyses of the first and second crops which had been cut at different stages of maturity very similar to our own. It is

interesting to note the similarity in composition of these two sets of averages. It will be seen that there is a decrease in the percentage of water, and therefore in the succulency of the material as maturity approaches. Referring to the part of the table in which the composition is calculated to water-free substance, it will be seen that the percent of crude protein also decreases, and that the crude fibre increases very rapidly. Since the other constituents are fairly constant in composition, the decrease and increase of the protein and fibre respectively affect to a very large extent the value of a fodder. As the plant matures, then, its most valuable constituent is decreasing in percentage while the most worthless part is increasing very rapidly. This would naturally lead one to the conclusion that the earlier the crop is cut the better it is for use as a fodder. It must not be forgotten, however, that up to a certain stage in the growth of a plant it increases in weight, and consequently while the percentage of crude protein decreases, the absolute amount may increase; also that, as maturity advances, the protein becomes more valuable as the amount of amides decreases. At the same time crude fibre is increasing both relatively and absolutely. This is shown very clearly in the following table:

Table showing the increase or decrease in the amounts of crude protein and crude fibre.

——	Total dry matter.	Percentage of crude protein.	Absolute amount of crude protein.	Percentage of crude fibre.	Absolute amount of crude fibre.
Second crop, 1897.	lbs.	%	%	%	%
First cutting	3,197	20 12	643.2	28.47	910.2
Second cutting	3,819	15.54	593.5	31.57	1,205.6
Third cutting	3,318	13.79	457.4	40.46	1,342.1
First crop, 1898.					
First cutting	3,045	20.45	622.7	29.98	912.9
Second cutting	4,251	14 72	625 7	33.16	1,409.6
Third cutting	3,894	13.59	529.2	36.75	1,431 4
Second crop, 1898.					
First cutting	1,899	16.77	318 5	26 10	495.6
Second cutting	2,505	16.32	409.3	31.46	788.1
Third cutting	2,214	14.30	236.6	35.81	792.8

It will be noticed that in two cases the absolute amount of crude protein increases with the second cutting, and that in one case it decreases slightly, but that in every instance there is a decrease with the third cutting. The absolute amount of crude fibre increases with each successive cutting, although the total dry matter shows a marked decrease in the third cutting. It is evident from the above figures that the second cutting of each crop yielded the largest amount of dry matter, and that here too, in two cases out of three, we obtained the largest amounts of crude protein. But the crude fibre has increased so rapidly that in order to decide whether the crop has actually increased in food value or not, it is necessary to determine the digestibility of the constituents of the various cuttings; for it is only the part of the food which is digested that has any nutritive value.

While the determination of the digestibility of the constituents of a fodder by an animal may seem to be comparatively simple, it is surrounded by many difficulties which make the work tedious, and tend to make the results somewhat uncertain. Consequently the work requires to be done a number of times before anything like reliable results can be obtained. We have now made, in all, seven tests with each of the three different cuttings.

The results of digestion experiments in Germany and in the United States warrant the general statement that all ruminants, such as cows, oxen, sheep and goats, digest practically the same amount of protein, fat, nitrogen-free extract and fibre from the same

kind of food. Greater differences have been observed between individual animals in the same breed than between young and old animals, or between animals of different breeds. In general, horses digest less of the food constituent than do ruminants. This is especially true of the fibre and fat in coarse hays and grasses. It will be seen, therefore, that the digestibility of a fodder by a sheep can be taken as a tolerably correct measure of its digestibility by a cow or steer. In our work, sheep have been used, because they are much more easily experimented with than larger animals.

Last year but one sheep was fed on each of the cuttings of lucerne; this year the experiment was made in triplicate with three shearling wethers that followed through in succession the three different cuttings of each crop.

A digestion experiment is usually conducted as follows: Healthy animals in the prime of life are fed a weighed amount of food of known composition, and in such a way as to prevent any possible waste. The undigested residue, which forms the solid excrement of the animal, is received directly into an appropriate bag attached to the animal. The excrement is dried, weighed, and a representative sample ground and analyzed. From the weight of the fodder fed and its percentage composition, the weight of each constituent fed can be calculated. In like manner, from the weight of the dried excrement and its percentage composition, the weight of each constituent in the excrement can be determined. The difference between these two gives the amount of each nutrient which has been digested and resorbed during the passage of the food through the alimentary canal. The urine, containing solid bodies representing the waste of the animal organism, does not require to be analysed for the simple control of the digestive activities outlined above.

Lucerne digestion co-efficients, or pounds of each constituent digested per 100 lbs. fed:

		Dry Matter.	Protein.	Fat.	Nitrogen-free Extract.	Fibre.
Second Crop, 1897:						
First Cutting		60.6	78.9	71.5	70.6	37.1
Second Cutting		59.5	70.8	41.7	70.7	50.4
Third Cutting		49.9	67.7	48.9	61.7	36.4
First Crop, 1898:						
First Cutting	Sheep No. I	58.4	72.6	52.5	68.9	45.0
	" " II	56.3	72.6	44.9	67.7	40.9
	" " III	56.1	67.8	35.3	70.3	43.0
Second Cutting	" " I	54.4	69.2	67.8	68.4	35.0
	" " II	54.4	70.3	68.0	68.0	34.2
	" " III	56.1	75.1	71.1	67.5	37.3
Third Cutting	" " I	52.2	68.0	60.8	65.1	35.7
	" " II	51.9	69.8	60.8	63.9	35.7
	" " III	49.2	68.9	63.0	60.0	33.3
Second Crop, 1898:						
First Cutting	" " I	60.5	74.4	43.7	76.7	37.0
	" " II	59.7	74.4	46.2	75.0	36.4
	" " III	58.7	73.4	47.2	73.5	34.3
Second Cutting	" " I	56.8	75.2	34.6	73.1	34.5
	" " II	55.3	74.2	29.5	71.0	35.4
	" " III	56.6	75.1	40.4	72.1	36.9
Third Cutting	" " I	52.2	64.0	14.7	67.2	42.2
	" " II*	.....	.....	.....	.....	.....
	" " III	52.2	68.1	16.1	65.9	39.7

* Sheep was sick.

In this year's work, each animal was placed in a pen which was about four feet square. The manger was arranged on the outside of the pen, with stanchions on the inside in which the animal's head was placed while feeding, thus effectually preventing any loss by scattering. No more of the fodder was fed than the animal would eat up without a particle of waste. A rubber-lined bag for collecting the fæces was attached to the animal by means of a suitable harness. Each experiment lasted thirteen days and was divided into two parts. The first seven days were given to preliminary feeding so that all traces of previous food may be removed from the system; the next six days formed the experiment proper, during which the solid excrement was carefully collected, being removed from the bags twice a day and placed on the drying pan. The results of this work will be found in the foregoing table, which gives the number of pounds of each constituent digested for every 100 pounds fed. It has been thought unnecessary to place in tabular form the number of pounds of each constituent that was fed, or the number of pounds of each constituent that appeared in the solid excrement, but that for all practical purposes the figures showing the digestion co-efficients, or the percentage digestibility of the constituents of the fodder, would be sufficient.

It has been stated that individual animals vary in their power to digest a given fodder. This is illustrated in the preceding table, where it is shown that three sheep feeding from the same lot of fodder and under similar conditions differ somewhat in their power of digesting the constituents of a fodder. So many circumstances tend to cause a variation in the digestibility of any fodder that even when the average of a number of determinations is taken, it should not be considered absolutely correct, but be used more as a general guide in considering the digestibility of a fodder.

Each of the results in the following table represents the average of seven digestion experiments, one of which was conducted with the second crop of lucerne in 1897, three with the first crop of lucerne in 1898, and three with the second crop in 1898.

Digestion co-efficients.—Average of the several cuttings:

——	Dry Matter.	Crude Protein.	Crude Fat.	Nitrogen-free Extract.	Crude Fibre.
First Cutting.....	58.6	73.4	48.8	71.8	39.1
Second Cutting...	56.2	72.8	50.4	70.1	37.7
Third Cutting....	51.3	64.4	44.1	64.0	37.1

From the above figures it will be noticed that there is a gradual decrease in the digestibility of the hay as growth advances. The deterioration appears to be more rapid during the period between the second and third cuttings than during that between the first and second; or, in other words, there is a more rapid decrease in digestibility after the early blooming stage than previous to that. Apparently the younger the plant the richer it is in valuable constituents and the more digestible are these constituents. But, as has been pointed out, as the plant matures the absolute weight of these constituents increases. Therefore, when a crop is cut for hay, the object should be to cut at such a stage of maturity that the largest possible amount of the valuable constituents can be got without too great a decrease in digestibility; and it has been shown in every case that the largest yield per acre of dry matter was obtained at the time of the second cutting, or when the plants were about one-third in blossom. It has also been shown that after this period there is a more rapid decrease in digestibility. Hence, it would appear that this is about the time when there is the largest amount of digestible nutrients present. This is borne out by the table given below, which shows the amount of digestible matter in the several cuttings. In this calculation the average digestion co-efficients given in the preceding table have been used.

Table showing the amount of digestible matter, calculated to the yield per acre, of the several cuttings of the different crops:

	Dry matter.	Digestion co-efficient.	Digestible matter.
Second Crop, 1897.	Lbs.		Lbs.
First cutting	3,197	58.6	1,873
Second cutting	3,819	56.2	2,146
Third cutting	3,317	51.3	1,701
First Crop, 1898.			
First cutting	3,045	58.6	1,784
Second cutting	4 251	56.2	2,380
Third cutting	3,894	51.3	1,997
Second Crop, 1898.			
First cutting	1,899	58.6	1,112
Second cutting	2,505	56.2	1,407
Third cutting	2,214	51.3	1,135

The above figures show clearly that in our work the largest amount of digestible matter was obtained at the time of the second cutting, or when the growing crop was about one-third in blossom. As the different cuttings were made two weeks apart, it is possible that a larger amount of digestible matter would have been obtained a little earlier or a little later than the period mentioned. All that we can say is that, according to the results of our work, the crop should be cut when *about* one-third in blossom, to obtain the maximum amount of digestible matter.

There is a marked decrease in the digestible matter in the two weeks between the second and third cuttings. Taking an average of the three different crops, we find that this decrease amounts to 18.8 per cent., or very nearly one-fifth of the digestible matter of the second crop. The decrease in digestibility is so rapid that by the time the plant has passed the full blooming stage it appears to be unsafe to feed it in large quantities to any animal. During our digestion experimental work, we fed the three sheep for four weeks entirely on lucerne hay that was made after the plants had reached full bloom; and, at the end of the fourth week, one of the animals was taken sick with impaction of the third stomach, caused, no doubt, by the indigestible nature of the food eaten. With proper treatment, it quickly recovered and, with the other two sheep fed for four weeks longer on earlier cuttings of lucerne without any further trouble. Some ripened lucerne has been fed by the Farm department with serious results. In one case a valuable cow died of stoppage of the bowels. Post mortem examination showed that all passage had been stopped by a ball of indigestible fibre, which was supposed to have been formed from the lucerne eaten. Although we have not had sufficient experimental evidence to prove it conclusively, it seems that there is great danger in feeding large quantities of lucerne hay that has been made from the plant in advanced stages of maturity. Because of the rapid decrease in food value, also because of the rapidity with which the new crop comes on when the old one is removed, and because of the danger in allowing stock to eat the fodder when the plant becomes hard and woody, lucerne, whether in the pasture field or in the hay field, should not be allowed to stand later than the early blossoming stage.

It is instructive to compare the composition of lucerne hay with that of red clover and timothy, each crop being cut at the time when it apparently yields the maximum amount of digestible matter. This, for lucerne, was, according to our work, when the plants were about one-third in blossom; for red clover, when about one-third of the total number of blossom had turned brown; and, for timothy, when the first blossom had

fallen. The following table gives the composition of the hays all figured to the same per cent. of moisture, and the calculated amounts of the several constituents digested per ton of hay fed:

Percentage Composition of Lucerne, Red Clover and Timothy Hay.

	Water.	Dry matter.	Crude protein.	Crude fat.	Nitrogen-free extract.	Crude fibre.	Ash.
Lucerne	15.00	85.00	13.20	2.98	35.42	27.25	6.15
Red clover	15.00	85.00	13.04	4.85	37.98	22.05	7.08
Timothy	15.00	85.00	4.70	2.83	42.42	30.00	5.05
Amounts digested per ton of hay fed.							
Lucerne	.....	955.4	192.2	30.0	496.6	205.5	.....
Red clover	.....	974.9	160.3	69.8	540.1	195.4	.....
Timothy	.....	920.2	37.9	26.9	495.7	325.2	.....

According to the above figures, the red clover hay contains the most digestible matter; but one ton of lucerne hay contains very nearly one-fifth more digestible protien than the same weight of clover hay, and fully five times as much as a ton of timothy hay. The red, clover, however, contains the most digestible fat and nitrogen-free extract, while the timothy contains over one-third more digestible crude fibre than either of the other two hays named. The above figures, which have been calculated from the results of our last three years' work, are very similar to those calculated from the average of American analysis, excepting that, according to their results, there is less digestible fat than in our own. If, along with the above facts, it it remembered that lucerne usually gives larger returns per acre than either red clover or timothy, some idea may be formed of its value as a fodder crop.

The foregoing results lead us to the following general conclusions:

1. That lucerne deteriorates very rapidly both in percentage composition and in digestibility after the early blossoming stage.

2. That, in our experimental work, a much larger amount of digestible matter was obtained by cutting when the plants were about one-third in blossom than by cutting either two weeks earlier or two weeks later.

3. That, cut when about one-third in bloom, lucerne compares very favorably in nutritive value with red clover and timothy.

4. That there appears to be danger in feeding lucerne hay that has been made from the plant in advanced stages of maturity.

5. That, notwithstanding the rapidity with which lucerne deteriorates after passing the early blossoming stage, the fact that, when properly saved, it yields a large amount of nutritious food, makes it a most desirable addition to our list of fodders.

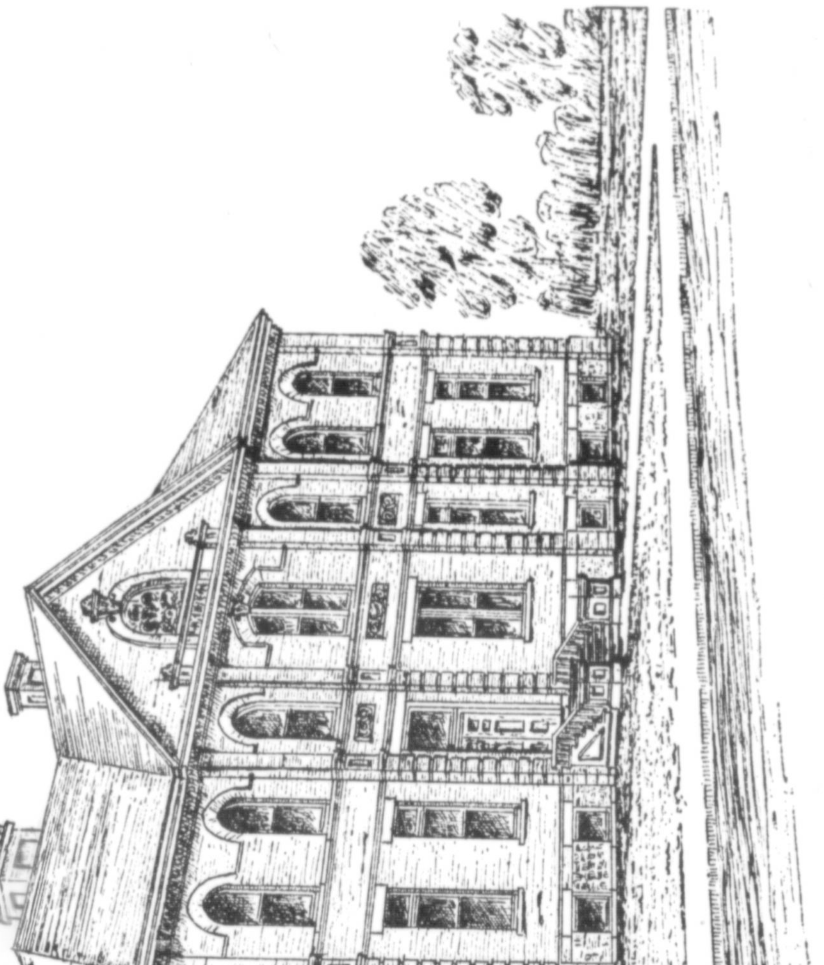
In this report of the work done on lucerne, no attempt has been made to treat of its value as a pasture crop or as a green fodder crop. Complaint has been made that cattle pastured on it show a tendency to bloat. Information is being gathered on this and other points, and a bulletin will be issued at an early date dealing with the whole question of lucerne.

In conclusion, I beg gratefully to acknowledge the co-operation of the Experimental department in our experimental work with lucerne.

Respectfully submitted,

R. HARCOURT,
Assistant Chemist.

December 31st, 1898.



Chemical Laboratory—Ontario Agricultural College, Guelph.

PART V.

REPORT OF THE

PROFESSOR OF VETERINARY SCIENCE.

To the President of the Ontario Agricultural College:

SIR,—I beg herewith to submit my annual repor' for 1897.

WORK IN THE CLASS ROOM.

The class-room work has been much the same as in previous years, viz.: To the First year I delivered a course of lectures on veterinary anatomy, considering the bones, muscles, ligaments, joints, etc., the digestive, respiratory, urinary, generative, circulatory and nervous systems, and the organs of special sense. We have in the class room the skeleton of a horse, and during most lectures on anatomy I have also a living animal, and I endeavor to teach the subject by illustration and make it as plain and simple as possible. I also delivered a short course of lectures, known as practical stable lectures, in which we discussed the most approved plans of constructing stables as regards location, material used, size and kinds of stalls, floors and mangers, drainage, ventilation, etc.; also the care and feeding of horses, watering horses, care of harness, saddles, etc. In addition to the above, I gave a course of lectures on veterinary materia medica, considering the general actions of medicines upon the different systems, the different modes of administration, with the modifications of action according to the mode of administration; and we considered separately the properties, actions, uses and doses of the principal medicines used in practice.

Second Year. To this class I delivered a course of lectures on disease and treatment, speaking of the causes, symptoms and treatment of the ordinary diseases to which the various domesticated animals are subject. I also gave a course in what we call Practical Horse, illustrating upon a living animal the manner of securing horses in order to preserve the operator from injury while engaged in such operations as stitching a wound, opening abscesses, cutting out tumors, removing warts, castrating, etc., etc., illustrating as well as possible, without actually performing the operations, the manner in which they are performed. In this course I point out the desirable and undesirable points of the different classes of horses in respect to size, conformation, action, manners, etc., and also teach the class how to examine a horse as to soundness. To this class I also delivered a course of lectures on veterinary obstetrics. In all cases I endeavor to make the points under discussion as simple and practical as possible. In speaking of diseases of bone, I show the class the condition the disease causes and compare it with a healthy bone (I have specimens of mostly all diseases of bone in the class room), point out and explain the alterations these diseases cause in the living animal, the symptoms which indicate their existence, and the manner of treatment; and, when possible, I exhibit an animal affected with the disease under discussion.

Third Year. To this class I delivered a short course of lectures upon the points and characteristics of the various breeds and classes of horses.

To the special dairy class I gave a few lectures, speaking of the ordinary diseases of dairy cattle, with the causes, symptoms and treatment.

Besides class room work, I gave professional attention to the farm, experimental, garden and dairy stock, and I am pleased to be able to state that, while we have had considerable sickness, there have been few fatal cases. Below will be seen the particulars of the diseases which occurred during the year in the different kinds of stock.

Horses. We had several cases of acute indigestion, colic, influenza, laminitis, nasal gleet, eczema, lymphangitis, wounds, etc., all of which yielded to treatment and made good recoveries. We had a fatal case of paralysis in an old mare belonging to the gardener's department.

Cattle. We had three severe cases of parturient apoplexy (milk fever) in cows—all of which made perfect recoveries. There were several cases of impaction of the rumen, indigestion, fardel-bound, mammitis, pyæmia, paralysis, retention of the placenta, difficult parturition, bronchocele, obstruction of teats, etc, etc, all of which recovered. We had one fatal case of fardel-bound in a heifer of the dairy herd, and a fatal case of paralysis in an old dairy cow.

In May Mr. Rennie purchased a herd of steers for feeding. He asked me to dehorn them as an experiment, and was so well pleased with the result in making the animals more quiet and docile with each other, and consequently feeding better, that when he sold them and bought others for the same purpose he had them dehorned. I also dehorned a few of Mr. Day's experimental herd.

Sheep. We had a few deaths in lambs, caused by wool balls in the fourth stomach; one fatal case of grub in the head in a ewe, and one or two deaths from diseased liver. About the middle of June, the lambs were noticed to be troubled with tape worm, and we treated them as follows, with the result that we had no losses. The lambs were kept without food for about twelve hours, and then drenched with from two to four ounces each (according to size and age) of the following mixture: Sweet milk, sixteen parts, and oil of turpentine, one part, well shaken to ensure thorough mixing. In about a week, the treatment was repeated. This treatment proved as effectual as the pumpkin seed treatment formerly used in the flocks, and the mixture is much more easily prepared.

Swine. We had very little sickness and no losses among the pigs, except in quite young animals.

I have, Sir, the honor to be,

Your obedient servant,

J. H. REED,

Professor of Veterinary Science.

GUELPH, Dec. 31st, 1898.

PART VI.

REPORT OF

PROFESSOR OF DAIRY HUSBANDRY.

To the President of the Ontario Agricultural College:

DEAR SIR,—I beg leave to submit my eighth annual report of the Dairy Department. I wish to acknowledge assistance given by the Farm department, the Chemical department, and the department of Bacteriology. To my assistants, Messrs. Rogers and Stratton, to the Dairy School staff, and to the gentlemen who have assisted from time to time in scoring cheese and butter for the dairy classes and for experimental purposes, my best thanks are also due.

DAIRY SCHOOL. The session of 1898 was one of the best in the history of the School. There were 110 students registered during the term, of whom nineteen were ladies. The addition of a lady instructor to the staff proved a popular and wise move. The enthusiasm of Miss Rose, the lady instructor, and that of a number of the ladies in the class, gave new life to the whole institution. The extension of the course to twelve weeks was beneficial, as it gave more time for lectures and instruction.

The students of 1898 came from nearly all parts of Canada, from the United States, and from Great Britain. In spite of the wide range from which our students were collected, there was no jarring in the wheels of progress nor stop to the separation of the cream from the skim-milk in the can of knowledge.

The College students took about two weeks of practical work in the dairy school at the beginning of the term.

At the final examinations forty one men and six ladies wrote for certificates of standing, of whom thirty-seven men and all the ladies passed. Certificates were withheld from a number until they have had the necessary factory experience, as stated in the requirements of our circular. Home Dairy certificates were granted to the ladies who completed the full course.

The following are applying for diplomas this year: J. W. Fotheringham, Courtice, Ontario, (cheese); A. M. Wheaton, Dayton, N.S., (cheese and butter); G. W. Hill, Summerhill, Ont., (cheese); Wm. Hope, Palermo, Ont., (butter); F. W. Smith, Greenwood, Ont., (butter); G. W. Black, Chaska, Minn., U.S.A., (cheese and butter); J. W. Boyes, Leesboro', Ont., (cheese); J. A. Dangerfield, Maple Creek, N.W.T., (butter); S. Flack, Red Deer, Alberta, N.W.T., (butter). Miss B. Millar, Coleman, is applying for a professional Home Dairy certificate and is sending in the necessary monthly reports at the present time.

One of the graduates of the 1898 class writes as follows from Nova Scotia:

"I am sending you a photo of the creamery I have been manager of during the summer. The building is a new one. I superintended the putting in of the plant, and in that way I have had many opportunities of putting to practical use many of the ideas I got at the dairy school. I have never for a moment regretted my time spent during that course. The three months at your Dairy School changed my views about my work, for I saw at once how little I knew, and the chance of improving by study and practical work, and especially the advantage of becoming personally acquainted with men of experience."

The above is a fair sample of a number of letters received from ex-students, and shows how the efforts of lecturers and instructors are appreciated. It is doubtful if any money spent by the Department of Agriculture gives such direct returns as that spent in equipping and maintaining our dairy schools. It pays.

One of our lady graduates took charge of a large dairy near Toronto early in the season. Later she received an appointment as lady instructor in the Dairy School at Strathroy, but the persons owning the dairy were so well pleased with her work that they insisted on her coming back as soon as possible after the session at Strathroy. In the meantime another of our lady graduates is in charge of the Toronto dairy. This speaks well for the training given in our Home Dairy department. We are aiming to improve this department still more in 1899, and we ought to have fifty students in the Home Dairy alone. With 100 students taking the factory and special courses relating to the cheese factory and creamery and fifty students in the Home Dairy, we shall have reached a good standard.

To all the instructors and lecturers who have so ably assisted during the past six sessions in bringing the school to its present standard, I am indebted, and I wish to express my thanks for their hearty co-operation and good work.

EXPERIMENTS IN BUTTER-MAKING.

The experiments in butter-making began soon after the close of the Dairy School in March. Mr. T. C. Rogers had charge of the work during the year. The experiments relate to the following points: Aëration, pasteurization, cream-ripening, churning, moisture in butter, and composite samples for milk-testing. Mr. Rogers also takes charge of the dairy herd records, and gives instruction to College students in separating and setting milk, and in the making of butter during the Fall term. Mr. Stratton has taken charge of the records of food cost in the herd for the past three years, in addition to his duties as experimentalist in the cheese department.

Aeration of Milk for Buttermaking.

From April to August some 17 experiments were made by aerating a portion of the milk for making butter. The remaining part was made into butter without any aerating. A Lister cooler and aerator was used for the work. The results in the quality of the butter indicate that there was no advantage in aerating the milk—in fact that made from unaerated milk scored higher at both the first and second scorings. These results coincide with former experiments relating to this question, i.e., where we have *clean, pure milk.*

Kind of butter.	Scoring.	Flavor. (Max. 45.)	Grain. (Max. 25.)	Total points scored. (Max. 100.)
Made from aerated milk. 17 samples	1st score..	40.30	24.11	93.72
	2nd " ..	37.76	24.71	92.07
Average		39 03	24.41	92.89
Butter made from milk not aerated. 17 samples	1st score..	60 65	24.17	94.12
	2nd " ..	38 56	24.90	93.21
Average		39.60	24.53	93.66

The creaming co-efficient was practically the same from both the aërated and unaerated milk.

The average temperature of the milk before aerating was 88, 80°, of the air 57°, and of the milk after aerating 80°.

The cream from aerated milk *without cooling* was not so easily mixed with the milk again after standing over night as was the unaerated milk *which had been cooled.* Aëration and cooling are both necessary with ordinary milk, in order to preserve it in good condition for buttermaking in hot weather, but the cooling is very essential. Night's milk for creameries should be cooled to 60° or 65° before the following morning, and as soon as possible after being milked. The morning's milk should also be cooled whenever possible before it leaves the farm.

Pasteurizing Milk and Cream compared with Raw Cream.

During June, July, August and September 32 experiments were made to ascertain the value of pasteurizing milk and cream for buttermaking. A portion of the milk was pasteurized in a Reid pasteurizer; and during the latter part of the season the milk was heated in an ordinary 800 pound vat. The cream was pasteurized in a can placed in a tank of hot water.

Last year we said: "the pasteurizers on the market are too expensive and too complicated for the average creamery." Since that time several machines have been placed on the market which give satisfaction in a creamery.

Conclusions: There was very little difference in the quality of the butter made from the three methods, as shown by the scorings in the table. A difference of one point or less in the average of the scorings means very little difference in the quality of the butter, or in its market value. In the summer, when cows are on good pasture and the conditions are favorable for the production of clean, pure milk, it would seem that there is little advantage from pasteurizing either the whole milk or the cream. In the winter, when conditions are less favorable for the production of pure milk, we have found that the heating of the milk or the cream to a temperature of 160° and the using of pure starters, has been a great help in securing uniformly fine butter. As we develop the export trade, pasteurization is likely to be more important, because the heating of the milk or cream tends to give the quality of butter desired in the British markets.

Kind of cream.	Scoring.	Flavor. (Max. 45.)	Grain. (Max. 25.)	Totol score. (Max. 100.)
Raw cream. 32 samples of butter	1st score..	40.42	23.1	92.58
	2nd " ..	38.44	23.65	91.29
Average		39.43	23.37	91.93
Pasteurized cream	1st score..	40.9	23.6	93.6
	2nd " ..	38.9	24.0	92.5
Average		39.9	23.8	93.05
Pasteurized milk	1st score..	40.9	23.53	93.46
	2nd " ..	38.84	23.77	91.71
Average		39.87	23.65	92.58

Broad *vs.* Narrow Exposure of Cream Surface during Ripening.

The question has been asked whether it is better to have much of the cream or as little as possible exposed to the air during the ripening process. Generally speaking, the answer will depend upon the purity of the atmosphere to which the cream is exposed. If the air is impure the cream should be protected as much as possible from the air, but if the air is reasonably pure the results of our experiments, as shown in the table, indicate that there is little or no difference in the quality of the butter made from the two methods of ripening.

The experiments were made during April, May and August. There was little or no difference in the average time required to churn the cream, or in the loss of fat in the buttermilk.

Kind of cream.	Scoring.	Flavor. (Max. 45.)	Grain. (Max. 25.)	Total score. (Max. 100.)
Cream ripened with a broad surface exposed to the air. 13 samples	1st score..	41.40	23.54	93.94
	2nd " ..	38.60	24.17	92.19
Average	.....	40.00	23.85	93.06
Cream ripened with a narrow surface exposed to the air	1st score..	41.54	23.84	94.68
	2nd " ..	39.07	24.15	92.52
Average	.....	40.32	23.99	93.61

Cream ripened at Different Temperatures.

During August, September and October ten trials were made by ripening one lot of cream at about 60° and another lot of the same cream at from 70° to 75°. The cream was ripened to an average of about .65 per cent. of acidity. The average temperature for churning was 56° for the cream ripened at 60° and 53.5° for cream ripened at 70° to 75°. The time required for churning was 34.6 minutes for the first and 38 minutes for the second. The average percentage of fat in the buttermilk was .16 for cream ripened at 60° and .24 for cream ripened at the higher temperature. The scorings indicate very little difference in the quality of the butter.

Butter made from cream—	Scoring.	Flavor (Max. 45.)	Grain. (Max. 25.)	Total score. (Max. 100.)
Ripened at about 60° F	1st score....	40 43	23.3	92 44
Ridened at 70° to 75° F	1st score....	40.55	23.78	93.44

Effect of Stirring Cream while Ripening.

From September 7th to the 23rd, ten trials were made to note the effects of stirring cream during the ripening process; 8,426 lbs. of milk were separated and the cream was equally divided each day. One-half was stirred during the ripening process and the

Kind of butter.	Scoring.	Flavor. (Max. 45)	Grain. (Max. 25.)	Total score. (Max. 100.)
Made from cream stirred frequently while ripening.	1st score.	41.55	23.9	95.00
	2nd score.	39.3	23.6	92.50
Average	.....	40.42	23.75	93.75
Made from cream not stirred while ripening	1st score.	41.11	23.77	93.88
	2nd score.	38.55	23.89	92.49
Average	.....	39.83	23.83	93.16

other half was ripened without stirring. There were used 586 lbs. of cream in each lot, testing 25.2 per cent. of fat. The acidity of the cream averaged about .7 of a per cent. Both lots churned in about the same time—32 minutes. The table shows that there was little difference in the quality of the butter, what difference there is being in favor of stirring the cream while ripening.

Cream Ripened with Different Percentages of Starter.

From October 13th to November 9th, eleven trials were made to note the effect of varying percentages of starter used in the cream while ripening. A quantity of cream was equally divided, and into one-half was put from eight to ten per cent of good starter. To the other half there was added from sixteen to twenty-five per cent. of the same starter. The cream tested twenty-eight per cent. of fat. The buttermilk tested an average of .14 for the low per cent. of starter, and .18 for the higher amount of starter.

Kind of butter.	Scoring.	Flavor. (Max. 45.)	Grain. (Max. 25.)	Total score. (Max. 100.)
Made from cream ripened with 8 to 10 per cent. starter	1st score.	40.5	24.2	94.4
	2nd score.	41.5	24.8	95.2
Average		41.0	24.5	94.8
Made from cream ripened with 16 to 25 per cent. starter	1st score.	40.72	24.0	94.26
	2nd score.	41.45	24.82	94.81
Average		41.08	24.41	94.53

Although these lots of butter was scored by several different persons, the results when averaged show that in these cases there was little difference in the quality of the butter, as shown in the table.

Granular *vs.* Lump Butter.

Experiments were made in April and May to see the effects of churning butter into lumps, which was the practice formerly, as compared with keeping the butter in the granular form until salted—the modern practice. The table of scorings indicates that the butter in granular form scored slightly less in the average of first scorings and more in

Kind of butter.	Scoring.	Flavor. (Max. 45.)	Grain. (Max. 25.)	Total score. (Max. 100.)
		Av.	Av.	Av.
Buttermilk drawn off when the butter was gathered into fine granules	1st score.	40.0	23.7	92.7
	2nd score.	37.6	23.6	91.1
Average		38.8	23.65	91.9
Butter churned into large lumps before the buttermilk was drawn off	1st score.	40.66	23.55	93.31
	2nd score.	37.1	23.90	90.66
Average		38.88	23.72	91.98

the second scorings. This difference is probably caused by the larger proportion of buttermilk retained by the lump butter, giving it a higher flavor when first made, but causing it to lack in keeping quality.

E. ᵀCT OF DIFFERENT QUANTITIES OF SALT ON BUTTER.

Experiments were made by using from one-quarter to one ounce of salt per pound of butter. The results indicate that three-quarters of an ounce has given the best results, as shown by the table.

—	Flavor.	Grain.	Color.	Salt.	Finish.	Total.
	(45)	(25)	(15)	(10)	(5)	(100)
¼ ounce of salt to 1 lb. of butter	40.14	22.3	13.3	9 7	5	90.44
1 " " " "	40.71	22.43	14.30	9.57	5	92.01
¾ ounce of salt to 1 lb. of butter	40.00	23.00	14.75	8.5	5	91.25
¾ " " " "	42.00	23.75	14.75	9.75	5	95.25

MOISTURE IN BUTTER.

These are a continuation of last year's experiments. This year samples from our experimental churnings, as well as from our regular churnings, were sent to the chemical laboratory to be analysed. The table shows the results from the different methods of treating the milk, cream, and butter. By keeping the butter in small granular form, there was more moisture, less curd and less salt in the butter than by churning into large granules. The highest per cent. of moisture in the small granular butter was 13.7 ; the lowest, 11.8. The large granular butter contained 13.3 as the highest, and 11.6 as the lowest per cent. of moisture. The highest and lowest percentage of curd from each was 1.05 and 0.67 for small granules; 1.7 and 0.69 for large granules. The ash and salt ranged from 3.0 to 2.4 for small granules, and 4.9 to 3.1 for large granular butter.

No. of Samples Analyzed.	Butter made from.	Average percentage of			
		Moisture.	Fat.	Casein.	Ash & Salt.
2	Broad surface cream.....	11.664	84.501	.842	3.310
2	Narrow " "	12.892	.....	.....	.....
7	Small granules	12.966	83.289	.833	2.941
7	Large "	12.414	82.839	1.009	3.745
12	Aerated milk	12.678	83.409	.912	2.980
11	Unaerated milk	12.702	83.323	.973	3.149
1	Washed with cold water.....	13.890	83.178	.527	2.405
1	" " warmer "	13.122	82.745	.684	3.499
12	Raw cream	12.594	82.972	.991	3.441
2	Pasteurized cream.....	12.296	83.942	1.082	2.679
10	" milk	12.287	83.750	.968	2.988
74	Ordinary and experimental cream.....	12.655	83.209	.949	3.206

The percentage of moisture in the butter from raw cream and pasteurized milk and cream ranged from 11.3 in pasteurized milk, to 13 6 in raw cream ; but the average is much the same in all. The range in casein or curdy matter was from .83 in raw cream,

to 1.3 in raw cream, *i.e.*, the highest and the lowest percentage of curdy matter was found in the ordinary or raw cream butter. The average is much the same in butter made by all three methods.

Composite Samples Tested Weekly and Monthly.

Composite samples of milk were kept in the butter-room of the Dairy for a month at a time during four months, while at the same time similar samples were kept in the basement, sitting on the cement floor. Samples of whole milk were added daily, and one jar in each place was tested weekly. Another jar was tested at the end of two weeks, another at the end of three weeks, and another at the end of four weeks. The results, as shown by the table, indicate that the monthly samples gave the same test of fat as the average of four individual weeks, and the average of two two-weeks' samples. The test of the three-week samples also correspond with the average of the first three weeks of the weekly test in each month. The table also indicates that the tests were alike, whether kept in the butter-room, which was at a temperature of 60° to 84°, or kept in the basement cellar at a temperature of 55° to 70°.

Week Ending.	Tested Weekly.		Tested at the end of the Second Week.		Tested at the end of the Third Week.		Tested at the end of the Fourth Week.	
	Butter-Room.	Cellar Floor.	Butter-Room.	Cellar Floor.	Butter-Room.	Cellar Floor.	Butter-Room.	Cellar Floor.
April 21	2.9	3.0	.....	.....	.....	.....	.....	.....
" 28	3.8	3.8	3.2	3.2	.....	.....	.....	.....
May 5	3.7	3.7	.....	.....	3.4	3.4	.....	.....
" 12	3.55	3.6	3.5	3.4	.....	.....	3.4	3.4
First month's averages	3.49	3.5	3.35	3.3	3.4	3.4	3.4	3.4
May 19	3.8	3.8	.....	.....	.....	.....	.....	.....
" 26	3.8	3.8	3.8	3.8	.....	.....	.....	.....
June 2	3.9	3.9	.....	.....	3.85	3.8	.....	.....
" 9	3.6	3.6	3.75	3.8	.....	.....	3.75	3.8
Second month's averages	3.77	3.77	3.77	3.8	3.85	3.8	3.75	3.8
June 16	3.6	3.6	.....	.....	.....	.....	.....	.....
" 23	3.65	3.65	3.7	3.8	.....	.....	.....	.....
" 30	3.5	3.5	.....	.....	3.65	3.65	.....	.....
July 7	3.5	3.45	3.5	3.55	.....	.....	3.5	3.65
Third month's averages	3.56	3.55	3.6	3.67	3.65	3.65	3.5	3.65
July 22	3.5	3.55	.....	.....	.....	.....	.....	.....
" 29	3.65	3.65	3.4	3.4	.....	.....	.....	.....
August 6	3.5	3.4	.....	.....	3.5	3.5	.....	.....
" 13	3.5	3.5	3.5	3.5	.....	.....	3.5	3.45
Fourth month's averages	3.54	3.52	3.45	3.45	3.5	3.5	3.5	3.45
Averages for four months	3.59	3.58	3.54	3.55	.....	.....	3.54	3.57
Average of 3 tests each month	3.69	3.61	.....	.....	3.60	3.59	.....	.....

The samples were preserved with a mixture of potassium bichromate (7 parts) and carrosive sublimate (1 part). Geary's tablets were also tried with satisfactory results. One tablet will preserve a daily ounce sample for about seven days in hot weather. The tablets are more convenient than the powder. The first lot of the tablets became pulverized before we had them all used; the second lot are all right at the present time of writing.

EXPERIMENTS IN CHEESEMAKING.

The experiments in the Cheese Department were in charge of Mr. R. W. Stratton. The experiments relate to aeration of milk, relation of fat in milk to quantity and quality of cheese produced, temperature and rennet in setting milk, acid in dipping, temperature of curds at pressing, curing cheese at temperatures of about 60°, 65° and 70°.

A summary of five years' experiments relating to the fat in milk as a basis of milk valuation at cheese factories is also included.

Aerating Milk for Cheesemaking.

Date.	Temperature of atmosphere and milk.						Rennet test of		Remarks.
	Air at Night.	Milk.	Milk after Æerating.	Air in Morning.	Æerated Milk.	Unaerated Milk.	Æerated Milk.	Unaerated Milk.	
July 21	72°	92°	82°	60°	65°	65°	14	5	Lister aerator used up to Sept. 28.
" 23	72°	90°	81°	72°	72°	72°	16	14	Both lots set in water, cooled to 75° and then taken out of water.
" 27	69°	90°	82°	.....	65°	65°	27	26	Both lots set in water, cooled to 72°, and then taken out of water.
Sept. 28	56°	D 92°	85°	.....	60°	60°	32	24	Both lots set in water, cooled to 71°, and then taken out of water.
	56°	F 86°	80°	.....	60°	60°	32	24	Both lots set in water, cooled to 71°, and then taken out of water.
" 29	55°	F 89°	.....	.....	63°to65°	63°to65°	31	26	Pump aerator used up to Oct. 5.
" 30	66°	D 94°	.....	.....	73°to74°	73°to74°	16	14	
	66°	F 89°	.....	.....	73°to74°	73°to74°	16	14	
Oct. 4.	63°	D 94°	85°	60°	66°	66°	26	26	Milk left outside after aerating.
	63°	F 87°	80°	60°	66°	66°	26	26	Milk left outside after aerating.
" 5..	46°	D 90°	.....	38°	60°to61°	60°to61°	31	27	Milk set inside after aerating.
	46°	F 81°	.....	38°	60°to61°	60°to61°	31	27	Milk set inside after aerating.

D. Milk from College Dairy.

F. Milk from Farmers' Dairies.

After mixing the night's and morning's milk together, both of which had been aerated but not cooled, the rennet test of the aerated milk in the vat was usually from 2 to 8 seconds higher, or, in other words, the aerated milk was sweeter than the unaerated milk.

QUALITY OF THE CHEESE FROM AERATED AND UNAERATED MILK.

—	Average lbs. milk used.	Average per cent. fat in milk.	Average lbs. cheese from 300 lbs. milk.	Scoring.	Average flavor. (Max. 35.)	Average closeness. (Max. 20.)	Average texture. (Max. 20.)	Average total. (Max. 100.)
Aerated.....	300	3.45	27.09	First	28.25	17.75	16.33	86.41
				Second ..	30.00	18.50	18.00	91.00
				Average..	28.50	17.85	16.57	87 07
Unaerated	300	3.44	26.92	First	27.91	17.16	16.33	85 50
				Second ..	28 50	18 00	16.50	87 50
				Average..	28 00	17.28	16.35	85.78

These are a continuation of the experiments made in 1897, except that this year we went to the farms of patrons and brought the night's milk to the College Dairy as soon as possible after it had been milked. (Last year we allowed the patrons to do the aerating.) The morning's milk was aerated after bringing it to the Dairy. Thirteen experiments were made during July, September and October. While the average scoring of the cheese made from aerated milk is slightly higher than that made from unaerated milk, none of these cheese scored as they should have scored. In fact, some of the poorest cheese made during the year was made during these experiments. We hope to make a special study of the effects of aeration during 1899. The question is in a most unsatisfactory state at the present time.

RELATION OF FAT IN MILK TO QUANTITY AND QUALITY OF CHEESE.

This is the fifth year that experiments relating to this question have been made. In addition to the report on the experiments for 1898, we have added a summary of our five years' work on this subject, as we indicated in the report for last year. The following is a summary for the past year :

1. The number of experiments made was 27, covering a period from April to November.

2. 300 lbs of milk were used in each vat, or 16,200 lbs. altogether.

3. The percentage of fat in the milk ranged from 2.9 to 4.3.

4. Both vats were ripened to the same degree before renneting.

5. About one per cent. of starter was used in each vat.

6. H (rich milk) curds were cooked to 100°, and the L (poor or medium milk) were cooked to 98°.

7. Both curds were given about one-eighth of an inch of acid before dipping.

8. The H curds mellowed more quickly than the L curds and were ready to salt in less time.

9. The H curds were salted $\frac{1}{4}$ lb. extra per 100 lb. curd.

10. The temperature for putting to press was 80° to 85° for both curds.

11. The curds were pressed about 20 hours.

12. The curing room ranged from 60° to 75°.—average 66°.

13. All cheese were weighed and marked when taken from the hoops. They were weighed again at the end of one month.

14. The cheese were scored when about six weeks old by Messrs. A. F. MacLaren, G. J. Brill and A. T. Bell. The scale used was: flavor, 35; closeness, 20; even color, 15; texture, 20; finish, 10.

The tables give the details of the most important points by months:

RELATION OF FAT IN MILK TO QUANTITY AND QUALITY OF CHEESE.

Date.	Per cent. fat in milk.	Lbs. of fat in milk.	Lbs. of cheese.		Lbs. of milk for 1 lb. cheese.		Lbs. cheese for 1 lb. fat in milk.		Per cent. fat in whey.
			Green.	Cured.	Green.	Cured.	Green	Cured	
April 28	3.80	11.40	31.00	29.50	.....	.....	.....	2.58	.15
	3.20	9.60	25.75	24.50	.....	.....	.....	2.55	.15
" 29	3.75	11.25	30.50	29.00	.....	.....	.....	2.57	.15
	3.30	9.90	26.25	24.75	.....	.....	.....	2.50	.15
Average for rich milk	3.77	22.65	61.50	58.50	9.75	10.25	2.71	2.58	.15
Average for poor milk	3.25	19.50	52.00	49.25	11.53	12.18	2.66	2.52	.15
May 6	3.80	11.40	30.75	28.50	.....	.....	.....	2.58	.20
	3.30	9.90	27.50	26.25	.....	.....	.....	2.65	.15
" 11	4.00	12.00	30.25	28.75	.....	.....	.....	2.39	.20
	3.00	9.00	27.50	26.00	.....	.....	.....	2.88	.15
" 19	4.10	12.30	30.25	29.00	.....	.....	.....	2.35	.20
	2.90	8.70	27.50	26.00	.....	.....	.....	2.98	.10
" 25	4.00	12.00	31.25	30.00	.....	.....	.....	2.50	.25
	3.20	9.60	28.25	27.00	.....	.....	.....	2.81	.15
" 31	4.30	12.90	31.75	30.50	.....	.....	.....	2.36	.28
	3.00	9.00	28.00	26.75	.....	.....	.....	2.97	.12
Average for rich milk	4.04	60.60	154.25	147.75	9.72	10.15	2.54	2.43	.226
Average for poor milk	3.08	46.20	138.75	132 00	10.81	11.36	3.00	2.85	.134
June 7	4.10	12.30	32 50	31.25	.....	.....	.....	2 54	.20
	3.00	9.00	27.00	25.75	.....	.....	.....	2.86	.12
" 14	4.30	12.90	31.50	30.25	.....	.....	.....	2.34	.20
	3.00	9.00	26 50	25.25	.....	.....	.....	2.80	.15
" 21	3.90	11.70	31.00	30.25	.....	.....	.....	2.67	.20
	2.95	8.85	28.00	27.00	.....	.....	.....	3.05	.15
" 29	4.00	12.00	30.00	29.00	.....	.....	.....	2.41	.25
	3.10	9.30	26.50	25.25	.....	.....	.....	2.71	.15
Average for rich milk	4.07	48.90	125.00	120.75	9.60	9.93	2.55	2.46	.12
Average for poor milk	3.01	36.15	108.00	103.25	11.11	11 62	2.98	2.85	.142
July 5	3.80	11.40	30.50	29.25	.....	.....	.....	2.56	.15
	3.20	9.60	27.50	26.25	.....	.....	.....	2.72	.15
" 19	4.00	12.00	30.25	29.00	.....	.....	.....	2.41	.20
	3.20	9.60	25.50	24.25	.....	.....	.....	2.52	.12
" 21	3.60	10.80	29.00	28.00	.....	.....	.....	2.59	.18
	3.00	9.00	25.50	24.75	.....	.....	.....	2.75	.12
Average for rich milk	3.80	34.20	89.75	86.25	10.02	10.43	2.62	2.52	.176
Average for poor milk	3.13	28.20	78.50	75.25	11.46	11.96	2.78	2.66	.13

RELATION OF FAT IN MILK TO QUANTITY AND QUALITY OF CHEESE.—*Concluded.*

Date.	Per cent. fat in milk.	Lbs. fat in milk.	Lbs. of cheese.		Lbs. of milk for 1 lb. of cheese.		Lbs. cheese for 1 lb. fat in milk.		Per cent. fat in whey.
			Green.	Cured.	Green.	Cured.	Green	Cured	
August 3	3.70	11.10	28.50	27.75	.....	.....	.....	2.50	.18
	2.90	8.70	25.00	24.25	.....	.....	.....	2.78	.15
" 9	3.90	11.70	29.25	28.50	.....	.....	.....	2.43	.20
	3.10	9.30	26.75	26.00	.....	.....	.....	2.79	.15
" 16	4.10	12.30	31.00	29.75	.....	.....	.....	2.41	.20
	3.00	9.00	28.00	26.75	.....	.....	.....	2.97	.12
" 30	4.00	12.00	31.75	30.50	.....	.....	.....	2.54	.18
	3.00	9.00	27.00	25.75	.....	.....	.....	2.86	.15
Average for rich milk	3.92	47.10	120.50	116.50	9.95	10.30	2.55	2.47	.19
Average for poor milk	3.00	36.00	106.75	102.75	11.24	11.67	2.96	2.85	.142
September 13	4.00	12.00	33.00	32.00	.....	.....	.....	2.66	.20
	3.20	9.60	28.75	27.50	.....	.....	.....	2.86	.12
" 27	4.20	12.60	32.00	30.75	.....	.....	.....	2.44	.20
	3.30	9.90	28.25	27.00	.....	.....	.....	2.72	.13
Average for rich milk	4.10	24.60	65.00	62.75	9.23	9.56	2.64	2.55	.20
Average for poor milk	3.25	19.50	57.00	54.50	10.52	11.00	2.92	2.79	.125
October 4	4.20	12.60	32.75	31.50	.....	.....	.....	2.50	.20
	3.20	9.60	27.00	25.50	.....	.....	.....	2.65	.15
" 8	4.00	12.00	31.25	29.75	.....	.....	.....	2.47	.15
	3.30	9.90	28.75	27.50	.....	.....	.....	2.77	.15
" 11	4.30	12.90	34.00	32.25	.....	.....	.....	2.50	.20
	3.30	9.90	28.25	26.50	.....	.....	.....	2.67	.12
" 18	4.30	12.90	35.25	33.50	.....	.....	.....	2.59	.20
	3.20	9.60	27.50	26.00	.....	.....	.....	2.70	.15
" 25	4.30	12.90	35.25	33.50	.....	.....	.....	2.59	.25
	3.10	9.30	26.75	25.25	.....	.....	.....	2.71	.15
Average for rich milk	4.22	63.30	168.50	160.50	8.90	9.34	2.66	2.53	.2
Average for poor milk	3.22	48.30	138.25	130.75	10.84	11.47	2.86	2.70	.144
November 1	4.20	12.60	35.00	33.25	.....	.....	.....	2.63	.18
	3.20	9.60	26.50	25.00	.....	.....	.....	2.60	.15
" 3	4.20	12.60	35.00	33.25	.....	.....	.....	2.63	.25
	3.10	9.30	26.75	25.25	.....	.....	.....	2.71	.15
Average for rich milk	4.20	25.20	70.00	66.50	8.57	9.02	2.77	2.60	.215
Average for poor milk	3.15	18.90	53.25	50.25	11.26	11.94	2.81	2.65	.150

BUTTER FAT AND CASEIN LOST IN THE WHEY.

The loss of fat in the whey at the different stages of cheesemaking has been carefully determined by the scales and the Babcock tester. The casein was determined in the chemical laboratory of the college. We regret that more of these determinations were not made by the laboratory, as it is a very important point to know what amount of the caseous or curdy matter is lost in the process of making cheese. The "drippings," after salting and pressing, include all grease pressed from the cheese. The whole was melted and samples were taken for Babcock testing the same as last year.

Butter Fat lost in Whey—300 lbs. Milk used in each Vat

Date.	Vat.	Drippings from dipping to milling.			Drippings from milling to salting.			Drippings after salting and pressing.		
		Lbs.	Per cent. fat.	Lbs. fat lost.	Lbs.	Per cent. fat	Lbs. fat lost.	Lbs.	Per cent. fat.	Lbs. fat lost.
April 28th	H	4.75	.10	.00475	2.50	7.0	.17500	3 25	2.0	.06500
" 29th	"	4.50	.12	.00540	2.50	7.4	.18500	3.75	2.0	.07500
Average		4.62	.109	.00507	2.50	7.20	.18000	3.50	2.00	07000
April 28th	L	5.00	.05	.00250	2.00	5.4	.10800	5.50	2.6	.14300
" 29th	"	4.25	.10	.00425	1.50	5.8	.08700	3.25	2.4	.07800
Average		4.62	.073	.00337	1.75	5.57	.09750	4.37	2.52	.11050
May 6th	H	4.00	.15	.00600	.....	.....	.....	6.25	3 6	.22500
" 11th	"	3.50	.12	.00420	.....	.....	.....	7.50	6.0	.45000
" 19th	"	4.50	.12	.00540	1.50	4.0	.06000	3.50	4.3	.15050
" 25th	"	5 50	.07	.00385	2.00	4.6	.09200	3.50	3.6	.12600
" 31st	"	3 00	.18	.00540	1.50	6.5	.09750	4.00	4.8	.19200
Average		5.10	.121	.00497	1.66	4.99	.08316	4.95	4.62	.22870
May 6th	L	5.00	.10	.00500	.....	.....	.....	5.00	2.6	.13000
" 11th	"	2.00	.05	.00100	2.00	1.9	.03800	3.25	2.0	.06500
" 19th	"	2.50	.02	.00050	3.00	1.0	.03000	3.00	2.7	.08100
" 25th	"	7.50	.02	.00150	2.50	4.1	.10250	3.00	1.1	.03300
" 31st	"	4.50	.10	.00450	1.50	6.4	.09600	2.50	2.8	.07000
Average		4.30	.058	.00250	2.25	2.96	.06662	3.43	2.33	.07580
June 7th	H	4 50	.15	.00675	1.25	6.4	.08000	3.75	1.7	.06375
" 14th	"	1.75	.40	.00700	1.75	15.0	.26250	3.50	2.9	.10150
" 21st	"	2.25	.10	.00225	1.25	6.2	.07750	4.00	1.8	.07200
" 29th	"	6.25	.35	.02187	2.75	12.1	.33275	2.75	2.9	.07975
Average		3.68	.256	.00946	1.75	10.75	.18818	3 50	2.26	.07925
June 7th	L	5.00	.05	.00250	1.50	3.9	.05850	3.00	1.7	.05100
" 14th	"	2.00	.15	.00300	1.75	6.4	.11200	2.50	1.7	.04250
" 21st	"	2.25	.05	.00112	1.75	3.4	.05950	2.50	1.2	.03000
" 29th	"	7.25	.05	.00362	3.25	5.4	.17550	2.50	2.8	.07000
Average		4.12	.062	.00256	2.06	4.91	.10137	2.62	1.84	.04837
July 5th	H	5.75	.08	.00460	1.75	4.0	.07000	3.00	1.7	.05100
" 19th	"	3.25	.10	.00325	1.00	9.0	.09000	4.00	1.5	.06000
" 26th	"	4.25	.10	.00425	1.25	3.4	.04250	4.00	4.5	.18000
Average		4.41	.091	.00403	1.33	4.06	.05062	3.66	2.64	.09700
July 5th	L	7.00	.03	.00210	3.00	1.1	.03300	2.50	8.6	21500
" 19th	"	5.75	.08	.00460	1.50	4.8	.07200	3.50	3.2	.11200
" 26th	"	4.25	.08	.00340	1.75	6.8	.11900	3.00	1.8	.05400
Average		5.66	.059	.00336	2.06	3.58	.07466	3.00	4.23	.12700
August 3rd	H	3.75	.08	.00300	1.75	10.5	.18375	3.75	4.00	.15000
" 9th	"	3.75	.12	.00450	2.25	14.0	.31500	4.00	6.10	.24400
" 16th	"	.....	.....	.....	2.00	7.5	.15000	3.25	6.70	.21775
" 30th	"	3.25	.15	.00487	1.25	7.5	.09375	3.50	1.60	.05600
Average		3.56	.115	.00412	1.81	10.24	.18532	3.62	4.60	.16693
August 3rd	L	5.25	.03	.00157	2.00	10.2	.20400	3.25	3.1	.10075
" 9th	"	6.50	.05	.00325	3.00	7.1	.21300	2.75	1.8	.04950
" 16th	"	.....	.	.....	1.00	9.2	.09200	3.00	2.3	.06900
" 30th	"	3.25	.10	.00325	1.50	5.4	.08100	3.00	1.4	.04200
Average		5.00	.053	.00269	1.87	7.86	.14750	3.00	2.18	.06531
September 13th	H	4.50	.08	.00340	1.75	5.0	.08750	4.25	3.2	.13600
" 27th	"	4.00	.10	.00400	1.75	6.0	.10500	4.00	6.3	.25200
Average		4.25	.087	.00370	1.75	5.50	.09625	4.12	4.70	.19400
September 13th	L	4.00	.08	.00320	1.75	2.2	.03850	2.75	2.3	.06325
" 27th	"	5.75	.05	.00287	3.25	1.4	.04550	3.00	3.2	.09600
Average		4.87	.062	.00303	2.50	1.68	.04200	2.87	2.76	.07962

BUTTER FAT LOST IN WHEY.—*Concluded.*

Date.	Vat.	Drippings from dipping to milling.			Drippings from milling to salting.			Drippings after salting and pressing.		
		Lbs.	Per cent. fat.	Lbs. fat lost.	Lbs.	Per cent. fat.	Lbs. fat lost.	Lbs.	Per cent. fat.	Lbs. fat lost.
October 4th	H	3.50	.05	.00175	1.75	7.8	.13650	3.75	2.1	.07875
" 8th	"	3.50	.08	.00280	3.50	6.6	.23100	3.75	1.4	.05250
" 11th	"	3.00	.10	.00300	5.50	3.6	.19800	3.75	2.6	.09750
" 18th	"	3.50	.08	.00280	2.00	4.2	.08400	4.25	1.4	.05950
" 25th	"	4.00	.10	.00400	1.50	4.0	.06000	4.00	2.8	.11200
Average		3.50	.082	.00287	2.85	4.98	.14190	3.90	2.05	.08005
October 4th	L	5.50	.05	.00275	2.50	3.3	.08250	3.25	1.8	.05850
" 8th	"	3.50	.08	.00280	2.75	3.9	.10725	3.50	1.4	.04900
" 11th	"	4.00	.04	.00160	5.00	1.6	.08000	3.00	0.8	.02400
" 18th	"	3.00	.06	.00180	2.00	3.2	.06400	3.00	1.2	.03600
" 25th	"	4.75	.04	.00190	2.75	3.0	.07250	3.50	2.8	.09800
Average		4.15	.052	.00217	3.00	2.74	.08245	3.25	1.63	.05310
November 1st	H	4.25	.08	.00340	1.50	3.2	.04800	3.00	1.0	.03000
" 3rd	"	4.00	.04	.00160	2.50	2.0	.05000	3.00	0.8	.02400
Average		4.12	.060	.00250	2.00	2.45	.04900	3.00	0.90	.02700
November 1st	L	4.50	.08	.00360	2.25	5.4	.12150	2.50	2.2	.06000
" 3rd	"	3.50	.04	.00140	2.50	4.3	.10950	2.75	1.6	.04400
Average		4.00	.062	.00250	2.37	4.86	.11550	2.62	1.98	.05200
Total loss for season	H	102.75	.....	.12409	50.00	.....	3.30725	105.00	.....	3.40150
	L	117.75	.....	.06958	59.25	.....	2.40825	84.25	.....	1.96450
Average loss per 300 lbs. milk	H	3.91	.....	.00476	2.00	....	.13229	3.88	.....	.12592
	L	4.52	.....	.00267	2.27	.....	.09262	3.12	.....	.07275

TOTAL FAT LOST IN WHEY (BEFORE DIPPING) AND THE LOSS PER 100 POUNDS CURED CHEESE.

Total pounds milk used.	Average per cent. fat in milk.	Total loss of fat in whey.	Loss of fat in whey per 100 lb. cured cheese.
		lbs.	lbs.
900	2.92	1.09	1.41
7,200	3.14	9.21	1.48
4,500	3.88	7.67	1.74
3,600	4.21	6.86	1.81

PERCENTAGE OF FAT IN WHEY BY MONTHS.

	Fat in whole milk.		Fat in whey from—	
	Rich milk.	Poor milk.	Rich milk.	Poor milk.
April	3.77	3.25	.150	.150
May	4.04	3.08	.226	.134
June	4.07	3.01	.212	.142
July	3.80	3.13	.176	.130
August	3.92	3.00	.190	.142
September	4.10	3.25	.200	.125
October	4.22	3.22	.200	.144
November	4.20	3.15	.215	.150
Average for season	4.03	3.12	.200	.139

CASEIN IN THE WHEY AND DRIPPINGS FROM RICH AND POOR MILK, AS DETERMINED IN CHEMICAL LABORATORY.

Date.	Per cent. fat in whole milk.	Vat.	Before dipping.	Drippings from dipping to milling.			Drippings from milling to salting.			Drippings after salting and pressing.		
				Lbs.	Per cent. casein.	Lbs. casein lost.	Lbs.	Per cent. casein.	Lbs. casein lost.	Lbs.	Per cent. casein.	Lbs. casein lost.
May 25	4.00	H	.104	5.50	.119	.00654	2.00	.343	.00686	3.50	.270	.00945
" 31	4.30	"	.100	3.00	.207	.00621	1.50	.333	.00499	.....	.....	.....
Average	.....	.....	.102	4.25	.150	.00637	1.75	.338	.00592	3.50	.270	.00945
May 25	3.20	L	.094	7.50	.073	.00533	2.50	.269	.00672	3.00	.213	.00639
" 31	3.00	"	.089	4.50	.082	.00369	1.50	.372	.00558	.....	.....	.....
Average	.....	.....	.091	6.00	.075	.00451	2.00	.307	.00615	3.00	.213	.00639
June 8	4.10	H	.074	4.50	.117	.00526	1.25	.379	.00473	3.75	.372	.01395
" 15	4.30	"	.181	1.75	.331	.00579	1.75	.627	.01097	3.50	.530	.01855
" 22	3.90	"	.114	.....	.....	.....	1.25	.407	.00508	4.00	.194	.00776
" 30	4.00	"	.121	6.25	.138	.00862	2.75	.399	.01097	2.75	.239	.00657
Average	.....	....	.125	4.16	.157	.00655	1.75	.451	.00793	3.50	.334	.01170
June 8	3.00	L	.056	5.00	.066	.00330	1.50	.434	.00651	3.00	.252	.00756
" 15	3.00	"	.105	2.00	.124	.00248	1.75	.693	.01212	2.50	.355	.00887
" 22	2.95	"	.089	.....	.....	.....	1.75	.302	.00528	2.50	.210	.00525
" 30	3.10	"	.095	7.25	.114	.00826	3.25	.365	.01187	2.50	.165	.00412
Average	.....	.....	.086	4.75	.098	.00468	2.06	.433	.00894	2.62	.245	.00645
July 5	3.8	H	.109	5.75	.108	.00621	1.75	.417	.00729	3.00	.115	.00345
" 19	4.0	"	.100	3.25	.240	.00780	1.00	.435	.00435	4.00	.217	.00868
" 26	3.6	"	.125	4.25	.105	.00446	1.25	.212	.00265	4.00	.189	.00756
Average	.....	.....	.111	4.41	.....	.00615	1.33	.357	.00476	3.66	.179	.00656
July 5	3.2	L	.089	7.00	.068	.00476	3.00	.291	.00873	2.50	.099	.00247
" 19	3.0	"	.082	5.75	.069	.00396	1.50	.429	.00643	3.50	.254	.00889
" 26	3.0	"	.115	4.25	.144	.00612	1.75	.303	.00530	3.00	.255	.00765
Average	.....	.....	.....	5.66	.087	.00494	2.06	.327	.00682	3.00	.211	.00635
Total loss for season	....	H	.....	34.25	.....	.05089	14.50	.....	.05789	28.50	.....	.07597
	....	L	.....	43.25	.....	.03790	18.50	.....	.06851	22.50	.....	.05120
Average loss per 300 lbs. milk	....	H	.113	4.28	.148	.00636	1.61	.399	.00643	3.56	.266	.00949
	....	L	.091	5.40	.087	.00473	2.05	.370	.00761	2.81	.227	.00640

LOSS IN WEIGHT OF CHEESE DURING ONE MONTH IN CURING ROOM.

Per cent. loss in cheese made from	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Average
	%	%	%	%	%	%	%	%	%
Rich milk	4.8	4.2	3.4	3.9	3.3	3.4	4.7	5.0	4.1
Poor milk	5.2	4.8	4.4	4.1	3.7	4.3	5.4	5.6	4.7

It will be noticed that the cheese made from the rich milk lost less in weight during one month's curing than did the cheese made from poor and medium milk—about one-half of one per cent. less. One reason for this is that there is a larger surface exposed per 100 lbs. of cheese in those made from the poorer milk, hence more evaporation.

THE EXPERIMENTS GROUPED ACCORDING TO THE PERCENTAGE OF FAT IN THE MILK.

Group.	Percentage of fat in milk.		Milk required to make 1 lb. cheese.	Cheese produced per 100 lbs. of milk.	Cheese produced from 1 lb. fat in milk.	Per cent. of fat in whey.
	Range.	Average.				
	%	%	lbs.	lbs.	lbs.	%
I.	below 3.	2.92	11.650	8.583	2.94	.133
II	3.00 to 3.50	3.14	11.598	8.620	2.74	.140
III	3.55 to 4.00	3.88	10.209	9.794	2.52	.189
IV	4.05 to 4.50	4.21	9.504	10.520	2.49	.213
Average		3.57	10.675	9.367	2.619	.1630

It will be noticed in the foregoing table, (1) that less milk was required to make a pound of cheese as the percentage of fat increased; (2) that the pounds of cheese per pound of fat in the milk decreased with an increased percentage of fat in the milk; (3) the percentage of fat in the whey increased with an increase of the fat in the milk.

THE QUALITY OF THE CHEESE.

Points scored by cheese.	Flavor.	Closeness.	Even color.	Texture.	Finish.	Total.
April (two experiments):						
Possible score	70	40	30	40	20	200
Milk 3.77% fat	59	36	28	35	20	178
Milk 3.25% fat	59	36	28	33	20	176
May (five experiments):						
Possible score	175	100	75	100	50	500
Milk 4.04% fat	152	86	68	85	50	441
Milk 3.08% fat	151	86	68	82	50	437
June (four experiments):						
Possible score	140	80	60	80	40	400
Milk 4.07% fat	126	71	57	71	40	365
Milk 3.01% fat	126	67	57	69	40	359
July (three experiments):						
Possible score	105	60	45	60	30	300
Milk 3.86% fat	94	56.5	42	54.5	30	277
Milk 3.13% fat	91.5	54.5	39	53.5	30	268.5
August (four experiments):						
Possible score	140	80	60	80	40	400
Milk 3.92% fat	123	72	58	72	40	365
Milk 3.00% fat	122	72	57	69	40	360
September (two experiments):						
Possible score	70	40	30	40	20	200
Milk 4.10% fat	60	38	30	32	20	180
Milk 3.25% fat	60	36	30	33	20	179
October (five experiments):						
Possible score	175	100	75	100	50	500
Milk 4.22% fat	158	94	75	85	50	462
Milk 3.22% fat	145	93	75	81	50	444
November (two experiments):						
Possible score	70	40	30	40	20	200
Milk 4.20% fat	66	38	30	36	20	190
Milk 3.15% fat	64	37	30	34	20	185
Total possible score	945	540	405	540	270	2700
Total points scored by H cheese	838	491.5	388	470.5	270	2458
" " " L "	818.5	481.5	384	454.5	270	2408.5

TABLE SHOWING AVERAGE SCORE OF QUALITIES IN THE CHEESE MADE FROM MILK GROUPED ACCORDING TO THE PERCENTAGE OF FAT.

Percentage fat in milk.	Flavor. (Max. 35.)	Closeness. (Max. 20.)	Even color. (Max. 15.)	Texture. (Max. 20).	Average total score. (Max. 90.)
Under 3.00 per cent	31.00	16.66	13.66	16.66	77.98
3.00 to 3.50 "	30 23	17.97	14.29	16 85	79.34
3.55 to 4.00 "	30.74	18.16	14.20	17 56	80 66
4.05 to 4.50 "	31.41	18 25	14 56	17.06	81.28

The cheese made from an increased percentage of fat have scored higher this year as shown by the foregoing tables.

AMOUNTS OF MONEY (CHEESE 8c) CREDITED BY THREE SYSTEMS AND ACCORDING TO WEIGHT OF CHEESE.

Pounds milk.	Average per cent. fat.	Pounds cheese made.	Weight milk.	Per cent. fat.	Per cent fat. +2.	Weight cheese.
			$ c.	$ c.	$ c.	$ c.
900	2.92	77.25	6 74	5 50	5 96	6 18
7 200	3.14	620.75	53 96	47 47	49 78	49 66
4,500	3.88	440.75	33 72	36 62	35 59	35 26
3,600	4.21	378.75	26 98	31 81	30 07	30 30

DIFFERENCE IN THREE SYSTEMS COMPARED WITH THE ACTUAL VALUE (AT 8 CENTS PER POUND) OF THE CHEESE PRODUCED.

Value of cheese made at 8c. per pound.	Weight of milk.	Per cent. of fat.	Per cent fat. +2.	Per cent. fat in milk.
$ c.	$ c.	$ c.	c.	
6 18	+ 56	— 68	—22	2 92
49 66	+4 30	—2 19	+12	3 14
35 26	—1 54	+1 36	+33	3.88
30 30	—3 32	+1 51	—23	4.21

MIXING RICH AND POOR MILK.

Average per cent. fat in milk.	Average lbs. fat in milk.	Average lbs. cheese.		Average lbs. cheese per lb. fat.		Average per cent. fat in whey.	Kind of milk.	Average lbs. cheese made per 300 lbs. milk.
		Green.	Cured.	Green.	Cured.			
4.23	12.36	33.66	32.08	2.65	2.52	0 21	Rich	29.16
3.23	9.70	27.75	26.25	2.85	2.70	0.13	Poor	
3.73	11.20	31.08	29 50	2 77	2.63	0.14	Mixed	29.50

It has been suggested by some that if the milk containing different percentages of fat were mixed together, as is the practice in cheese factory work, where the milk is not made up separately as in our experiments, the results might be different. To test this

point three trials were made in September, October and November, by taking 450 lbs. of rich milk and 450 lbs. of medium or poor milk, and then after removing 300 lbs. of each the remainder was mixed together and made into cheese to compare with the vats of rich and poor milk. The table shows the results to practically agree with those obtained by making up the milk of different qualities separately. There seems to have been a slightly greater weight of cheese produced from the mixed milk than from the average of the rich and poor milk made up separately, though this may be due to differences in the amount of moisture retained in the cheese.

GENERAL SUMMARY OF FIVE YEARS' EXPERIMENTS ON THE RELATION OF FAT IN MILK TO THE QUANTITY AND QUALITY OF CHEESE MADE.

—	1894.	1895.	1896.	1897.	1898.	Totals and averages.
Number of experiments	42	*101	†50	29	27	250
Pounds of milk used in each vat	300	300	600	600	300	.....
Total lbs. milk used in H (rich milk) vat each year	12,600	30,300	30,600	17,400	8,100	99,000
" L (poor milk) "	12,600	30,600	30,000	17,400	8,100	98,700
Total pounds milk used each year	25,200	60,900	60,600	34,800	16,200	197,700
Highest per cent. fat in milk each year	4.50	5.50	5.30	4.30	4.30	5.50
Lowest " "	2.90	2.70	2.90	2.80	2.90	2.70
Average per cent. fat in H milk	3.94	4.013	4.190	3.874	4.031	4.023
" L "	3.37	3.178	3 238	3.171	3.120	3.216
Average per cent. fat in milk used during five years	3.654	3.593	3.698	3.525	3.575	3.620
Pounds fat in H milk each year and for five years	496.44	1,216.00	1,269.60	574.10	326.55	3,982.69
Pounds fat in L milk each year and for five years	424.62	972.60	971 40	552.90	252.75	3,174.27
Pounds cured cheese made from H milk	1,236.25	3,155.75	3,258 00	1,753.75	819.50	10,223.25
" " L "	1,125.50	2,763.50	2,779.00	1,572.00	698.00	8,936.00
Pounds cured cheese made from 1 lb. fat in H milk	2.490	2 595	2.566	2 600	2.509	2.566
" " L "	2.645	2.841	2.866	2.843	2.761	2.815
Average pounds cured cheese made from 1 lb. fat in H and L milk	2.561	2.704	2.693	2.710	2.619	2.677
Pounds cured cheese made from 1 lb. fat and casein (per cent. fat + 2) in H milk	1.651	1.732	1.737	1 715	1.677	1.716
Pounds cured cheese made from 1 lb. fat and casein (per cent. fat + 2) in L milk	1.660	1.744	1 768	1.747	1.683	1.736
Average pounds cured cheese made from 1 lb. fat and casein (per cent. fat + 2) in H and L milk	1 655	1.738	1.751	1.730	1 680	1.725
Average per cent. fat in whey from H milk and average for five years	.197	.230	.271	.331	.200	.242
Average per cent. fat in whey from L milk and average for five years	.187	.185	.201	.246	.139	.190

The above table shows that during the five years of this work 250 experiments have been made, in which nearly 200,000 lbs. of milk were used. The percentage of fat in the milk ranged from 2.7 to 5.5 and averaged 3 6. The pounds of cured cheese per pound of fat in the milk averaged 2.5 for rich milk and 2.8 for poor milk. The pounds of cheese per 1 lb. of fat and casein (estimated by adding two to the per cent. of fat) was fairly constant whether rich or poor milk was used, there being a slight decrease as the percentage of fat increased. The average percentage of fat in the whey was higher from rich milk.

* One vat of H milk not included as it was over-ripe.

† One vat of L milk not included because of accident in handling.

TABLES SHOWING LBS. CHEESE MADE PER 1,000 LBS. MILK, PER LB. FAT IN THE MILK, AND PER LB. FAT AND CASEIN (PER CENT. FAT + 2) IN THE MILK. ALSO LOSSES OF FAT AND CASEIN IN WHEY. EXPERIMENTS OF FIVE YEARS GROUPED ACCORDING TO PERCENTAGE OF FAT IN MILK.

	Cheese made per 1,000 lbs. of milk.	Cheese per lb. of fat.	Cheese made per lb. of fat and casein.	Average fat in whey.	Average per cent. casein in whey.
	lb.	lb.	lb.	lb.	
Milk below 3. per cent.—Average 2.87	87.518	3.040	1.794	.184	.115
" 3.00 to 3.50 " — " 3.22	90.345	2.802	1.729	.191	.112
" 3.55 to 4.00 " — " 3.83	100.255	2.615	1.718	.222	.134
" 4.05 to 4.50 " — " 4.23	106.781	2.538	1.712	.242	.118
" 4.55 to 5.00 " — " 4.74	114.404	2.412	1.697	.412	.....
" 5.05 to 5.50 " — " 5.21	121.388	2.328	1.682	.387	.....

TABLE SHOWING LOSS OF FAT AND CASEIN IN WHEY BY MANUFACTURING RICH AND POOR MILK INTO CHEESE.

	Per 1,000 lbs. Milk.			Per 100 lbs. Cured Cheese.		
	Fat.	Casein.	Fat and Casein.	Fat.	Casein.	Fat and Casein.
	lb.	lb.	lb.	lb.	lb.	lb.
Av. loss of fat and casein in whey below 3 per cent.	1.671	1.004	2.718	1.910	1.190	3.094
" " " " 3.00 to 3.50 "	1.807	1.018	2.754	1.923	1.165	3.153
" " " " 3.55 to 4.00 "	1.997	1.203	3.345	1.992	1.223	3.212
" " " " 4.05 to 4.50 "	2.161	1.054	3.217	2.024	0.991	3.023
" " " " 4.55 to 5.00 "	3.648	.....	.....	3.189	.....	.....
" " " " 5.05 to 5.50 "	3.400	.....	.....	2.801	.....	.....

These tables bring out some interesting points in the experiments when grouped according to the percentage of fat in the milk. The chief points to notice are:

1. There is an increased yield of cheese per 1,000 lbs. of milk as the percentage of fat increases. An increase of one per cent. (3.2 to 4.2) in the fat of the milk caused an average increase of nearly 16.5 lbs. of cheese per 1,000 lbs. milk, which at 8c. per lb., gives an added value of $1.32 per 1,000 lbs. of milk testing 4.2 per cent. fat as compared with the value of 1,000 lbs. of 3.2 per cent. milk.

2. As the *percentage of fat* in the milk *increased* there was a gradual *decrease* in the pounds of cheese made per pound of fat in the milk. Milk testing 3.2 per cent. fat produced an average of 2.8 lbs. cheese per lb. fat in the milk, while milk testing 4.2 per cent. fat yielded an average of 2.5 lbs. cheese per lb. of fat in the milk.

3. The yield of cheese per lb. of fat and casein, the latter estimated by adding 2 to the per cent. of fat, ranged from 1.7 to 1.8 lbs. A fairly constant ratio is necessary in order to establish the fat casein theory or method of dividing proceeds among patrons. As the yield of cheese is slightly less per lb. of fat and casein in the richer milk as compared with the poorer, this system gives a slight advantage to the richer milk when compared with the actual cheese capacity of the two. This is well.

4. The experiments prove that not only is the percentage of fat higher in the whey from rich milk, but the total loss of fat per 1,000 lbs. of milk and per 100 lbs. of cured cheese is greater from the rich milk. There was not much difference in the loss of casein in the whey from rich and poor milk.

TABLE SHOWING PER CENT. LOSS IN WEIGHT DURING ONE MONTH'S CURING OF CHEESE MADE FROM RICH AND POOR MILK. FIVE YEARS' EXPERIMENTS.

	Average five years.
Per cent. loss in curing cheese made from milk below 3.00 per cent	4.260
" " " " " 3.00 to 3.50 "	4.434
" " " " " 3.55 to 4.00 "	4.107
" " " " " 4.05 to 4.50 "	4.054
" " " " " 4.55 to 5.00 "	3.076
" " " " " 5.05 to 5.50 "	3.532

TABLE SHOWING SCORINGS OF CHEESE MADE FROM RICH AND POOR MILK. AVERAGE OF FIVE YEARS' SCORINGS.

	Flavor.	Closeness.	Color.	Texture	Average total.
	Max. 35.	Max. 20.	Max. 15.	Max. 30.	Max. 100
Average score of cheese made from milk below 3. per cent.	30.39	18.06	14.39	17.08	89.92
" " " " " 3.00 to 3.50 "	30.19	17.94	14.03	17.19	89.35
" " " " " 3.55 to 4.00 "	30.80	18.04	14.00	17.49	90.33
" " " " " 4.05 to 4.50 "	31.04	18.17	13.94	17.28	90.43
" " " " " 4.55 to 5.00 "	30.99	18.54	13.56	16.74	89.83
" " " " " 5.05 to 5.50 "	31.50	19.50	13.75	16.87	91.62

The preceding tables show:

1. That the rich milk cheese lost less in curing than did those made from poor or medium milk.

2. The average of the five years' scoring does not show very much difference in the quality of the cheese made from the milk containing the different percentages of fat. In individual cases there was a marked difference in the quality, but when all was averaged this difference largely disappeared. The extreme difference in total points scored in the groups was 2.27 points in favor of the richer milk. The percentage of fat in *normal* milk is but a small factor in determining the quality of the cheese which is made from it, so long as the fat is about 3.5 per cent.

TABLE SHOWING AMOUNTS OF MONEY THAT WOULD BE CREDITED TO PATRONS BY THE THREE SYSTEMS NOW IN USE, BASED ON FIVE YEARS' EXPERIMENTS.

Pounds milk.	Average per cent. fat.	Pounds cheese made.	Amounts of money (cheese 8 c.) credited by three systems and according to weight of cheese.			
			Weight milk.	Per cent. fat.	Per cent. fat + 2.	Weight cheese.
lbs.	%	lbs.	$ c.	$ c.	$ c.	$ c.
13,800	2.87	1,207.75	106 99	85 13	92 91	96 62
77,400	3.22	6,992.75	600 07	534 88	558 09	559 42
72,300	3.83	7,248.50	560 53	594 01	582 09	579 88
28,200	4.23	3,011.25	218 63	255 93	242 65	240 90
4,200	4.74	480.50	32 56	42 68	39 08	38 44
1,800	5.21	218.50	13 96	20 11	17 92	17 48

TABLE SHOWING DIFFERENCES BETWEEN AMOUNTS OF MONEY RECEIVED BY THE THREE SYSTEMS AND THE ACTUAL VALUE OF THE CHEESE MADE DURING FIVE YEARS' EXPERIMENTS.

Value of cheese made.	Weight of milk.	Per cent. of fat.	Per cent. fat. + 2.	Average per cent. fat in milk.
$ c.	$ c.	$ c.	$ c.	%
96 62	+ 10 37	- 11 49	- 3.71	2.87
559 42	+ 40 65	- 24 54	- 1.33	3.22
579 88	- 19 35	+ 14 13	+ 2.21	3.88
240 90	- 22 27	+ 15 03	+ 1.75	4.23
38 44	- 5 88	+ 4 24	+ .64	4.74
17 48	- 3 52	+ 2 63	+ .44	5.21

NOTE.—+ 10.37 in the first co umn means that the patrons who supplied milk containing 2.87 per cent. fat and were paid according to the weight of milk, received $10.37 more than thay were entitled to ; and - 19.35 means that those who supp ied milk containing 3 83 per cent. fat, and were paid according to the weight of milk, received $19.35 less than they were entitled to.

APPLICATION OF RESULTS TO METHODS OF PAYING PATRONS.

Many valuable scientific points have been settled as a result of the work done during the five years ; but, from a practical dairyman's standpoint, the most important feature of the experiments is their application to conditions as we find them in Canadian cheese factories. We have three methods or systems of dividing proceeds of sales of cheese among the patrons who have supplied the milk to make this cheese. The oldest is that known as the "pooling system," or dividing according to the weight of milk delivered. The results indicate very clearly that this system is very unjust, yet the majority of factories continue to divide on this basis, largely for the reason that it is the easiest and least expensive method. The second system practised by a number of factories is the "butter-fat" or "test" plan. This is a marked improvement over the former, but our experiments show that this system places too great a premium on the butter-fat when compared with the actual cheese produced from the milk. The third system, that proposed by this station, is what may be called the "fat and casein" method, the latter being estimated by adding two to the percentage of fat. Our five years' experiments prove that this system comes nearest to the actual value of the cheese produced, though it still places a slight premium on the butter-fat. It encourages the production of good milk, and at the same time does not discourage the majority of patrons who have average milk, and who are apt to envy those patrons whose cows give a small amount of rich milk and draw a disproportionately large share of the proceeds of cheese sales when the money is divided on the basis of the fat alone.

EFFECT OF SETTING MILK AT DIFFERENT TEMPERATURES.

The experiments relating to the effects of temperature of the milk at time of adding rennet are a continuation of those made in 1895 and 1896. One vat of milk was set at 86° at each trial and the other vat varied in temperature from 76° to 96°. In former trials, when the milk was set below 80°, the time from setting to dipping and from dipping to setting was increased ; but this year there is not so much difference on these points when compared with setting at 86°. There was, however, an agreement in the greater loss of fat in the whey from setting at a low temperature and consequently a smaller yield of cheese, as shown by the table. There is not much difference in the quality of the cheese from setting at different temperatures, as shown by the score.

We may repeat the rule as laid down in bulletin 102 and in the report for 1896 : "Above 86° and up to 95°, each increase of one degree in temperature of the milk

decreases the time required for coagulation by about one minute. Below 86° to 80° a decrease of one degree in temperature of the milk increases the time for coagulation by from one to two minutes. Below 80° the time is irregular."

Date.	Per cent. fat in milk.	Temperature for setting.	Minutes coagulating.	Hours from setting to dipping.	Hours from dipping to salting.	Per cent. fat in whey.	Lbs. cheese.	Score.
	%	°	min.	hrs. min.	hrs. min.	%	lbs.	
October 1.....	3.50	86	31	[illegible] 49	2 59	.15	27.75	89
" 1	3.50	76	52	2	3 15	.28	27.25	90
Sept. 16	3.30	88	29	3 06	2 53	.15	27.50	86
" 16.....	3.30	77	49	2 49	3 02	.25	26.50	88
" 14.....	3.40	86	32	2 51	3 14	.12	27.50	87
" 14.....	3.40	78	45	2 58	3 14	.20	27.25	87
Oct. 28.....	4.20	86	31	2 42	3 08	.15	31.75	90
" 28	4.20	93	25	2 46	3 08	.15	31.75	86
" 28	4.20	79	46	2 41	3 19	.25	31.25	86
Sept. 24.....	3.30	86	30	2 42	3 23	.15	27.75	84
" 24	3.30	80	39	2 40	3 32	.20	27.75	84
Nov. 5.... .	3.50	86	32	2 46	3 07	.15	30.00	90
" 5.... .	3.50	82	40	2 47	3 07	.20	29.75	88
" 5.....	3.50	90	26	2 45	3 07	.15	30.25	90
Sept. 23.....	3.20	86	31	3 00	3 05	.12	28.00	86
" 23	3.20	82	38	3 10	3 14	.15	27.75	86
Oct. 12.....	3.50	86	32	3 17	3 45	.15	29.25	91
" 12.... .	3.50	92	26	3 31	3 45	.15	29.00	91
" 21.....	3.80	86	33	2 48	3 22	.15	29.50	92
" 21.....	3.80	94	26firm	2 48	3 22	.15	29.25	91
" 22	3.30	86	33	2 57	3 17	.15	28.25	91
" 22.....	3.30	94	26	2 57	3 23	.15	28.25	92
" 26.....	3.80	86	32	2 20	3 55	.15	29.50	88
" 26	3.80	95	25	2 22	3 51	.25	29.25	89
" 14.....	3.60	86	33	2 57	3 42	.15	29.50	91
" 14.....	3.60	96	25	3 03	3 44	.18	29.50	90

This rule is valuable when making a rennet test of milk which is not at the proper temperature, viz., 86°. With normal milk, a temperature of 86° is advisable when adding the rennet.

Effect of Different Quantities of Rennet.

This is the fourth year for the experiments relating to the effect of different quantities of rennet used in milk for cheesemaking. They point to the following conclusions:

1. Less than 3 oz. of standard rennet per 1,000 lbs. of milk causes a loss of fat in the whey much greater than is the case by using over 3 oz. of rennet. In the experiments for 1898, it will be noticed that where 1 to 2 oz. of rennet was used, the percentage of fat in the whey was .45 and .30, whereas when a larger quantity was used, the fat in the whey was seldom over .15 of one per cent.

2. The length of time from setting to dipping and from dipping to salting was much the same, whether a large or a small quantity of rennet was used.

3. When less than 2 oz. of rennet per 1,000 lbs. of milk was used, the yield of cheese was considerably lessened; but an extra large quantity did not always give an increased yield, though it did in some cases, especially in 1897.

4. The highest scoring cheese were made by using about 3 oz. of standard rennet per 1,000 lbs. of milk.

5. The time required for coagulation decreased as the quantity of rennet was increased. (See table.)

Date.	Rennet test—seconds.	Rate of rennet per 1,000 lb. milk.	Minutes coagulating.	Time from setting to dipping.	Time from dipping to salting.	Lbs. cured cheese from 300 lb. milk.	Per cent. fat in—		Score—max. 100.
							Whole milk.	Whey.	
		ounces.		hrs. min.	hrs. min.	lbs.	%	%	
June 10	21	3⅛	32	3 29	3 04	26.75	3.20	.12	89
" 10	21	1	90	3 30	3 11	25.50	3.20	.45	86
" 15	21	3⅛	33	3 11	3 05	27.50	3.30	.12	90
" 15	21	1½	61	3 16	3 04	27.25	3.30	.30	90
" 16	20	3⅛	35	2 52	3 01	27.75	3.30	.15	87
" 16	20	2	50	2 57	3 00	27.75	3.30	.30	87
" 17	20	3⅛	35	3 23	3 28	28.00	3 40	.15	92
" 47	20	2½	45	3 25	3 29	28.00	3.40	.18	88
" 18	20	3⅛	34	3 17	3 00	26.75	3.40	.15	87
" 18	20	4	28	3 17	3 01	26.75	3 40	.12	85
" 23	14	3⅛	25	1 22	4 09	27.25	3.40	.30	91
" 23	14	4½	21	1 21	4 10	27.25	3.40	.30	91
" 24	21	3⅛	34	3 06	3 51	25.00	3.00	.15	76
" 24	21	5	26	3 04	3 51	24.50	3 00	.15	70
" 25	20	3⅛	34	3 25	3 55	26.75	3.20	.10	81
" 25	20	5½	23	3 25	3 55	26.75	3.20	.20	83
" 28	18	3⅛	31	2 44	3 43	27.50	3.20	.10	88
" 28	18	6	18½	2 45	3 43	27.50	3.20	.10	85
" 30	19	3⅛	30	3 30	3 20	27.50	3.30	.15	89
" 30	19	6½	17	3 25	3 27	27.25	3.30	.15	87
July 6	18	3⅛	31	3 20	4 08	27.25	3.30	.15	90
" 6	18	7	15	3 22	4 07	27.50	3.30	.15	88
" 8	19	3⅛	33	3 09	3 11	25.50	3.10	.15	84
" 8	19	8	15	3 10	3 10	24 75	3 10	.15	88
" 9	19	3⅛	32	3 10	3 17	26.50	3.30	.12	89
" 9	19	8½	14	3 11	3 10	26.50	3.30	.12	89½

6. Cheese having a large quantity of rennet matured more quickly than those made by using a small quantity of rennet in the milk.

7. We have endeavored to deduce a law for the effect of rennet on the time required for coagulation; but many difficulties are met, such as the difference in the ripeness of milk, and a difference in the susceptibility of milk for rennet influence. However, roughly speaking, we may say that the average of four years' experiments indicate that an increase of from 1 oz. to 2 oz. per 1,000 lbs of milk decreases the time for coagulation about 30 minutes; from 2 to 3 oz. the time is decreased 10 minutes; from 3 to 4 oz. the time is decreased 7 minutes; and above 4 oz. the time is decreased an average of about 3 minutes for each increase of one oz. of rennet per 1,000 lbs. milk.

THE TIME REQUIRED FOR COAGULATION.

Quantity of rennet per 1,000 lbs. milk.	Minutes coagulating. Rennet test 20 seconds.				
	1895.	1896.	1897.	1898.	Average for four years.
1 ounce	65	65.5	79	90	74.8
1½ "	.....	53.0	59	61	57.3
2 "	42	37	53	50	45.5
2½ "	40	36	44	40	40.0
3 "	.....	.....	36.5	35	34.8
3½ "	27	.....	.....	.....	27.0
4 "	26	28	26	28	27.0
4½ "	25.5	23	24	21	23.3
5 "	20	26	23	26	23.7
5½ "	.....	20	22	23	21.6
6 "	18	18.5	20.5	18.5	18.8
6½ "	.....	17.5	19	17	17.8
7 "	16	17	18	15	16.5
7½ "	.....	15	18	.....	16.5
8 "	17.5	14	17.5	15	16.0
8½ "	.....	14	.....	.....	14.0
9 "	13	13	.....	14	13.3

EFFECT OF DIPPING AT DIFFERENT STAGES OF ACID.

Date.	Hot iron test.	Hours from setting to dipping.	Hours from dipping to salting.	Lbs. cheese.		Per cent. fat in			Score. Max. 100.
				Green.	Cured.	Milk.	Whey.	Drippings	
	Inch.	h. m.	h. m.	lbs.	lbs.	%	%	%	
June 3..	Slight show.	2 30	4 05	28.50	27.50	3.30	.15	1.90	87
" 3..	¼	3 26	3 22	28.50	27.50	3.30	.15	1.90	90
May 13..	1-16	2 40	3 38	28.00	26.25	3.30	.15	3.00	90
" 13..	⅛	3 05	3 01	27.75	26.25	3.30	.15	3.10	92
" 16..	⅛	3 09	3 12	27.75	26.25	3.30	.17	2.60	94
" 15..	⅛	3 37	2 44	28.00	26.50	3.30	.17	3.80	85
" 5..	⅛	2 55	2 42	29.00	27.50	3.50	.16	4.00	87
" 5..	⅛	3 21	2 21	29.00	27.25	3.50	.16	5.20	85
" 23..	⅛	3 13	3 40	28.00	26.75	3.40	.20	4.20	91
" 23..	⅛	3 55	3 02	28.50	27.50	3.40	.20	3.60	89
" 14..	⅛	2 38	2 52	29.00	28.00	3.50	.18	4.40	90
" 14..	⅛	3 02	2 28	28.50	27.75	3.50	.18	10.30	88
" 30..	⅛	3 03	3 11	30.00	28.75	3.60	.15	1.70	87
" 30..	⅛	3 41	2 31	29.75	28.50	3.60	.15	3.70	91
June 6..	⅛	3 14	3 31	29.50	28.25	3.30	.15	1.40	87
" 6..	⅛	3 47	3 00	29.50	28 25	3.30	.15	2.40	89
May 18..	⅛	2 40	3 02	29.75	28.00	3.40	.15	1.80	85
" 18..	⅛	3 17	2 25	29.25	27.50	3.40	.15	3.70	85
June 9..	⅛	2 29	2 57	27.50	26.00	3.00	.15	2.30	90
" 9..	⅛	3 17	2 10	27.50	26.00	3.00	.15	2.40	83
May 26..	¼	2 37	3 00	28.50	27.25	3.30	.20	2.20	89
" 26 .	1	3 14	2 22	28 50	27.00	3.30	.20	4.40	85

These experiments, relating to the effect of acid on curds when in the whey, have been conducted for four years. The four years' work points to the following conclusions:

1. Curds dipped with one-eighth to one-quarter of an inch as shown on the hot iron, remained less time in the whey than those allowed to develop one-half to one inch of acid, but they took a longer time to mature after dipping before they were ready to salt. The whole length of time from setting to salting was much the same, whether curds were dipped early or late. There is no gain in time by leaving curds in the whey too long.

2. There was not a great deal of difference in the yield of cheese from early or late dipping. What difference there was, was in favor of early dipping—one-eighth to one-quarter inch acid.

3. The loss of fat in the whey first drawn was practically the same in both cases; but the percentage of fat in the whey drippings was, in nearly every case, higher from the curds allowed to develop over one quarter of an inch of acid in the whey. This explains the harsh nature of acidy cheese. It is, to some extent at least, due to the loss of butter fat from the curds after dipping,

4. The quality of the cheese in nearly every case was better from the early-dipped curds. Curds allowed to remain in the whey until they show over half an inch of acid are harsh in texture, "cut" in color, and usually sour to the taste.

About one-eighth of an inch of acid by the hot iron, or two-tenths of one per cent. of acid as shown by the alkali test, gives the most satisfactory results with normal milk in Canadian Cheddar cheesemaking.

Putting Curds to Press at Different Temperatures.

These experiments have been conduoted for the fourth year. The range of temperature at pressing has been from 60° to 92°. The highest scoring cheese in 1898 was from curd put to press at 82°, and the next highest was put to press at 94°. A range of from 80° to 90° seems to be favorable for putting curds to press. No particular harm resulted from cooling the curds to 60° or 62°, except that in one or two cases the cheese were slightly open, as was also the result from pressing at 92°. Again at 94° the cheese were fairly close.

Date.	Lbs. of milk.	Per cent. fat in milk	Lbs. cheese.		Temperature when put to press.	Scoring of cheese.					
			Green.	Cured.		Flavor.	Closeness.	Even color.	Texture.	Finish.	Total.
	lbs.	%	lbs.	lbs.	Deg.						
October 29	600	3.90	31.75	.....	85	32	19	15	16	10	92
			33.25	.....	60	31	19	14	16	10	90
November 8	600	3.60	31.25	.....	84	31	17	14	17	10	89
			33.00	.....	62	30	19	12	16	10	87
" 10	600	3.60	32.00	.....	81	31	18	13	18	10	90
			33.75	.....	62	31	19	12	16	10	88
" 12	600	3.60	32.00	.....	82	32	19	14	18	10	93
			33.50	.....	62	31	17	13	16	10	87
July 14	600	3.40	28.50	27.25	81½	29	18	14	17	10	88
			28.00	26.75	88	28	18	14	18	10	88
August 23	600	3.30	27.50	26.50	83	32	18	14	18	10	92
			28.00	27.00	88	32	18	14	18	10	92
" 17	600	3.30	28.00	27.25	83	30	18	14	16	10	88
			27.50	26.25	92	29	18	14	17	10	88
July 29	600	3.20	27.00	26.00	84	30	18	14	18	10	90
			26.50	25.50	92	30	17	14	17	10	88
" 22	600	3.20	27.00	25.75	84	31	18	14	18	10	91
			26.00	25.00	94	31	18.7	14	18.7	10	92.4
" 30	600	3.40	28.00	27.00	79	30	18	13	17	10	88
			27.00	26.00	94	29	18	14	18	10	89

The general conclusion is that quite a wide range in temperature may be allowed for putting curds to press, so long as the press room is kept moderately warm to enable the cheese to form a proper rind.

Curing Cheese at Different Temperatures.

During June, July, August and September, eighteen experiments were made to note the effects of temperature in curing cheese. Three cheese were made from one vat of milk, after which each cheese was weighed and then placed in the rooms kept at the different temperatures as shown in the tables. At the end of a month each cheese was weighed again, and at the end of about six weeks each cheese was scored. A number of the cheese were kept four or five months and scored several times by different judges. In nearly every case there was a marked difference in favor of the cheese cured at a temperature of about 60°. These cheese weighed about 30 lbs. each. The readings for temperature and moisture were taken about 8 a.m. each day. During July and August from 150 to 200 lbs. of ice were used in room No. 2. Steam was used to regulate the temperature in September and October. In August fresh lime was used in No. 1 room to reduce the moisture, but it had little or no effect.

Beginning October 18th, we arranged for three cheese per day to be sent to our curing rooms from Freelton and Rockwood factories. (Owing to a misunderstanding, only two cheese were sent the first day from Rockwood.) This was done for three days. The cheese were taken from the hoops at the factories and sent to us as quickly as possible. On arrival at the curing rooms, they were carefully weighed and one cheese placed in each of the rooms kept at different temperatures. The cheese were weighed weekly for four weeks. They were scored by Messrs. Brill and Bell during the same week when they were a month old, and again on November 29th by Mr. I. W. Steinhoff, Stratford, western representative of Hodgson Bros., cheese exporters of Montreal. The cheese from these factories weighed an average of 84 lbs. from Rockwood and 80 lbs. from Freelton.

Cheese-curing experiments for month of June. The highest outside temperature was 93°, the lowest 34°, and the average 61.5°.

Number of experiments, 4.		Room No. 1.	Room No. 2.	Room No. 3.
Size of room—cubic feet		1,844	863	863
Method of controlling temperature		Sub-earth duct.	Sub-earth duct and ice.	No control.
" " moisture		"	"	"
Highest temperature in room during month		72°	66°	75°
Lowest " " " "		58°	56°	59°
Average " " " "		66.2°	60.3°	67.5°
Highest per cent. moisture in room during month		95	95	84
Lowest " " " " "		83	84	73
Average " " " " "		87.9	88.8	77.2
Average per cent. shrinkage in cheese in one month		3.08	2.71	3.19
Quality of Cheese.	Average flavor (max. 35)	31	31	30
	" closeness (max. 20)	17	18	17.6
	" color (max. 15)	14.2	14	14
	" texture (max. 20)	17	17.2	17.2
	" total score (max. 100)	89.2	90.2	89

Cheese-curing experiments for month of July. The highest outside temperature was 96°, the lowest 34°, and the average 68.2°.

Number of experiments, 4.	Room No. 1.	Room No. 2.	Room No. 3.
Size of room—cubic feet	1,844	863	863
Method of controlling temperature	Sub-earth duct.	Ice.	No control.
" " moisture	Lime & "	"	"
Highest temperature in room during month	75°	67°	79°
Lowest " " "	55°	53°	57°
Average " " "	65.8°	59.7°	67°
Highest per cent. moisture in room during month	95	95	84
Lowest " " " "	73	84	63
Average " " " "	88.1	88.9	76.8
Average per cent. shrinkage in cheese in one month	3.44	3.22	4.04
Quality of Cheese. Average flavor	29.2	29.5	28.7
" closeness	17.5	18.2	18.2
" color	13.7	13.7	13.5
" texture	16.7	17.7	17.5
" total score	87.2	89.2	88.0

Cheese-Curing experiments for month of September. The highest outside temperature was 96°, the lowest 11°, and the average 51.20°.

Number of Experiments. 6.	Room No. 1.	Room No. 2.	Room No. 3.
Size of room—cubic feet	1844	863	863
Method of controlling temperature	sub. earth duct.	Ice	some steam
" " " moisture	" "	"	no control
Highest temperature in room during month	75°	65°	86°
Lowest " " " "	55°	53°	57°
Average " " " "	66.3°	59.5°	70.0°
Highest per cent moisture in room during year	91.	97.	91.
Lowest " " " " "	70.	43.	46.
Average " " " " "	81.9	76.1	68.5
Average per cent shrinkage in cheese in one month	4.34	3.76	4.67
Quality of cheese Average Flavor	28.6	29.6	27.1
" Closeness	19.0	19.1	18.5
" Color	14.8	15.0	14.8
" Texture	13.8	16.3	13.0
" Total Score	86.3	90.1	83.5

Cheese-curing experiments for the month of October. The highest outside temperature was 87°, the lowest 11°, and the average 44.20°.

Number of Experiments. 4.	Room No. 1.	Room No. 2.	Room No. 3.
Size of room—cubic feet	1844	863	863
Method of controlling temperature	Duct. & Small amt. of steam	Ice used on Oct. 3rd.	Steam
" " " moisture	"	duct. part of time	Pan of water on steam pipe
Highest temperature in room during month	75°	65°	86°
Lowest " " " "	62°	54°	62°
Average " " " "	66.6°	59.0°	71.6°
Highest per cent. moisture in room during month	90.	97.	85.
Lowest " " " "	70.	43.	46.
Average " " " "	79.4	70.0	62.6
Average per cent. shrinkage in cheese in one month	4.71	3.97	5.32
Quality of cheese: Average Flavor	30.5	32.0	27.2
" " Closeness	18.7	19.2	18.0
" " Color	15.0	15.0	14.5
" " Texture	16.0	17.2	13.7
" " Total Score	90.2	93.5	85.5

Detail and average score of cheese cured at different temperatures.

Dates cheese were made	Dates of Scoring	66.1 degrees		60 degrees		68.6 degrees	
		Points scored	Average	Points scored	Average	Points scored	Average
June 8	July 13	89	90.0	90	91.0	.....	.....
	Aug. 13	91		92			
" 13	July 13	92	89.1	93	91.0	92	89.0
	Aug. 13	89		90		89	
	Sept. 2	86.5		90		86	
" 20	Aug. 13	87	88.0	87	90.3	88	88.0
	Sept. 17	86		91		86	
	Oct. 13	91		93		90	
" 27	Aug. 13	89	89.4	91	90.2	87	84.6
	Sept. 17	89		88		90	
	Oct. 13	92		92		90	
	Nov. 17	91		90		83	
	" 29	86		90		73	
July 4	Sept. 17	90	88.5	92	91.5	89	87.5
	Oct. 13	87		91		86	
" 25	Sept 17	83	83.2	89	89.5	85	82.5
	Oct. 13	87		93		86	
	Nov. 17	83		89		85	
	" 29	80		87		74	
Sept. 3	Nov. 17	89	87.5	92	92.0	86	81.0
	" 29	86		92		77	
" 12	Nov. 17	81	83.0	90	90.5	77	74.5
	" 29	85		91		72	
" 19	Nov. 17	84	84.5	91	92.0	81	78.0
	" 29	85		93		75	
Oct. 3	Nov. 17	90	90.0	96	95.0	84	80.0
	" 29	90		94		76	
" 10	Nov. 17	90	91.0	92	92.5	87	85.5
	" 29	92		93		84	
" 17	Nov. 17	91	92.0	93	95.0	86	85.0
	" 29	93		97		84	
" 24	Nov. 17	90	89.0	93	94.5	85	83.5
	" 29	88		96		82	
Average for season	.....	.....	87.95	.....	91.42	.....	83 71

Summary of cheese-curing experiments—four months. Cheese made in College Dairy. The highest outside temperature was 96°, the lowest 11°, and the average 59.7°.

Total number of experiments, 18.	Room No. 1.	Room No. 2.	Room No. 3.
Size of room, cubic feet	1,844	863	863
Method of controlling temperature	Sub-earth duct.	Ice and duct.	No control.
" " moisture	"	"	"
Highest temperature in room	75°	67°	86°
Lowest " "	55°	53°	57°
Average " "	66.15°	59.69°	68.64°
Highest per cent. moisture in room	95	97	91
Lowest " " "	70	43	46
Average " " "	84.63	81.71	72.16
Average per cent. shrinkage in cheese in one month	3.85	3.40	4.31
Quality of Cheese — Average flavor	29.72	30 44	28.53
" closeness	18 16	18.72	18 17
" color	14.50	14.50	14.29
" texture	15.66	17.05	15.00
" total score	88.04	90.71	85.99

Cheese-curing experiments with cheese bought from factories. The highest outside temperature was 66°, the lowest 11°, and the average 39.3°.

Three experiments, factory at Rockwood.	Room No. 1.	Room No. 2.	Room No. 3.
Size of room, cubic feet	1,844	863	863
Method of controlling temperature	Duct and steam.	Steam.	Steam.
" " moisture	Duct.	No control.	Water pan on pipe.
Highest temperature in room	72°	64°	80°
Lowest " "	62°	54°	66°
Average " "	66.6°	58.6°	72.1°
Highest per cent. moisture in room	84	80	75
Lowest " " "	64	43	45
Average " " "	76.0	61.6	56.3
Average per cent. shrinkage during first week	1.17	.98	1.57
" " " " second week	.89	.89	1.00
" " " " third week	.60	.70	.91
" " " " fourth week	.60	.30	.81
" " " " four weeks	3.23	2.86	4.21
Quality of Cheese — Average three scorings on flavor	30.16	30.66	28.88
" " " " closeness	17.50	18.11	17.00
" " " " color	14.50	14.55	14.33
" " " " texture	16.33	17.11	14.88
" " " " total	88.50	90.44	85.11

Cheese curing experiments with cheese bought from factories. The highest outside temperature was 66°, the lowest 11°, and the average 39.3°.

Three experiments, factory at Freelton.	Room No. 1.	Room No. 2.	Room No. 3.
Size of room, cubic feet	1,844	863	863
Method of controlling temperature	Duct and steam.	Steam.	Steam.
" " moisture	Duct.	No control.	Water pan on pipe.
Highest temperature outside 66°			
Lowest " " 11°			
Average " " 39.3°			
Highest temperature in room	72°	64°	80°
Lowest " "	62°	54°	66°
Average " "	66.6°	58.6°	72.1°
Highest per cent. moisture in room	84	80	75
Lowest " " "	64	43	45
Average " " "	76.0	61.6	56.3
Average per cent. shrinkage during first week	1.05	.94	1.56
" " " " second week	.85	.84	1.05
" " " " third week	.75	.53	.74
" " " " fourth week	.43	.43	.75
" " " in four weeks	3.05	2.72	4.06
Quality of Cheese: Av. three scorings on flavor	31.00	31.88	29.44
" " " " closeness	18.77	19.33	18.44
" " " " color	14.44	14.55	14.22
" " " " texture	17.22	18.00	14.66
" " " " total	91.44	93.77	86.77

Freelton.			Score of cheese cured at an average temperature of					
			66.6°.		58.6°.		72.1°	
Dates cheese were made.	Dates of scoring.	Names of judges.	Points scored.	Average.	Points scored.	Average.	Points scored.	Average.
Oct. 17....	Nov. 15.	G. J. Brill	90		94		88	
	" 17.	A. T. Bell	91	91.3	91	93.3	87	87.0
	" 29.	I. W. Steinhoff	93		95		86	
" 19....	" 15.	G. J. Brill	92		93		93	
	" 17.	A. T. Bell	89	91.3	93	94.6	88	87.0
	" 29.	I. W. Steinhoff	93		98		80	
" 21....	" 15.	G. J. Brill	94		93		92	
	" 17.	A. T. Bell	90	91.6	92	93.3	85	86.3
	" 29.	I. W. Steinhoff	91		95		82	
				91.44		93.77		86.77
		Rockwood.						
Oct. 18...	Nov. 15.	G. J. Brill			88		88	
	" 17.	A. T. Bell			91	88.3	87	85.3
	" 29	I. W. Steinhoff			86		81	
" 19....	" 15.	G. J. Brill	89		90		86	
	" 17.	A. T. Bell	90	88.6	94	91.6	87	84.3
	" 29.	I. W. Steinhoff	87		91		80	
" 20....	" 15.	G. J. Brill	87		91		88	
	" 17.	A. T. Bell	87	88.3	91	91.3	86	85.6
	" 29.	I. W. Steinhoff	91		92		83	
				88.50		90.44		85.11

Conclusions.

1. The cheese lost considerably more during one month's curing when kept at a comparatively high temperature. This was true for each month during the experiments, and also for the season. The average per cent. of shrinkage during the season for one month, in cheese weighing about thirty pounds, cured at 60°, was 3.40 per cent.; cheese cured at 66° lost 3.85 per cent. in weight, and cheese cured at 69° lost 4.31 per cent.

2. The quality of the cheese was very much better by curing at 60°. The average score for the season of cheese made in the College dairy was nearly three points in favor of cheese cured at 60° as compared with similar cheese cured at 66°, and five points higher compared with those cured at 69°. The difference was more marked still in September and October cheese. The flavor was very much better in the cheese cured at 60°, and the texture was a marked improvement. Cheese cured at a high temperature go off in flavor quickly and have a sandy or mealy texture. Mr. Steinhoff pronounced the cheese made in October, and cured at 60°, as being worth from one to two cents more per pound than similar cheese cured at 70° to 75°. Cheese cured at the lower temperature have very much better keeping quality.

3. There was little or no mould on the cheese in room No. 3, kept at a high temperature. After the duct was closed in No. 2 and ice was used to lower the temperature very little mould appeared on the cheese. In room No. 1, where the duct was open all summer, and partly open in the fall, a great deal of mould grew on the cheese until steam heat was used. Various strengths of formalin solutions were used to prevent the growth of this mould. We commenced with a two per cent. solution and increased it to ten per cent.; it was ineffective. A ten per cent. solution prevents the mould for about a week; and to keep cheese right they need to be sprayed every week or ten days; but cheesemakers have not time to spray so often.

Mottled Cheese.

In 1897 there was considerable trouble with what are known as "mottled" cheese. Several factories had losses due to this mottling. A cheesemaker sent us a small sample of mottled cheese in the autumn of 1897. From this sample a starter was made by pasteurizing skim-milk, and to this was added some mottled cheese which had been finely grated. After the starter had developed properly, it was strained into a vat of 300 pounds of milk on November 27th, 1897. The cheese made was very badly mottled and had a characteristic unpleasant odor. At the present time (December 1st, 1898) the coloring has nearly all disappeared. This cheese is what is known as Starter No. 1 in the experiments of the past year.

During the session of the Dairy School of 1898, one day's make, (February 21st,) developed mottles. It is supposed that the starter used in making the cheese for that day was set in the curing-room, near the cheese made on November 27th. Starter No. 2 was made from a cheese of February 21st.

When the experiments began on April 4th, the first starter was from cheese made February 21st. This cheese was used as a foundation for future propagations, and is indicated in the table as Starter No. 3.

Experiments were made during April, May, August and September—forty-five in all; 300 pounds of milk were used in each vat. Unless otherwise stated, the cheese made were colored with Hanson's Cheese Coloring at the rate of one and a quarter ounces per 1,000 pounds of milk. In most cases a "control" vat of the same milk was used. Starters were made by pasteurizing skim-milk and adding to it either some of the cheese from which we wished to make a starter, or some of a previous day's starter. On four days sour whey from the whey tank was added directly to the vat of milk. Several cultures were sent from the Bacteriological Laboratory and were used as starters. These came originally from the mottled cheese in the Dairy.

Table showing results of experiments relating to Mottled Cheese.

Date cheese were made.	Description of Starter.	Lbs. Starter used.	Effect on quality of cheese.
April 4..	Propagated from No. 2....	4	Flavor very bad; badly mottled; mottles appeared when cheese was two weeks old.
" 5..	Same starter as used April 4th	6	Flavor bad; badly mottled; mottles appeared when cheese was two weeks old. November 30th, 1898, color nearly all gone.
" 6..	Propagated from starter used April 5th..	8	Poor flavor; no mottling.
" 7..	Same as used on 6th	8	Poor flavor; mottled.
" 9..	Propagated from No. 1.....	6	Flavor very bad; two or three mottles, May 7th; mottled June 10th.
" 11..	" " April 9th starter	7	Flavor bad; no mottling (white cheese).
" 12..	Same as used April 11th	7	" " "
" 13..	Propagated from No. 1	9	Milk was pasteurized; flavor fair; slightly mottled.
" 14..	Same as used on 13th	9	Milk was pasteurized; flavor fair (white cheese); very pale color.
" 15..	Propagated from No. 2	9	Milk was pasteurized; flavor fair; (white cheese) color good.
" 16..	Same as used on April 15th	9	Milk was pasteurized; flavor sour; color good May 7th; mottled June 10th.
" 18..	Culture from Bacteriological Laboratory.	2½	Flavor fair; color good.
" 19..	Propagated from starter used on 18th....	5	Mustard flavor; color good.
" 20..	Culture from No. 1	1¾	Flavor fair; color fair.
" 21..	Propagated from starter used April 20th.	2¾	Flavor fair; mottles appearing May 7th; badly mottled June 10th and July 13th; mottles almost gone August 13th.
" 22..	Culture from Laboratory...	2¾	Flavor fair; color good.
" 25..	Propagated from starter used April 22nd.	3¼	Flavor good "
" 26..	Culture from No. 1	2½	Flavor fair "
" 27..	Propagated from starter used on 26th....	3½	" "
" 30..	Culture from No. 3	2	" "
May 2..	Propagated from starter used April 30th.	2¼	Flavor fair; slightly mottled.
" 3..	Sour whey from whey tank	3	Poor flavor; slightly mottled (milk overripe).
" 4..	" " "	3	Flavor very bad; badly mottled.
" 7..	Culture from Laboratory	2	Flavor very good; color good.
" 9..	Propagated from starter used May 7th...	2½	" " slightly mottled.
" 10..	Culture from Laboratory	2	" " "
" 12..	Propagated from starter, May 10th	2½	Flavor fair; color good.
" 20..	Culture from Laboratory	3	" "
" 21..	Propagated from starter, May 20th	4	" "
August 12 .	Sour whey from whey tank	6	Flavor fair October 13th; color good October 13th; very bad flavor November 29th; white spots appearing November 29th.
" 15..	" " "	6	Bad flavor; mottled.
" 18..	Propagated from No. 3	6	Flavor fair, color good.
" 19..	Same as used August 18th	6	" "
" 20..	Propagated from starter, 19th	4	" "
" 22..	Same as used on 20th	4	" " (white cheese).
" 27..	Propagated from No. 3	4	Flavor fair; black mould on end of cheese: color, navy, October 13th; two out of five plugs mottled on November 29th; special coloring used.
" 29.	Propagated from starter, August 27th..	4	Poor flavor; slightly mottled October 13th; no mottles November 29th.
" 31..	Propagated from starter, August 29th..	4	Fair flavor; no mottling.
Sept. 15..	Culture from mottled cheese	3	" " (white cheese).
	" "	3¾	Good flavor; no mottling.
		3¾	Good flavor; slightly mottled October 13th; no mottles November 29th; special coloring used same as on 22nd.
			Flavor fair; color good.
			" "

Conclusions.

1. Mottled cheese may spread from one day's make to another, but it is most likely to do so from or through the starter.

2. The mottles usually appeared in from two to four weeks after the cheese were made.

3. Sometimes a starter produced mottles, and sometimes the same starter did not.

4. Pasteurizing the whole milk used in the vat did not prevent mottling.

5. In no case did mottles appear in the white cheese made from any of the starters.

6. The cultures sent from the Bacteriological Laboratory did not cause the mottling to any extent. In one or two cases, there was a slight waviness or mottling.

7. In some cases the mottles appeared quite strongly and then disappeared after a time. In some cases the mottling appeared in spots through the cheese. A cheese made Aug. 22 was examined on Nov. 29th, and the first plug showed no mottles. Out of five plugs drawn from different parts of the cheese, two of them showed mottling.

8. Starters made from the whey tank produced mottling of the cheese and a very bad flavor. It is probable that the difficulty is caused in some cases by taking whey home in the milk cans and then sending the milk to the factory in these cans not properly washed and scalded.

9. It is also probable that the root of the difficulty lies in the fact that a germ or bacterium attacks the coloring matter added to the milk to produce colored cheese. It takes some time for the effects to become marked and the white spots to appear.

10. So far we have heard no complaints about mottled cheese made in 1898; and it is likely that the trouble appears only under certain favorable conditions of weather, etc. Should this trouble appear in a factory, the maker should look closely after the whey tank and washing of cans, especially if the whey is returned to patrons in the milk-cans. He should also make white cheese, which are cleaner and more wholesome.

Excelsior Cheese Coating.

A sample of what is known as Excelsior Cheese Coating was sent to us by a Toronto firm to experiment with. It is claimed for this material that it prevents loss of weight in curing; that it improves the flavor and keeping quality of the cheese; and that it prevents the growth of mould on the cheese. The following table shows that it does prevent shrinkage; but the scorings do not indicate any improvement in the quality of the cheese. It did not prevent mould.

	Cheese coated.			Not coated.
	When taken from press.	When two weeks old.	When four weeks old.	
Average score	91.6	91.3	91.5	92.0
" per cent. shrinkage in eight weeks	3.31	4.03	6.27	7.00

It is some trouble to "dip" the cheese into the melted wax; and it is doubtful if the average cheese-maker has the time to melt the coating and dip the cheese. It is also doubtful if the results would warrant the expense and trouble.

The cheese weighed only about 8 lbs. each; hence the large percentage of shrinkage in the uncoated cheese.

EXPERIMENTS IN DAIRY STABLE.

Milking Cows Twice and Three Times per Day.

During the month of July two cows—Margaret 4th, a Holstein, and Patience 5th, an Ayrshire—were milked three times per day. Beginning Aug. 1st they were milked twice a day. The bulky feed was also changed on Aug. 1st from green peas and oats to corn silage and hay. The meal remained practically the same during each period reported on, though there was slightly less fed during the period when the cows were milked twice per day, as the cows did not eat it quite so clean. The table shows the amount of food consumed per week for two weeks of each milking period and the yield of milk and butter fat by weeks when the cows were milked three times a day and when milked twice. The food consumed and the milk and fat produced for an intervening week (when the food was changed and the cows were milked three times per day for five days and twice a day for two days) are also given.

Margaret dropped her last calf on June 20th, 1898; and Patience was fresh on May 5th, 1898.

Table showing food consumed and milk and fat produced when milking two cows twice and three times per day.

Week ending.	Cow.	Lbs. food consumed per week.							No. times milked per day.	Lbs. milk in 1 week	Lbs. fat in 1 week	Gain (+) or loss (−)	
		Green peas and oats.	Corn silage.	Hay.	Oats.	Pease	Bran.	Oil-cake.				Lbs. milk	Lbs. fa
July 19	Margaret.	560	.....	.....	35	35	70	10	3	348	10.39	.....	.....
" 26	"	560	.....	.....	35	35	70	10	3	387	10.83	+39	+0.44
Aug. 2	"	400	160	6	35	35	70	10	2 (2days) 3 (5days)	376	10.53	−11	−0.30
" 9	"	.....	490	21	35	35	60	10	2	369	10.32	−7	−0.21
" 16	"	....	490	21	35	35	60	10	2	353	11.29	−16	+0.97
July 19	Patience.	490	.....	.....	30	30	60	10	3	289	10.40	.....	.....
" 26	"	490	.....	.....	30	30	60	10	3	308	10.47	+19	+0.07
Aug. 2	"	350	120	6	30	30	60	10	2 (2days) 3 (5days)	295	9.44	−13	−1.03
" 9	"	.....	420	21	30	30	57	7	2	302	9.66	+17	+0.22
" 16	"	.....	420	21	30	30	57	7	2	290	9.86	−12	+0.20

Conclusions.

Margaret gave 13 lbs. less milk in two weeks when milked twice per day as compared with the quantity given in the same length of time when she was milked three times per day; but she produced 0.39 lbs. more fat during the two weeks when milked twice a day than she did in the same length of time when milked three times a day.

Patience gave 5 lbs. less milk when milked twice a day for two weeks than she did in two weeks when milked three times a day; and she produced 1.35 lbs. less fat when milked twice a day for two weeks.

In the case of these two cows, one of which produced an average of 52 lbs. of milk per day, and the other about 42 lbs. per day, it did not pay to milk them three times a day. With cows producing 60 lbs. of milk or over per day it will likely be profitable to milk them three times a day.

The percentage of fat by weeks was for Margaret, 2.7, 2.8, 2.8, 2.8, 3.2; Patience, 3.6, 3.4, 3.2, 3.4, 3.4. Samples were taken from each milking and the whole was tested once a week. Margaret, it will be seen from the foregoing, gave the highest weekly test for the *last* week of the experiment, and Patience for the *first* week.

Pasteurized vs. Raw Skim Milk for Calves.

It has been claimed that pasteurizing (scalding) skim milk renders it indigestible for calves, and that they will not thrive upon it. An experiment was commenced July 18th, 1898, with four calves—three heifers and one steer. A preliminary feeding period of one week was allowed before the experiment proper began. Two of the calves were fed on pasteurized skim milk for four weeks; and, after a preliminary period of one week, they were fed on raw, or unscalded, skim milk for four weeks. Two others were started on raw skim milk fed warm, and then changed to pasteurized skim milk at the end of four weeks, with an intervening period of one week as with the other two.

The table following shows milk consumed and gain of calves fed on raw and scalded skim milk:

Name.	Breed.	Dropped.	Lbs. milk consumed in 4 weeks.	Kind of milk.	Lbs. meal, oats, bran, oil cake in equal parts.	Gain during 4 weeks.	Period.
						Lbs.	
1. Meg. ...	Holstein.....	Dec. 18, 1897..	840	Pasteurized.	28	59	July 18 to Aug. 15.
			896	Raw	35	47	Aug. 22 to Sept. 19.
2. Chummy.	Grade steer. ..	Jan. 25, 1898..	840	Raw	28	48	July 18 to Aug. 15.
			896	Pasteurized.	35	68	Aug. 22 to Sept. 19.
3. Minnie ..	Grade Ayrshire.	Jan 15, 1898..	700	Pasteurized.	14	53	July 18 to Aug. 15.
			784	Raw..	21	43	Aug. 22 to Sept. 19.
4. Jean.....	Grade Holstein.	Mar. 1, 1898..	700	Raw.....	14	64	July 18 to Aug 15.
			784	Pasteurized.	21	52	Aug. 22 to Sept. 19.

Conclusions.

All the calves appeared to thrive equally well whether fed on the pasteurized or on the raw skim milk. No. 1 weighed 536 pounds at the beginning of the experiment and 675 pounds at the close—a gain of 139 pounds in ten weeks, or nearly two pounds per day. No. 2 weighed 352 pounds at the beginning and 515 pounds at the close—a gain of 163 pounds in ten weeks. No. 3 weighed 297 pounds at the beginning and 425 pounds at the end of ten weeks—a gain of 128 pounds. No. 4 weighed 228 pounds at the beginning and 363 pounds at the close of the experiment—a gain of 135 pounds. In addition to the milk and meal, all the calves were fed some hay and green feed; the amount varied according to appetite. It would seem that after calves receive a fair start they will do well on skim milk, meal, green feed and hay. The gains were good, and in this experiment three of the four calves made the greatest gain on the pasteurized skim milk along with meal and other food. To prevent skim milk souring at the creamery or on the farm, pasteurization is the most practicable method; and all creameries should adopt this plan, in order to return the skim milk in good condition to the farm, and thus preserve a valuable food for calves and pigs.

DAIRY STOCK.

As intimated in my report last year, no pigs were fed by this department during the past year, as Mr. Day has taken the piggery, which formerly belonged to the dairy, for experimental purposes. The by-products were sold to private persons and to the Experimental department.

A horse and rig are maintained by the Dairy, for the use of the Dairy, Experimental and Poultry departments.

The dairy herd consists of four Jersey cows, three Holsteins, one Ayrshire, and twenty-five grade cows and heifers.

At the annual sale, the following bull calves were disposed of at fair prices: Two Jerseys, two Holsteins and one Ayrshire.

An approximate account of the food fed to each cow was kept during the year. Each cow's milk was weighed night and morning and samples were taken to determine the percentage of butter fat, as in other years. The pounds of butter produced by each cow were estimated by adding fifteen per cent to the butter fat. The table shows the record for 1898 of all the cows which were in the herd a full year, with the exception of the last two in the list which were here eleven and ten months respectively. The record for the two previous years is also given for comparison.

The food cost of milk, butter, and cheese was estimated as closely as possible by weighing the food fed to each cow once a month and measuring it for the rest of the time. The hay, silage and mangels were furnished by the Farm department and were charged at the following prices: Hay, $6.00 per ton; silage, $1.30 per ton; mangels, 7c. per bushel.

Pasture was also furnished by the Farm, and was charged at one dollar per month per cow for five months.

Grains and the bran fed were bought on the Guelph market at an average of 73c. per 100 lbs. for oats, 75c. for peas (including grinding), 50c. for bran.

The pounds of butter were estimated from the fat by adding ten per cent. to the fat, though this is too low. Fifteen per cent. is more nearly correct and we have added a column in the individual cow's record to show the production by adding fifteen per cent. to the fat.

Points to Notice.

1. The cost of the food fed to the individual cows in the herd varied from $20 to $45 during one year. It will also be noticed that the food cost for the cows was usually much less in 1897 than in 1896 or 1898, largely for the reason that the season of 1897 was an excellent one for grass, and very little grain was fed during the summer.

2. The pounds of milk given by one cow varied from 3,000 to nearly 10,000 per year. The cow which consumed the greatest amount of feed produced the greatest amount of milk during the year.

3. The pounds of butter varied from 186 to 437 as the yearly production of individual cows. There was also a marked variation in the production of the same cow from one year to another, due to various causes, such as sickness, being farrow, bad season, etc. The *lowest* producer and the *highest* producer are cows belonging to the same breed, which shows plainly that there is as much difference in the cows of the *same* breed as among cows of different breeds.

4. The pounds of cheese varied from 400 to nearly 1,000 lbs. per cow per year.

5. The cost of food to produce a gallon of milk varied from nearly seven cents to as low as about three cents. (This food cost includes the value of the food fed to each cow during the period when she was not milking as well as when milking.) This *low* food cost was produced in 1897, a year of abundant pasture in this section, by a cow of a breed specially adapted to making good use of grass for milk production.

6. The food cost of a pound of butter varied from fifteen to six and a half cents for the individual cows. In order to grow wealthy, if the food cost of the butter was near fifteen cents, it is evident that a man would need to keep a *great many cows* when selling butter at "a shilling a pound."

7. The food cost of a pound of cheese varied from nearly seven cents to below three cents. Some cows are constituted to produce butter and cheese more economically than milk, while others produce milk more cheaply than butter or cheese.

8. The most important point to notice is that it pays to *learn* what each cow in the herd is doing, by weighing and testing the milk, and by keeping an account of the food consumed by each cow.

Individual Record of Cows in Dairy Herd for Three Years.

Name.	Breed.	Total cost of food.			Pounds of milk.			Pounds of butter.				Pounds of cheese.				Food cost 1 gal. milk.			Food cost 1 lb. butter.				Food cost 1 lb. cheese.			
								10 p.c. added to fat.			15% to fat.	10 p.c. added to fat.			15% to fat				10 p.c. added to fat.			15% to fat.	10 p.c. added to fat.			15% to fat.
		1896.	1897.	1898.	1896.	1897.	1898.	1896.	1897.	1898.	1898.	1896.	1897.	1898.	1898.	1896.	1897.	1898.	1896.	1897.	1898.	1898.	1896.	1897.	1898	1898.
		$ c.	$ c.	$ c												c.	c	c.	c.	c.	c.	c.	c.	c	c.	c.
Margaret.....	Holstein..	39 89	27 98	45 35	7,994	9,131	9,793	312	335	343	358	702	753	772	806	5.0	3.06	4.63	12.7	8.35	13.22	12.67	5.6	3.71	5.87	5.62
Belle Temple..	Jersey....	37 50	29 32	Dry	6,702	5,907	.....	424	360	....	....	954	810	....	....	5 6	4 96	...	8 8	8.14	.....	.....	3 9	3.62	....	....
Birdie	Grade....	38 85	26 90	26 98	7,787	6,375	4,142	365	264	197	205	821	594	443	461	4.9	4.22	6.51	10 6	10.18	13.69	13.11	4.7	4.52	6.09	5.85
Annie.....	Grade....	28 23	26 92	29 23	5,341	4,463	5,561	239	213	258	270	537	479	581	608	5.2	6.03	5.25	11.8	12.63	11.32	10.82	5 2	5.62	5.93	4.80
Patience.....	Ayrshire..	30 06	23 09	39 46	7,473	5,559	8,779	329	266	398	416	740	598	896	936	4.0	4.15	4.49	9.0	8.68	9.91	9.48	4.0	3.86	4.40	4.21
*Wedo.....	Holstein..	19 90	28 52	31 89	3,434	6,617	5,992	119	238	208	218	293	536	468	491	5.8	4 31	5.32	16.7	11.98	15.33	14.62	6.8	5.32	6.81	6.49
*Ont. Belle...	Jersey...	17 43	22 37	20 14	3,195	3,214	3,035	194	220	178	186	436	495	401	418	5.4	6 96	6.64	9 0	10.16	11 31	10.82	4.0	4.51	5.02	4.81
*Rena B'nette	Jersey....	18 21	22 17	28 44	4,126	3,188	7,611	231	200	418	437	520	450	941	983	4.4	6.94	3.73	7.9	11.08	6.80	6.50	3.5	4.92	3 02	2.89
*Lily X. Y...	Jersey....	8 17	21 26	Dry	1,278	3,705	.....	66	224	....	....	150	504	....	....	6 3	5.74	....	12 3	9.49	....	.....	5.4	4.21	....	....
Meg	Holstein ..	....	27 40	27 01	.....	†4,442	6,393	....	†159	234	245	....	†397	527	551	....	6.17	4.22	....	†17 23	11.11	11.02	....	†6.90	5.10	4.90
Jean	Grade....	.....	.....	27 80	.....	.....	6,785	....	....	288	301	....	...	648	677	....	....	4.10	....	.....	9.65	9.23	....	....	4.29	4.10
Elsie	Grade....	.....	.....	24 37	.....	.....	6,335	....	....	212	222	....	....	477	500	....	....	3.85	....	.....	11.49	10.97	....	....	5.10	4.87
Ethel	Grade....	.....	.....	24 05	.....	.....	6,034	....	....	248	259	....	...	558	583	....	..	3.98	....	....	9.69	9.28	....	..	4.31	4.12
Grey	Grade....	.....	.....	36 81	.....	.....	8,411	....	....	360	377	....	....	810	848	....	....	4.37	....	.....	10.22	9.76	....	....	4.54	4.34
Lady.....	Grade....	.....	.. .	31 61	.....	.....	6,754	....	....	269	281	....	...	605	632	....	....	4.68	....	.....	11.76	11.25	...	....	5.22	5.00
Bessie.....	Grade....	.....	.....	32 61	.....	.....	6,468	...	....	315	329	....	..	709	740	....	....	5.04	....	.....	10 35	9.91	....	....	4.59	4.40
Cherry.....	Grade....	....	.....	30 94	.....	.....	8,297	....	..	286	299	....	....	644	673	....	....	3.73	....	.....	10.81	10.34	...	....	4.80	4.59
Beatrice .. .	Grade.. .	....	....	30 83	.....	.....	7,096	....	....	273	285	....	....	614	641	....	....	4.34	....	.....	11.29	10.81	...	....	5.02	4.81

*Not a full year in '96. † Not full year.

Food Cost of Milk, Butter, and Cheese, from Dairy Herd for three years.

Cherry	Grade	....	....	.....	30	94	.....	.....	8,297	....	..	286	299	....	....	644	673	....	....	3.73	....	.....	10.81	10.34	..	....	4.80	4.59
Beatrice ..	Grade ..	....	....	.....	30	83	.....	.....	7,096	....	....	273	285	....	....	614	641	....	....	4.34	....	.....	11.29	10.81	..	....	5.02	4.81

*Not a full year in '96. † Not full year.

Food Cost of Milk, Butter, and Cheese, from Dairy Herd for three years.

Month.	No. of cows milking.			Total food cost.			Pounds of milk.			Pounds of butter.			Pounds of cheese.			Food cost of 1 gal. milk,			Food cost of 1 lb. butter.			Food cost of 1 lb. cheese.		
	1896.	1897.	1898.	1896.	1897.	1898.	1896.	1897.	1898.	1896.	1897.	1898.	1896.	1897.	1898.	1896.	1897.	1898.	1896.	1897.	1898.	1896.	1897.	1898.
				$ c.	$ c.	$ c.										c.	c.	c.	c.	c.	c.	c.	c.	c.
December	16	19	16	62 00	49 25	46 39	7,767	8,246	8,096	329	384	333	740	864	749	8.0	5.97	5.73	18.8	12.82	13.93	8.4	5.70	6.19
January	16	*19	20	43 60	58 33	62 06	7,043	10,609	11,812	317	466	511	713	1,152	1,149	6.2	5.50	5.25	14.0	11.39	12.14	6.1	5.06	5.40
February.....	*15	19	16	46 00	50 91	44 54	8,029	8,839	9,491	373	392	411	839	969	924	5.7	5.76	4.69	12.3	11.81	10.83	5.5	5.25	4.82
March	17	18	17	45 53	48 62	50 54	7,224	8,590	9,724	334	411	416	722	924	936	6.3	5.66	5.19	13.6	11.82	12.14	6.1	5.26	5.39
April	*18	16	18	48 40	40 59	53 02	10,487	7,033	12,394	463	308	523	1,041	693	1,176	4.6	5.77	4.27	10.4	13.17	10.13	4.6	5.84	4.50
May	*17	*20	21	33 09	65 46	52 28	11,665	13,178	12,478	490	590	522	1,102	1,327	1,174	2.8	4 97	4.19	6.7	11.09	10.01	3.0	4 93	4.45
June	21	22	21	23 73	32 57	21 00	11,664	13,240	15,476	568	551	648	1,278	1,239	1,458	2.0	2.46	1.35	4.2	5.91	3 24	1 8	2 62	1.44
July	22	22	21	37 65	30 88	58 53	10,245	12,277	16,952	454	486	664	1,021	1,093	1,494	3.7	2.51	3.45	8.3	6.35	8.81	3.7	2.82	3.91
August...	24	21	23	58 64	31 27	56 93	11,511	14,633	15,248	464	575	594	1,045	1,293	1,336	5.1	2.13	3.73	12.6	5 43	9.58	5.6	2.41	4.26
September.....	21	19	21	69 34	35 87	52 60	8,939	9,934	13,551	400	423	555	900	951	1,248	7.7	3.60	3.88	17.3	8.48	9.47	7.7	3.77	4.21
October	*22	20	22	73 65	31 63	59 60	10,205	9,653	14,984	479	403	632	1,077	906	1,422	7.2	3.27	3.97	15.3	7.84	9.43	6 8	3.49	4.19
November.....	20	*18	23	54 38	63 12	67 08	9,237	9,209	12,746	435	420	565	979	945	1,271	5.9	6.86	5.26	12 5	15.02	11.87	5.6	6 67	5.27
Averages ..	19.1	19.4	19.9	49 66	44 88	52 04	9,501	10,453	12,746	425	450	531	955	1,029	1,194	5.2	4.53	4.08	11.6	10.9	9 79	5.2	4.48	4.35

* Five weeks in the month.

1. The average number of cows milking each month was about twenty.

2. The average cost of the food per month for these twenty cows varied from $45 to $52 during the three years.

3. By charging pasture at one dollar per month per cow, the month of June is most favorable for the economical production of milk, butter and cheese, although in 1897 the month of August was the most favorable.

4. The food cost of a gallon of milk varied from four to five cents as the average cost for the three years. The lowest cost for one month was 1.35c. and the highest was 8c.

5. The food cost of a pound of butter varied from 10 to 11½ cents. The lowest was 3.2c., the highest 18.8c.

6. The food cost of a pound of cheese varied from 4.35 to 5.2 cents. The lowest food cost for one month was 1.44c. in June, 1898, and the highest was 8.4c. in December, 1896.

MISCELLANEOUS DAIRY NOTES.

Milking Competitions at Fairs.

I took charge of the dairy tests at Brantford Southern Fair; at the Bayham Central Exhibition, Straffordville; and at the Walpole Exhibition, Jarvis. At Brantford the prizes were awarded according to a scale of points, the same as last year; at Straffordville the prizes were given for a herd of three cows, according to a certain scale of points; and at Jarvis the competition was for the greatest production of butter fat. At Brantford seven cows entered and six completed the test, which continued for twenty-four hours. At Straffordville twelve cows entered and completed the test, which continued but six hours; while at Jarvis six cows entered and finished the test of twelve hours.

Southern Fair, Brantford, September 21. Test, twenty-four hours.

Class.	Rank.	Name of cow.	Breed.	Owner.	Lbs. milk.	Lbs. fat.	Lbs. solids not fat.	Total score.
Open to factory cows.	1	Daisy Banks	Holstein	Jas. Rettie	56.25	1.431	4.786	123.81
	2	Daisy of Clandeboye	Jersey	W. J. Elliott....	29.50	1.253	2.672	94.65
	3	Dunoon	Ayrshire	J. R. Alexander.	32.25	0.999	2.889	86.59
Open to all.	1	Brierybanks Cora	" ...	N. Dyment	45.75	1.711	4.187	115.92
	2	Nellie Gray.....	"	N. Dyment	36.25	1.369	3.098	104.62
	3	Maud	Grade Holstein.	Wm. Brittain....	33.50	1.091	2.872	83.90

Straffordville, September 21st. Test, six hours.

Open to all.	1	3 cows	Grades	J. A. Jackson ...	35.25	1.498	3.233	186.83
	2	3 cows	"	L. Johnson	29.25	1.127	2.600	151.57
	3	3 cows	"	Geo. Murphy	24.25	0.910	2.124	142.13
	4	3 cows	"	A. L. Scott.....	23.75	1.180	2.056	141.57

Jarvis, September 30. Twelve hours' test.

Open to all.	1	....	Grade Jersey ..	Jas. Williamson..	17.0	0.816	.....	.....
	2	Beckie	" ..	J. Lawrence	12.0	0.588	.....	.....
	3	Spot	" ..	A. Underhill	8.0	0.256	.....	.....

These milk tests at fairs are becoming very popular; and there is likely to be more of them during the coming years. If the competition continued for a greater length of time, and if all would agree on some basis or scale to be used at all these tests, it would be an improvement. The cost of the food is also an important item which should be considered; but we must "creep before we walk." No doubt these things will come in due time. The fact that people are becoming awakened to the importance of weighing the milk from individual cows and having it tested is a very important step in advance. It is the first fruits of the agitation in favor of individual testing of cows in a herd. The seed has been sown and the harvest is just appearing. There are many difficulties in the way of conducting a milk test in a satisfactory manner at a fair; but most of these will be overcome in time. The graduates of our College and Dairy Schools should be able to take full charge of such tests.

Milk Tests at Farms.

Some cows are very much affected by their surroundings at a fair and are unable to do themselves or their owners justice at such a time; hence the need for tests conducted at home, where the cows are surrounded by their usual conditions. Several of our Canadian breeders of Holsteins have competed for the liberal prizes given by the American Holstein-Friesian Association. We have had several requests to go, or send reliable persons, to make such tests; and we are arranging that, so far as possible, this work shall be done by graduates of the College, thus entailing less expense upon those who are having their cows tested and less loss of time on the part of our dairy staff, who cannot be spared for a whole week at any season of the year.

Thermometers and Hygrometers for the Dairy and Curing Room.

It is very difficult to secure thermometers which are accurate and will register alike at different temperatures. A prominent cheesemaker sent us the following test of thermometers made by him May 18th, 1898:

Kind of thermometer.	Temp. 50% F.	Temp. 60% F.	Temp. 86% F.	Temp. 100% F.
Quevenne lactometer (standard)	50	60	86	100
Float bulb (dairy) No. 1	51	61	86½	101
" " 2	50	60¼	87½	102¼
Float dairy No. 1	53	64	91	106½
" 2	51	61¾	88	104
Metal back	53	63	88	102¼
Brass guards No. 1	51	61½	86	102
" 2	52	62	86¼	101

It will be noticed in the table that some of the thermometers read alike or nearly so at fifty degrees, but at eighty-six and one hundred degrees there was quite a marked difference. This difference at the various temperatures is caused by the unequal size of the bore, or opening, in which the mercury expands. There is room for some firm to supply a large trade in accurate thermometers at reasonable prices.

To know what variation in temperature has taken place in the curing-room during twenty-four hours a maximum (highest) and minimum (lowest) recording thermometer is necessary. We have tried several different makes and, all things considered, a U-shaped thermometer, made in Germany and sold in this country for ninety cents, is the one we can recommend to dairymen. It is simple, fairly accurate and easily set. When purchasing, select one that corresponds with a standard thermometer, between sixty and

seventy-five degrees, as we have found quite a variation in the different instruments of this make. The needles which mark the highest and lowest temperatures are set with a magnet. These needles should be set at regular intervals of twenty-four hours, to be of good service. A maximum and minimum thermometer (latest U. S. Weather Bureau pattern) sold by dealers in New York, is a serviceable and accurate instrument; but it is more trouble to set than the one previously mentioned, and it costs $8.

The "relative humidity" of the curing-room is also an important point in curing cheese. If the atmosphere is too dry the cheese crack and lose a great deal in weight by evaporation. We found that the sub-earth duct supplied an abundance of moisture in the air—in fact too much, as it made the conditions very favorable for growth of mould.

For ascertaining the "relative humidity," or percentage of moisture in the air, several kinds of hygrometers or psychrometers are in use. We have three kinds in our curing rooms—the Polymeter (cost $8), the dry and wet bulb thermometer (latest U. S. Weather Bureau pattern, cost $6.50), and the coil hygrometer ($2). This last is not an accurate instrument at all; but it points to the maker and says the air is becoming dry in this room, or it is moist or moderately moist, etc.

Any cheesemaker can make a hygrometer by securing two ordinary dairy thermometers which read alike. About the bulb containing the mercury of one thermometer, wrap the end of a piece of lamp-wick. The other end of the lamp-wick may be placed in a cup containing condensed steam or clean rain water. Hang the two thermometers in a convenient place near the centre of the room and place the cup containing the water a little to one side of the "wet bulb" thermometer. As the water evaporates from about the bulb it causes the mercury to contract in the wet bulb thermometer by taking up heat, and gives a lower reading. The dry bulb thermometer is also read; and a table sent out by the Dairy Division of the Experimental Union gives the percentage of moisture in the atmosphere. Any cheesemaker can make such a hygrometer as is here described.

Testing New Churns.

Nearly everyone of an inventive turn of mind tries his skill at a new style of churn, which promises, in his estimation, to take the place of the old-fashioned churns now in use. We have tried a few of these new churns during the past season and in other years with the same result—failure. Most of the men who invent and patent these churns are honest, and really think they have done a service to mankind in general, and to dairymen and buttermakers in particular, by placing on the market the results of their brain work and skill.

The goal of nearly all these churns is to obtain butter quickly, and experience shows that butter which is churned too quickly is not so good in quality as that which takes a moderate amount of time—say twenty to thirty minutes with a small churning and forty to sixty minutes with a larger one.

Another feature of these churns is that they will remove turnip, pantry, cellar and other flavors, as if by magic. Our experience is that these flavors do not disappear so rapidly by the simple process of churning. A great deal of time and money are being wasted by the inventors who do not understand that it is simplicity which is required in a churn. Many farmers are persuaded to buy these churns, and find that they are difficult to clean and no better than the common box or barrel churn.

Excursionists.

The month of June was almost wholly given up to the instruction and entertainment of the thousands of visitors who came to see us from the farms, villages, and towns of Ontario. Miss Rose gave valuable assistance in this work. Her practical lessons on buttermaking were very much appreciated by the farmers' wives and daughters, who form a large proportian of these annual visitors.

Our rooms are far too small to handle in a satisfactory manner the very large crowds which come on some of these excursions. By giving a number of lessons and talks during the afternoon, and requesting the people to move from the class-room to some other department at the close of each lesson, we managed fairly well.

Correspondence.

This branch of our work grows larger each year. A great deal of help and advice is given to dairymen by means of letters, bulletins, pamphlets, etc. It takes a good deal of time, but it keeps the department in touch with the needs of dairymen in all parts of the Province.

Another feature in this connection is becoming quite prominent. Many persons send us samples of butter, cheese, milk and cream, to score and test. The results of the scoring and testing are returned to the parties as soon as possible, and we frequently receive a second or a third lot, and in some cases we notice a marked improvement in the quality of the second samples. One man sent us, from the northern part of the Province, twenty samples of milk at one time and twenty-six samples at another time to test. Many excursionists bring samples of whole milk, skim-milk and butter-milk to be tested. The results are reported through the mail, as we seldom have time to do so at once.

Improvements.

To conduct experiments in the curing of cheese, we divided the curing-room into three parts and lined the inside with building paper and matched lumber. Each room is connected with a sub-earth duct, which was also put in about the same time as the changes in the curing-room were made. The duct is about 90 feet long and has six rows of ordinary six inch drain title placed at a depth of six feet in the ground. Three rows of tile are placed in the bottom of the drain and three directly on top of these, but the joints are broken about four inches apart. The inlet is a galvanized iron pipe, fourteen inches in diameter, and thirty feet high, with a hood or cowl on the top so arranged that it always faces the wind. An outlet from the curing-room consists of a wooden box from the ceiling to the roof and a twelve-inch galvanized iron pipe fifteen feet long placed over that. Slides regulate the amount of cold air coming into the room, and a door on hinges, worked by a rope, regulates the outlet of warm air. The whole cost of the duct was about $65, including a drain 220 feet long from the inlet end to take away any water that might collect in the duct.

As an instance of the effect of the duct in cooling the air coming into the room, we may mention that on September 3rd the maximum temperature outside was 94°, the air coming into the room was 68° and the temperature of the curing-room was 70°.

The only drawback to the duct that we have noticed so far is, that it appears to cause mould to grow on the cheese at a very rapid rate. This may not be so bad another year.

At the time of writing we are making some changes in the Dairy School building which will add to its effectiveness in teaching creamery practices.

Meetings Attended During the Year.

In addition to my regular work at the College, I have attended meetings in connection with the dairy industry at the following places: Lindsay, (Eastern Butter and Cheese Association); London, (Western Butter and Cheese Association); Woodstock, (Cheese and Butter Makers' Association); Fenwick, Strathallan, Thorndale, Peterboro', Straffordville (Fair), Jarvis (Fair), Cannington, Orillia, Nilestown, and Dorchester.

I judged butter and dairy cattle at Brantford Fair, and judged butter and cheese at Jarvis. The churning competition at the Jarvis Fair was also under my supervision.

In December I am advertised to attend Farmers' Institute meetings at Chesterville and Mountain, in the County of Dundas.

Dairy Exhibit at the Industrial Fair, Toronto.

A small exhibit of pasteurized and "preserved" milk and cream, and experimental butter and cheese, was sent to Toronto during the Exhibition. The cheese and butter were scored by the judges in dairy products, and cards stating how each lot had been made were tacked on the different articles, together with the judges' score-card. Many questions were answered and the work of the dairy school and experimencal dairy was brought to the notice of quite a large number of people; but, owing to the dairy building being in such an out-of-the-way place, so much good as might have been done was not accomplished. Many bulletins, pamphlets, Dairy School circulars, etc., were given to visitors.

Fly Mixtures for Cows.

A number of these mixtures were tried, but the most satisfactory was the following: 10 lbs. lard, 1 pint coal oil, 1 pint coal tar, and 2 ounces of crude carbolic acid. Melt the lard, then pour in the coal tar, and mix thoroughly. Remove from the stove, or from wherever it is being heated, and add the coal oil and carbolic acid and apply at once with cloths. Put the mixture on all parts of the body. The quantities given will be sufficient for about twenty-five cows. It takes two men about one and one-half hours to apply this to 25 animals, and it will keep the flies off for three to seven days. It is more effective for the first two or three applications than later. If a rain comes soon after the mixture is applied the benefits are largely lost. The lard at five cents a pound is cheaper as the base of the mixture than fish oil, which costs 80 cents per gallon. Ten pounds of lard are equal to one gallon of the oil.

During the past year a bulletin was issued prepared by the Instructors in the Dairy School (32 pages). Copies of this bulletin may be had on application to the Department of Agriculture at Toronto. The subjects discussed in that bulletin are as follows: Methods of Sewage Disposal; Milk Testing; Care of Milk for Cheese Factories and Creameries; A Starter, Separators, and the Separation of Milk; Butter-making in the Creamery; Butter-making on the Farm; Cheese-making.

Suggestions and Improvements Needed.

1. It having been decided to give more attention to the practical work of our regular College students, more room will be required in the Home Dairy department. As the Home Dairy classes of our Special Course are likely to be larger hereafter, this change is advisable in the near future. The present room devoted to Home Dairy instruction will not accomodate more than ten or twelve students at once with any degree of satisfaction.

2. During November and December we have had two men and one lady student taking up special work along with our College classes. It will be well to consider whether a short course before Christmas, say from Dec. 1st to 21st, would not be advisable, as others have written to know if they could not begin the Dairy School before the New Year. Many who are establishing winter creameries would likely come for a short term if we had the necessary accomodation and means of instruction.

3. The dairy stables need repairing before another winter.

All of which is respectfully submitted,

H. H. DEAN,

Professor Dairy Husbandry.

Guelph, December 30th, 1898.

PART VII.

PEPORT OF THE AGRICULTURIST.

To the President of the Ontario Agricultural College:

SIR,—I have the honor to submit herewith my sixth annual report.

Teaching. Lectures in the College constitute, probably, the most important part of my work, and I have essayed to make my teaching as practical as possible. Believing that animal husbandry is bound to become the leading industry of our Province, I have made every effort to interest our students in live stock. To this end I have devoted considerable time to training students in judging live stock; for I have found this to be the most effective means of awakening interest. The course of lectures in agriculture and live stock is fully outlined in the College Circular, and therefore does not require further description.

Bulletin. A considerable portion of my time during the summer months was devoted to the preparation of a bulletin on farm-yard manure, which has been recently published as Bulletin 109. The bulletin deals with the characteristics, composition, care, application and valuation of farm-yard manure, and an attempt was made to bring the light of most recent investigations to bear upon the subject.

Correspondence. During the year I have received a large number of letters containing questions relating to a great variety of agricultural topics. I have attempted to answer the questions satisfactorily, though they have made very serious demands upon my time.

Live Stock Experiments. Work in this department has increased considerably, and a number of investigations are under way. Much of our work is a repetition of last year's work; for if experiments in feeding are to be of value, they must be thorough, and thoroughness requires repetition. Following is an account of the principal experiments of the year.

EXPERIMENTS IN CATTLE FEEDING.

DIFFERENT QUANTITIES OF MEAL FOR FATTENING STEERS.

This experiment is a repetition of last winter's work, an account of which appears in my last report. Nine steers were divided into three groups, with three steers in each group. It was planned to start group I. on a medium meal ration and increase rapidly until the ration reached, as nearly as possible, one pound of meal per day per 100 pounds live weight of the animals. Group II. was to receive, as nearly as practicable, two-thirds of a pound of meal per day per 100 pounds live weight. Group III. was to be started on about one-third of a pound of meal per 100 pounds live weight and increased as deemed advisable until equal with group II. In addition to the meal ration, the steers received a mixture of hay and straw during part of the time, and hay without straw during the remainder of the feeding period, together with 15 pounds of roots per steer per day. The quantity of roots was increased to 25 lbs. on April 1st, and continued at this rate until the close of the experiment. Outside the meal the steers were fed exactly the same rations, and all fodders were carefully weighed and recorded. After 30 days' preliminary feeding, during which all the steers received the same ration, the experiment proper commenced December 3rd and closed May 31st, covering a period of 179 days. The meal ration consisted of equal parts by weight of peas, barley and oats.

The daily meal rations for each group were, approximately, as follows :

	Group I.	Group II.	Group III.
	lbs.	lbs.	lbs.
December	8	6	4
January	10	8	4.5
February	11	8	5
March	12	9	8
April	13	9	9
May	13	10	10

One steer in group I. was considerably lighter than the other two, and his daily meal ration was one pound lighter than the quantities stated above for Group I.

In order to show the relation which the weight of meal consumed by the animals bears to the weight of the animals, the following table is given, in which the calculations are based upon the quantities of meal actually consumed.

The table shows the average weight of the steers for the whole fattening period, and the relation which the meal rations bears thereto.

	Average weight of steers throughout experiment.	Average daily meal ration per steer.	Average amount of meal consumed per day per 100 lbs. live weight.
	lbs.	lbs.	lbs.
Group I. (Heavy ration)	1,229	10.66	.81
" II. (Medium ration)	1,265	8.21	.65
" III. (Light ration)	1,269	6.68	.53

From the above table it will be seen that group I. averaged slightly over four-fifths, group II. slightly under two-thirds, and group III. a little over one-half of a pound of meal per day per 100 pounds live weight.

As the experiment proceeded, one steer in group II. and one in group III. were discarded as unsuitable for the test, and the experiment was completed with two steers in each of these two groups.

The following table shows the weights and gains of the different groups :

	Weight Dec. 3rd.	Weight May 31st.	Total gain in 179 days.	Average gain per steer in 179 days.	Average gain per steer per day.
	lbs.	lbs.	lbs.	lbs.	lbs.
Group I. Heavy ration, (3 steers)	3,235	4,140	905	301.66	1.68
" II. Medium ration, (2 steers)	2,245	2,815	570	285.	1.59
" III. Light ration, (2 steers)	2,241	2,835	594	297.	1.65

It will be noticed that all the gains are low. This was due to having to feed some very poor hay during part of the time. It will also be noted that the results are somewhat contradictory, the medium ration group making the smallest gain, whereas the light and heavy ration groups are practically equal. This apparent discrepancy is due to the individuality of the animals in different groups. However, the rate of gain is not the most important point, but the cost of gain is extremely important. In valuing fodders difficulties always arise ; but, as the sole object of this experiment is to compare the relative merits of different methods of feeding, it has been thought advisable not to

attempt to follow the fluctuating market prices, but to adopt reasonable average values for the different fodders. For the sake of uniformity, therefore, the same values are used in this experiment as were employed in the first experiment, namely, meal, $13; hay, $6; straw, $3; and roots, $2 per ton. The valuation of the meal is rather below the average market price of the past winter, but a higher valuation would simply make the comparison of the different methods even more striking. Using the same values throughout simplifies the comparison of results obtained in the two experiments.

The table given below shows the cost of one pound of gain in each experiment, together with the average of the two experiments.

——	Cost of 1 lb. gain, first experiment.	Cost of 1 lb. gain, second experiment.	Cost of 1 lb. gain, average of two experiments.
Group I. Heavy ration..	6.37c.	7.70c.	7.03c.
" II. Medium ration	5.59c.	7.26c.	6.42c.
" III. Light ration ..	5.91c.	6.46c.	6.13c.

In the case of the light and medium rations, the results of the two experiments are somewhat contradictory, since in the first experiment the medium ration proved to be the more economical of the two, while in the second experiment this result has been reversed. But in both experiments the results have been decidedly in favor of the two lighter rations as compared with the heavy ration. The results of the two experiments, therefore, point to the conclusion that for fattening steers, a moderately light meal ration is more profitable than a heavy meal ration, provided, of course, that the coarser fodders are of good quality and palatable.

Corn vs. Peas for Fattening Steers.

Corn is attracting considerable attention as a food for stock, and numerous questions have been received regarding its value as compared with peas, for fattening animals. One experiment was conducted with steers during the winter of 1897-98, in which a mixture of corn, barley, and oats, equal parts by weight, was compared with equal parts by weight of peas, barley, and oats. Three steers were fed a ration exactly the same as that of Group II. in the experiment with different quantities of meal, except that their meal ration consisted of corn, barley, and oats, instead of peas, barley, and oats.

In estimating the cost of a pound of grain, corn has been charged at the same price per pound as peas, though the actual cost was less than the peas. This plan has been followed in order to simplify the comparison. In this experiment the same values have been adopted as were used in the preceeding one, viz., meal $13; hay, $6; straw, $3; and roots, $2 per ton.

The following table shows the weights, gains, and cost of a pound of gain in the two groups:

——	Total weight Dec. 3rd.	Total weight May 31st.	Total gain in 179 days.	Average gain per steer.	Average gain per steer per day.	Cost of 1 lb. gain.
Group I. (3 steers):	lb.	lb.	lb.	lb.	lb.	c.
Meal ration—Corn, barley and oats..	3,233	4,175	942	314	1.75	6.56
Group II. (2 steers):						
Meal ration—Peas, barley and oats..	2,245	2,815	570	285	1.59	7.26

In this experiment, therefore, the corn, barley, and oats gave much better results than the peas, barley, and oats. If reference is made to the experiment with different quantities of meal, it will be seen that Group II., that is the group receiving the medium meal ration, made lower gains than the light ration group. As previously noted, the difference is, no doubt, due to individuality rather than to food. This makes the comparison of corn and peas unsatisfactory, and it would not be fair to assume that the larger gain of group I. in this experiment was entirely due to the superior feeding value of corn as compared with peas. It is worthy of note, however, that the group receiving corn, barley, and oats made more rapid gains than any of the groups receiving peas, barley, and oats. That is to say, the group receiving about two-thirds of a pound of meal per day per 100 pounds live weight, when the meal ration was corn, barley, and oats, made a more rapid gain than the group receiving about four-fifths of a pound of meal per day per 100 pounds live weight, where the meal ration was peas, barley, and oats.

Though the results are decidedly in favor of corn as compared with peas for fattening steers, the experiment will be repeated.

Green Oats and Peas and Oats and Tares as Soiling Crops for Milch Cows.

The green fodders used in this experiment were grown by Mr. Zavitz on the experimental plots. In order to extend the feeding period, early and late varieties of peas and oats were used. For the early plots, Daubeney oats and Chancellor peas were used, and Siberian oats and Prussian Blue peas were used for the later plots. All the plots were sown on the same date and comprised one-eighth acre Daubeney oats mixed with Chancellor peas, one-eighth acre Daubeney oats mixed with tares, one eighth acre Siberian oats mixed with Prussian Blue peas, and one-eighth acre Siberian oats mixed with tares.

The cows received their first feed of green fodder on the evening of July 7th. At this time the Daubeney oats were in the early milk stage and the Chancellor peas had a few pods well formed. The early plots lasted until July 16th at noon, or a period of nine days. By this time the Siberian oats and Prussian Blue peas were fit to use, and extended the feeding period nearly eleven days longer. Thus, by sowing early and later varieties of oats and peas, green fodders from the same date of seeding were furnished for practically twenty days. On the whole, the oats and tares gave a somewhat heavier yield per acre than the oats and peas in this particular case. This is contrary to the results of other experiments here, and attention is called to the report of the Experimentalist, Mr. Zavitz, where much fuller information is given regarding yields of different mixtures for green fodders. In the feeding experiment, four cows were used. The cows were obtained from the Dairy department, care being taken to select animals as near the same period of lactation as possible. Cows No. 1 and No. 2 were fed oats and peas for eleven days, and cows No. 3 and No. 4 were fed oats and tares for the same time. At the end of eleven days the rations were changed; cows No. 1 and No. 2 receiving oats and tares, and cows No. 3 and 4 oats and peas during the remainder of the time. For purposes of comparison, it has been thought advisable to take an equal number of days on each kind of food, after the cows had become accustomed to changed conditions. For this reason the milk yield during the first five days has been left out of consideration, and Period I. is made to comprise the remaining six days before the rations were changed. The milk yield during the two days following the changing of the rations has been omitted, and Period II. comprises the next six days. This arrangement, therefore, shows the milk yield of each cow for six days on oats and peas, and for six days on oats and tares, thus allowing a very fair comparision to be made. In addition to the green fodders, each cow received two pounds of bran per day during the first eleven days, and four pounds per day during the remainder of the time.

The results of the test are given in the following tables:

TABLE I.—Milk Yield During Period I. (July 13-18.)

Date.	Oats and peas.		Oats and tares.	
	Cow No. 1.	Cow No. 2.	Cow No. 3.	Cow No. 4.
	lbs.	lbs.	lbs.	lbs.
July 13	21.25	21.	23.50	19.25
" 14	18.	19.25	22.50	19.75
" 15	18.25	20.	22.25	18.25
" 16	18.75	20.25	22.	19.75
" 17	18.	19.50	20.	18.
" 18	19.25	19.	21.	18.
Total	113.50	119.00	131.25	113.00

TABLE II.—Milk Yield During Period II. (July 21-26.)

Date.	Oats and tares.		Oats and peas.	
	Cow No. 1.	Cow No. 2.	Cow No. 3.	Cow No. 4.
	lbs.	lbs.	lbs.	lbs.
July 21	19.	19.	20.25	18.25
" 22	19.	19.25	19.75	19.25
" 23	18.50	18.75	17.50	19.
" 24	17.50	18.	18.	17.
" 25	17.75	17.50	20.75	18.75
" 26	17.25	18.25	17.75	18.75
Total	109.00	110.75	114.00	111.00

TABLE III.—Summary showing Milk Produced and Green Fodder Consumed.

	Milk produced		Green Fodder consumed.	
	by 4 cows in 6 days from oats and peas.	by 4 cows in 6 days from oats and tares.	Oats and peas consumed by 4 cows in 6 days.	Oats and tares consumed by 4 cows in 6 days.
	lbs.	lbs.	lbs.	lbs.
Cow No. 1	113.50	109.00	510	510
" 2	119.00	110.75	510	510
" 3	114.00	131.25	420	420
" 4	111.00	113.00	420	420
Total	457.50	464.00	1,860	1,860

Difference in favor of oats and tares, 6.5 lbs., or an average of .27 lb. milk per cow per day.

From tables I. and II. it will be noted that cow No. 3 shrunk considerably in milk yield after changing from oats and tares to oats and peas, whereas cow No. 4 maintained a very constant flow under the same conditions. This would indicate that the shrinkage was not altogether due to the change of food.

It will also be noted, as shown in table III., that cows 1 and 2 were much larger eaters than cows 3 and 4, the average daily consumption of green fodder per head being 85 lbs. for cows 1 and 2, against 70 lbs. for cows 3 and 4. Owing to the arrangement of the results, this fact does not materially affect the comparison.

Taking everything into consideration, the results of the experiment indicate that there is very little, if any, difference between the value of oats and peas and oats and tares as milk producers.

Sugar Beets *vs.* Mangels for Milch Cows.

In this experiment four cows were used, which were obtained from the Dairy department. The sugar beets and mangels were grown on the experimental plots, under the direction of Mr. Zavitz. The experiment covered a period of four weeks During the first two weeks cows 1 and 2 received sugar beets, and cows 3 and 4 mangels while during the second two weeks cows 1 and 2 received mangels, and cows 3 and sugar beets. Each cow received per day 60 lb. roots, 7 lb. meal (equal parts by weight of peas, barley and oats) and all the hay she would eat.

The following table shows the average daily milk yield for each week :

	Average daily milk yield during first week ; cows 1 and 2, sugar beets; cows 3 and 4, mangels.	Average daily milk yield during second week ; cows 1 and 2, sugar beets; cows 3 and 4, mangels.	Average daily milk yield during third week ; cows 1 and 2, mangels ; cows 3 and 4, sugar beets.	Average daily milk yield during fourth week ; cows 1 and 2, mangels ; cows 3 and 4, sugar beets.
	lb.	lb.	lb.	lb.
Cow No. 1. First two weeks, sugar beets ; second two weeks, mangels	22.33	21.46	20.	19.64
Cow No. 2. First two weeks, sugar beets ; second two weeks, mangels	27.75	28.50	28.71	29.39
Cow No. 3. First two weeks, mangels ; second two weeks, sugar beets	19.08	19.82	19.21	18.21
Cow No. 4. First two weeks, mangels ; second two weeks, sugar beets	22.71	22.82	22.64	21.00

The results of this experiment are far from conclusive. It will be noticed that cow No. 1 steadily decreased in milk yield throughout the four weeks, while cow No 2 increased in milk yield during the same time. On the other hand, cow No. 3, and cow No. 4 both increased in milk yield while receiving mangels, and both decreased while receiving sugar beets. On the whole, the results are slightly in favor of the mangels as the following table shows :

	Milk produced on sugar beets.	Milk produced on mangels.
Cow No. 1	306.75	277.50
" 2	393.75	406 75
" 3	262.	272.50
" 4	305.50	318.75
Total	1,268.00	1,275.50

It will be seen that while cow No. 1 is the only one which gave more milk on sugar beets, yet the difference in her case was so great as to make the total difference in favor of mangels comparatively insignificant. (For comparative yields of mangels and sugar beets, see Report of Experimentalist.)

Another experiment is in progress, which, when completed, may afford more definite information.

EXPERIMENTS IN SHEEP FEEDING.

Comparison of Alfalfa and Red Clover Hay for Lambs.

In this experiment thirteen lambs were used. Group I. contained four lambs and received red clover hay. Group II. contained five lambs, and received first crop alfalfa hay. Group III. contained four lambs, and received third crop alfalfa hay. In addition to the hay ration, each group received a grain ration composed of equal parts by weight of oats and peas, the quantity of grain per lamb being the same for all groups. Each group received, proportionately, the same quantity of hay. The red clover and first crop of alfalfa were both injured by rain, but the third crop of alfalfa was in very good condition, and was much finer in stalk than the first crop. The experiment continued for 74 days. The results of the experiment are given in the following table:

	Group I. Red Clover.	Group II First Crop Alfalfa.	Group III. Third Crop Alfalfa.
	lbs.	lbs.	lbs.
Average weekly gain per lamb	2.10	2.15	2.31
Meal consumed per 1 lb. gain	5.14	4.93	4.67
Hay received per 1 lb gain	9.03	8.48	8.20
Total cost of 1 lb. gain	6.63 cts.	6.32 cts.	6.05 cts.

In the above table, oats are valued at 25c. per bushel, peas at 48c. per bushel, and hay at $6.00 per ton. In all groups there was some hay wasted, the waste in the case of the first crop alfalfa being considerably greater than in the other two.

Throughout the whole experiment all the animals were in perfect health, no bad results being noticeable from eating the somewhat woody first crop alfalfa.

A comparison of the groups would lead to the conclusion that groups I. and II. are practically even, it being quite as probable that the slight difference is due to individuality as to feed. Group III., however, possesses quite a marked advantage over the other two groups, a result which would naturally be expected, owing to the superior quality of the hay. The results are rendered somewhat unsatisfactory owing to the fact that it is impossible to say which of the two kinds of hay, viz., the red clover or the first crop of alfalfa, had been most seriously injured. The best obtainable hay of each kind was used, but further experiments may give different results.

So far as the experiment goes it would indicate that the feeding value of alfalfa hay approaches very closely to that of red clover when fed to sheep.

Corn vs. Peas for Fattening Lambs.

In this experiment, eight lambs were used. Group I. contained four lambs, which were fed equal parts by weight of peas and oats, together with clover hay. Group II. also contained four lambs, but received equal parts by weight of corn and oats with clover hay. The experiment lasted 74 days. The results of the experiment are given below.

	Group I. Peas and Oats.	Group II. Corn and Oats.
	lbs.	lbs.
Total Meal consumed	456.75	456.75
Total Hay fed	802.	802.
Average weekly gain	2.10	2.29
Meal consumed per 1 lb. gain	5.14	4.72
Hay fed per 1 lb. gain	9.03	8.27
Cost of 1 lb. gain	6.63 cts.	5.79 cts.

In estimating the cost of the fodders, the peas are valued at 48c. per bushel, and the corn at 38c. per bushel, which was the actual cost including grinding, while the hay is valued at $6 00 per ton.

This experiment, therefore, gives a marked difference in favor of the corn, both in rate of gain and cost of gain, and at the same price per pound for corn and peas the corn would still have the advantage. Further tests are necessary, and preparations are being made for repeating the experiment.

EXPERIMENTS IN SWINE FEEDING.

Experiments With Pure Bred Swine.

This experiment is a continuation of the work of the past two years, and constitutes the third experiment of the series. This year some new features were added, a report of which is given below. In the spring, thirty six pure bred pigs were purchased, comprising six pigs of each of the following breeds: Yorkshire, Chester White, Tamworth, Duroc Jersey, Poland China, and Berkshire. The pigs were purchased from reputable breeders, and they arrived at the College early in June. Their ages ranged from seven to nine weeks at time of delivery. They were weighed and divided into three groups on June 14th, and the experiment proper commenced July 4th, after the pigs had become accustomed to their changed surroundings and feed. Each group contained two pigs of each breed, or twelve pigs. The pigs in Group A were kept in pens, the pigs of each breed being kept separate. Group B was treated in exactly the same way—the two groups occupying the same building. Each pen opened into a small outside yard, thus allowing a limited amount of outside exercise. The pigs in Group C were given the run of a half-acre lot with shelter. This lot furnished some clover and grass until about the middle of August, after which it afforded practically no pasture. The pigs, however, took plenty of exercise and did considerable rooting.

The meal ration for all the groups was as follows: Wheat middlings until August 19th. Barley and shorts, equal parts by weight, from August 19th until September 12th. Peas, barley, and shorts, equal parts by weight, from September 12th until October 24th, the close of the experiment. The pigs in Group B, however, were fed whey in addition to the meal ration. Thus Group B differed from Group A in that it received whey in addition to the meal ration; and Group C differed from Group A in that it was fed in an outside lot, with plenty of room for exercise.

In comparing the gains and food consumed by the different breeds, only Groups A and B were used, because it was only in these groups that the breeds were kept separate. Therefore the comparisons are based upon four pigs of each breed. In dividing up the pigs into groups, several rather unthrifty animals were put into Group C so as not to interfere with the comparison.

The table given below, in which the breeds are arranged in order of economy of gain, represents the average results of Groups A and B. The whey consumed by Group B is not taken into consideration in this table, because it was the same for all breeds, and therefore does not affect the comparison.

Breed.	Average weight July 4th.	Average weight Oct. 24th.	Total gain per hog in 112 days.	Average daily gain per hog.	Meal consumed per 100 lb gain.
	lbs.	lbs.	lbs.	lbs.	lbs.
1 Yorkshire	52.	175.75	123.75	1.10	350.1
2 Berkshire	49.5	169.5	120.	1.07	369.79
3 Duroc Jersey....	59.25	179 25	120.	1.07	376.04
4 Tamworth	47.75	167.	119.25	1.06	377.77
4 Chester White	56.	175.25	119 25	1.06	377.77
5 Poland China ..	68.75	186.5	117.75	1.05	383.22

The uniformity of the gains of the different breeds is rather remarkable. The Yorkshires and Berkshires consumed rather less meal than the other breeds, and this accounts for the considerable difference in the quantities of meal required for 100 pounds gain. The Poland Chinas were placed at a slight disadvantage in that they were heavier than the other breeds. This point will be found illustrated in a subsequent table.

At the close of the experiment the hogs were shipped to the Wm. Davies Company, Toronto, where they were slaughtered and examined by experts. Mr. J. W. Flavelle, managing director of the firm, furnished the following report on the characteristics of the different breeds. Mr. Flavelle was given merely the number of the groups without any information regarding the breeds.

The groups were arranged as follows: A, Yorkshires; B, Chester Whites; C, Tamworths; D, Duroc Jerseys; E, Poland Chinas; F, Berkshires.

Mr. Flavelle's Report.

Dear Sir.—Covering the hogs which you marketed with us last week, please note the following concerning the various groups, as indicated by ear-tags:

Group A.—General characteristics: Great length, side of even depth throughout, sides full of flesh, great length between shoulder and ham, fat even on back, bone moderate, head small, fore-arm too long, belly only moderately thick, shoulder moderate in size. These pigs have qualities which make them peculiarly suitable for cross-breeding purposes on account of their great length, great development of flesh and the even depth of the side.

146: Too heavy, full of flesh, fat reasonably even down back; would have been an excellent pig if marketed earlier. Sides from this hog will not grade No. 1, because they are too fat.

126: Long, fat even on back, full of flesh, even depth of side throughout. Will make side of No. 1 selection.

The remaining four hogs of this class were scalded on account of being too thin for singers. They are simply good, strong stores, but they carry with them the same general excellent qualities of the other two, and if they had been fed for a sufficient time they would have made desirable sides.

Group B.—General characteristics: Heavy shoulder, head a little coarse, belly only moderate in thickness, bone moderate, short middle, quite too short to make a desirable side, undue development of fat on shoulder, fat uneven down back, tendency for fat to arch on the crown, generally undesirable because of shortness and tendency to run to thick fat shoulder.

145: Undue development of fat on shoulder, arches up on crown; would be classed as fat bacon, with an average value of say four shillings per cwt. less than best. Middle short, not long enough between ham and shoulder for good cutting, bone moderate, head a little coarse, belly only fair in thickness.

144: Better length than 145, fat more even down the back, and altogether a better pig; would be passed as No. 1 bacon, but would not make an ideal side.

128: Short, apparently stunted, fat arched a little on the shoulder; an undesirable hog.

129: Shows the same tendency of the fat arching on the crown, hog too small, developed as a finished pig too early.

119: Better length, fairly useful pig, coarse head, better development of flesh than any of the others; would be classed as a No. 1 side, but not at all an ideal one.

One scalded hog in this lot shows the same general characteristics.

Generally speaking, Group B. seems to represent a type of hog that will make short, thick, fat sides, unless there is the very greatest amount of care exercised in feeding.

Group C.—General characteristics: Moderate bone, long head but small jowl, flesh well developed, slight tendency for fat to arch on the crown, which would possibly cause

Meal consumed per 100 lb gain.
lbs.
350.1
369.79
376.04
377.77
377.77
383.22

too many sides to be classed as "fat" on account of thickness at this one point if hogs were moderately well fed, belly thick and very excellent, generally a desirable type of hog, which, with judicious feeding, ought make good export sides.

132: A little short, not enough cutting between shoulder and ham, slightly too fat but fairly even down the back, would not pass as a No. 1 owing to being too fat.

133: Very thick belly, fat on the back, arched somewhat at the crown, thus making the side too fat for No. 1 selection, if marketed a little earlier this defect would not have been so noticeable and the product would have made sides of No. 1 selection.

Three scalded hogs in this group, Nos. 131, 130 and 123, are too light for marketing, being a little better than good stores, but have the general characteristics indicated above, the thickness of the belly being particularly noticeable.

GROUP D.—General characteristics: Heavy shoulder with poorly developed loin, bone moderate, head moderate in size with a good deal of jowl, side uneven in depth, shoulder altogether over-balancing the ham and loin, short and thick, tendency of the fat on the shoulder to arch on the crown, fair belly, generally very undesirable on account of undue development of shoulder and shortness of hog. This hog if fed carelessly would develop short thick sides, the very opposite of an ideal side.

116: Short, dumpy, moderate bone, flesh well developed, good belly, would probably pass as a short No. 1 side.

137: Heavier than 116, longer, fat, would make decidedly fat bacon, skin coarse, bone somewhat coarse.

135: Bone coarse, but side full of flesh.

117: Has put on too much fat; would class as a No. 2 side on this account.

Two scalders in this lot were too light to be singed, 134 coarse in bone, but side full of flesh and fat even down the back. 136 shows great length, entirely unlike any other hog in the group, full of flesh, coarse in bone, very long fore arm, an undesirable hog on his own account, but would make an excellent type of hog to cross with some of the others in the group.

Generally speaking, the above class shows great irregularities and unevenness, no two hogs in the lot being alike.

GROUP E—General characteristics: Coarse, very heavy shoulder, side runs off at loin, coarse head, generally full of flesh, undesirable because of coarseness, undue development of shoulder and heavy head. The heavy development of shoulder in these hogs and light loin fail to produce a side of even depth.

149: Thick, heavy, fat, coarse head and shoulder, undesirable.

148: Same type as 149, but not so fat.

114: An excellent pig, entirely unlike any other in the group, fat even on the back, excellent belly, head coarse, bone somewhat coarse, but on the whole a useful pig.

138: Very thick shoulder, pinched in the loin, coarse, skin coarse.

139: A strong, coarse, lean hog.

GROUP F.—General characteristics: Flesh well developed, fat even down back, well developed sides of reasonably even depth, hogs irregular in length, head moderate with rather large jowl, bone moderate, generally good hogs but show a decided tendency to uneven development as evidenced by the great irregularity in the length.

121: The best of the three singers in this group, good length, moderate shoulder, head slightly coarse, even middle and good hams; a desirable hog, the product of which will make a No. 1 side.

142: Much shorter than No. 1, with a thicker shoulder and a good deal of jowl.

143: A fairly useful hog, but quite too short, a good deal of jowl, plenty of flesh which would permit it to pass as a No. 1 selection on a general inspection, but not at all an ideal side.

Two scalders, 140 and 120, excellent length, good belly, would have made first-rate pigs if fed longer.

141 : Is much shorter than the above two pigs; if forced, would probably give a thick pug when finished.

Generally speaking, this group is to be commended for the quantity of flesh developed If the hogs had been more even in length it would have greatly improved the general quality of the group.

Yours truly,

J. W. FLAVELLE,
Managing Director of The Wm. Davies Co., Limited.

TORONTO, Oct. 31st, 1898.

It must not be forgotten that Mr. Flavelle's report deals with the hogs purely from the standpoint of the export bacon trade. On the whole, the breeds rank pretty much the same in his report as in previous years.

It is worthy of note that it did not cost more in this feeding test to produce a pound of gain in the case of a good type of bacon hog than in the case of less suitable types.

The experiment also indicates that while the bacon type is apparently more common in some breeds than others, yet very good bacon types occur in practically all the breeds tested. The selection of breeding stock however, to conform to the bacon type, among some of the breeds tested, would mean a divergence from the standards of excellence provided for the direction of breeders.

FEEDING VALUE OF WHEY, AND INFLUENCE OF EXERCISE.

It has been explained already that the pure-bred hogs were divided into three groups, each group containing two hogs of each breed, or 12 hogs in all. Group A was fed in pens. Group B was also fed in pens and on the same meal ration, with the addition of whey. The whey feeding was commenced before the hogs were three months old. A very small quantity of whey was fed at first, but is was gradually increased until about two pounds of whey were fed with each pound of meal. Group C received exactly the same ration as Group A, but was given exercise in a half acre lot.

The following table shows the results of the different methods of treatment :

——	Total weight July 4th.	Total weight Oct. 24th.	Total gain in 112 days.	Average daily gain per hog.	Food consumed per 100 lbs. gain live weight.	
					Meal.	Whey.
Group A. 12 hogs (two of each breed) in pens with meal and water.....	lbs. 651	lbs. 1,897	lbs. 1,246	lbs. .92	lbs. 428.25	lbs. .....
Group B. 12 hogs (two of each breed) in pens with meal and whey	682	2,802	1,620	1.20	333.27	674.44
Group C. 12 hogs (two of each breed) outside with meal and water.....	598	1,953	1,355	1.00	400.22	.....

The table shows a very marked difference in rate and economy of gain in favor of the whey, while the outside group shows a decided advantage over the inside group receiving the same ration. The fact that several unthrifty hogs were put into the outside group, makes the difference in gains all the more striking.

In this experiment, 100 pounds of whey proved equal in feeding value to 14 pounds of meal, showing that whey is valuable food for swine when fed juidiciously.

Special attention is directed to the influence of whey on the firmness of bacon, which is reported in another place.

Influence of Weight Upon Amount of Meal Required for One Pound of Gain.

In the experiment with pure-bred hogs, a rather interesting point was brought out incidentally. It has been shown by other experiment stations that the cost of producing a pound of gain in hogs increases as the animal becomes heavier. As our pure-bred hogs were weighed at regular intervals, and as every pound of meal which they consumed was carefully weighed, an opportunity was afforded to test further the truth of the claim, and a statement of the results is given below. These results are computed from the gains made and the food consumed by 36 hogs, so that they afford very conclusive evidence. In computing the average weights of the hogs, fractions of pounds were neglected, the nearest whole number of pounds being taken in each case.

Statement of Food Consumed for One Pound of Gain by Hogs of Different Weights.

While increasing in live weight from 54 pounds to 82 pounds, hogs required 3.10 pounds meal per one pound gain.

While increasing in live weight from 82 pounds to 115 pounds, hogs required 3.75 pounds meal per one pound gain.

While increasing in live weight from 115 pounds to 148 pounds, hogs required 4.38 pounds meal per one pound gain.

While increasing in live weight from 148 pounds to 170 pounds, hogs required 4 55 pounds meal per one pound gain.

This statement shows that there is a steady increase in the amount of meal required to produce a pound of gain as the hogs increase in weight, and is a strong argument in favor of marketing hogs by the time, or a little before, they reach 200 pounds live weight.

Rape for Fattening Hogs.

Two experiments were conducted to test the feeding value of rape for fattening hogs. At the same time cornmeal was compared with a mixture of equal parts by weight of peas, barley and shorts. The primary object of the experiments was to test the effect of these foods upon the firmness of the bacon, and attention is directed especially to the report on firmness which is given under a special heading.

Experiment No. 1. For the first experiment twelve hogs were used. They were divided into three groups of four hogs each. Group I. was fed cornmeal and rape, the meal ration being two-thirds of that fed to Group II. Group II. was fed cornmeal alone, and Group III. was fed a mixture of equal parts by weight of peas, barley and shorts. The rape was fed to the hogs in their pens, and they were given all they would eat in addition to the meal ration. The weights, gains and food consumed per 100 pounds gain are given in the following table :

Group.	Average weight of hogs at beginning of experiment.	Average weight of hogs at close of experiment.	Total gain per hog in 42 days.	Average daily gain per hog.	Food consumed per 100 lbs. gain.	
					Meal.	Rape.
Group I. (4 hogs): Corn and rape	lbs. 118	lbs. 179	lbs. 61	lbs. 1.45	lbs. 260.65	lbs. 847.54
Group II. (4 hogs): Corn alone	107	171	64	1.52	368.75	.....
Group III. (4 hogs): Peas, barley and shorts alone	104	164	60	1.42	393.33	.....

Experiment No. 2. In the second experiment eleven hogs were used and divided into three groups. Group I. was fed equal parts by weight of peas, barley and shorts, together with rape, receiving two-thirds of the meal ration given Group II. The rape was fed to the hogs in their pens, and they were allowed all they would eat in addition to the meal. Group II. was fed cornmeal alone, and Group III. was fed peas, barley and shorts alone. The results are given in the following table :

Group.	Average weight of hogs at beginning of experiment.	Average weight of hogs at close of experiment.	Total gain per hog in 42 days.	Average daily gain per hog.	Food consumed per 100 lbs. gain.	
					Meal.	Rape.
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Group I. (4 hogs): Peas, barley and shorts with rape....	100	147	47	1.12	278.72	846.81
Group II. (4 hogs): Corn alone	94	140.5	46.5	1.10	408.60	.....
Group III. (3 hogs): Peas, barley and shorts a'one.... ...	107	158	51	1.21	388.23	.....

If the two tables are compared it will be seen that the hogs in the first experiment made more satisfactory gains than those in the second. Those in the first experiment had been running on stubble fields previous to the experiment, while those in the second experiment had been confined in pens from time of weaning, so that the difference in gains is easily accounted for. On the whole the gains of the different groups in each experiment show no marked variation—probably no more than might occur on the same food. The most striking feature of the experiments is the marked saving in meal required for 100 pounds of gain effected by the use of rape. It indicates that rape has a very considerable value as a food for hogs ; but owing to the somewhat contradictory results in connection with its effect on the firmness of bacon, it is hardly safe to recommend it for hog feeding until it has been further tested.

Influence of Food and Exercise on the Firmness of Bacon.

The question of the influence of food upon the quality of bacon is an extremely important one. If we are to maintain our footing in the English market, it is necessary that we should look carefully after the quality of our products. In fact quality is the first consideration, for it will be of little use to produce bacon cheaply if by so doing we ruin the reputation of our goods, and thus lose our best market. Unfortunately all Canadian bacon is not first-class, and the following extract from a letter written by Mr. J. W. Flavelle, managing director of the Wm. Davies Company, should be sufficient to set feeders thinking : " Every year the packer finds in the product of hogs purchased during the months of May, June, and part of July, an inordinate quantity of soft bacon. We have never known such a quantity as was present this year, when, for weeks at a time, the percentage of soft, inferior bacon averaged 20, 30, and 40 per cent. of the whole.". Such a condition of affairs is certainly lamentable, for when this inferior product is put upon the market as Canadian bacon it tends to discredit Canadian bacon as a whole. While the loss upon inferior goods falls upon the packer in the first place, it must of necessity fall upon the farmer in the end, and there is no doubt that had there been less soft bacon this year prices would have been higher at the present time.

" Soft bacon " does not mean fat bacon. In fact, observations during this year indicate that softness is more likely to develop in hogs that are too lean than in those which

are too fat. The softness develops while the bacon is in the salt, and when taken out of the salt the fat is soft and spongy, the value of the bacon being reduced according to the degree of softness.

Since softness is evidently due to the methods of feeding and managing hogs, it becomes of great importance to discover, if possible, the conditions likely to produce soft and firm bacon. With this object in view experiments were commenced during the past summer, and, though they constitute merely a beginning, they are not without value.

The hogs used in these experiments comprised three different classes of animals, which will be described in turn. In September, twelve hogs, which had been running on the stubble fields for about six weeks, were purchased from a neighboring farmer. They were well-grown, fleshy stores, averaging about 109 pounds in weight. They were divided into three groups and constitute groups I., II., and III., described in the table which follows. Group I. was fed rape and corn meal, the meal ration being two-thirds of that fed to Groups II. and III Group II. was given a full ration of corn meal, and Group III. a full ration of equal parts by weight of peas, barley, and shorts. They were kept on these rations for six weeks before slaughtering.

Groups IV., V., and VI., comprised 11 hogs which were purchased when about six weeks old, and were kept in pens until they were slaughtered. They were fed on wheat middlings, and wheat middlings with shorts, mixed with skim milk until they weighed between 90 and 100 pounds. They were then divided into three groups and fed as follows : Group IV. received rape with a mixture of equal parts by weight of peas, barley, and shorts, the meal ration being two-thirds of that fed to Group V. Group V. received corn meal, and Group VI. peas, barley, and shorts. These rations also were continued for six weeks.

Groups A, B, and C, were made up of the purebred hogs used in the breed experiment previously described. These hogs were purchased when from 7 to 9 weeks old. Each group contained two hogs of each of the six breeds in the test.

The hogs of Group A were kept in pens with small outside yards—two hogs in each pen. From June 14th to Aug. 19th, they were fed wheat middlings mixed with water. From Aug. 19th to Sept. 12th, they were fed equal parts by weight of wheat, shorts, and barley, with water. From Sept. 12th to Oct. 24th (the close of the experiment), they were fed equal parts by weight of peas, barley, and shorts, with water. The hogs in Group B were given exactly the same treatment and the same meal ration as those in Group A, but were fed whey in addition—about two pounds of whey to one of meal. The hogs in Group C had the run of a half-acre lot, which furnished some grass until about the middle of August. They received exactly the same ration as Group A. Thus, Groups A and B were kept under the same conditions but received different rations, while Groups A and C received the same rations but were kept under different conditions.

At the close of the experiments all the hogs were shipped to the Wm. Davies Company, Toronto. There they were slaughtered, and the different groups were kept separate when in the salt. When they were taken out of the salt, the firmness of the bacon was carefully noted, and the report of the examination is given in the table which follows.

The terms used in the table require some explanation. Wiltshire bacon is made from well-fed hogs, weighing from 160 to 200 pounds live weight. Cumberland bacon is made from lighter and, generally, leaner hogs, and the side is cut differently. Thus, in Group I. all the hogs were heavy enough for Wiltshire bacon, but in Group II. only three of the hogs were suitable for "Wiltshires," and the fourth hog was cut into "Cumberlands." Where the tenderness is barely noticeable, the bacon may still pass as "number one selection ;" when there is decided tenderness, it must go into a cheaper grade ; but a really soft side is of very little value.

Table showing condition of bacon from the different groups.

Description of groups.	Condition of bacon.
Group I. 8 sides. Hogs had been running on stubble fields. Average weight at commencement of experiment, 118 lbs. Fed 6 weeks on corn meal and rape.	Wiltshires: 8 sides firm.
Group II. 8 sides. Same previous treatment as Group I. Average weight at beginning of experiment, 107 lbs. Fed 6 weeks on corn meal.	Wiltshires: 6 sides firm. Cumberlands: 2 sides firm.
Group III. 8 sides. Same previous treatment as Group I. Average weight at beginning of experiment, 104 lbs. Fed 6 weeks on peas, barley, and shorts.	Wiltshires: 4 sides firm. Cumberlands: 2 sides firm. 2 sides tender.
Group IV. 8 sides. Hogs had no outdoor exercise from time of weaning. Previous to experiment were fed wheat middlings and shorts, with skim milk. Average weight at beginning of experiment, 100 lbs. Fed 6 weeks on peas, barley, and shorts, with rape.	Wiltshires: 2 sides firm. 2 sides showing very slight indications of tenderness. Cumberlands: 2 sides firm. 2 sides soft.
Group V. 8 sides. Same treatment previous to experiment as Group IV. Average weight at beginning of experiment, 94 lbs Fed 6 weeks on corn meal.	Wiltshires: 2 sides firm. Cumberlands: 6 sides firm.
Group VI. 6 sides. Same treatment previous to experiment as Group IV. Average weight at beginning of experiment, 107 lbs. Fed 6 weeks on peas, barley, and shorts.	Wiltshires: 2 sides firm. Cumberlands: 4 sides firm.
Group A. 24 sides. Pure bred hogs, comprising two hogs of each of six different breeds. Purchased when from 7 to 9 weeks old. Kept in pens with small outside yards. Fed wheat middlings until Aug. 19; shorts and barley until Sept. 12; peas, barley, and shorts, until Oct. 24. See "Experiments with pure bred swine," Group A.	Wiltshires: 4 sides firm. 2 sides showing indication to tenderness. 2 sides tender. 2 sides soft. Cumberlands: 4 sides firm. 8 sides tender to soft.
Group B. 24 sides. Same as Group A. Same treatment and same meal ration as Group A, but fed whey with meal ration. See "Experiments with pure bred swine," Group B.	Wiltshires: 20 sides firm. Cumberlands: 2 sides firm. 2 sides tender.
Group C. 22 sides. Same as Group A. Hogs were allowed to run in a half-acre lot during whole of experiment. Lot furnished some grass until about the middle of August. Fed the same ration as Group A. See "Experiments with pure bred swine," Group C.	Wiltshires: 10 sides firm. 2 sides very slightly tender. Cumberlands: 2 sides firm. 8 sides tender to soft. Quality of Group C much superior to that of Group A as regards firmness.

A careful analysis of the results brings out some rather interesting points, though care must be exercised in drawing conclusions at this early stage of the investigation.

In the first place it will be noticed that the condition of the first three groups was generally satisfactory. The hogs fed on rape and corn meal and on corn meal alone all

produced firm bacon, while the only tenderness was developed in the group fed on peas, barley, and shorts. It is scarcely probable that this tenderness was due to the food, since only one hog was tender while the other three were remarkably firm. It must not be assumed that corn will not produce soft bacon, for it must be borne in mind that the hogs in these three groups were strong, fleshy hogs before the corn-feeding commenced, and that they had had an abundance of exercise up to the commencement of the experiment. It is fairly safe to assume, however, that neither corn nor rape will injure hogs that have been reared in this manner, but the influence of corn on very young animals is not shown in this experiment. Investigations in this latter connection are in progress

Passing on to Groups IV., V., and VI., which all received the same treatment previous to the commencement of the experiment, we find that tenderness is evinced in only one group, namely Group IV., which received peas, barley and shorts with rape. A logical conclusion would be to attribute the tenderness to the rape, but an objection to this conclusion is encountered when we refer back to Group I., where rape produced no injurious effect. Possibly the hogs in these groups, having had no exercise like those in the first three groups, were more susceptible to injury from rape feeding. Be that as it may, the point must be left for further investigation. In these groups, also, six weeks of corn feeding produced no bad results.

But the most striking comparisons are yet to be made. A glance at the condition of Group A shows it to be very bad indeed, while that of Group B may be called very satisfactory. The only difference in the treatment of these two groups consisted in feeding whey to Group B along with the meal, and giving Group A only water and meal. The difference in firmness is so striking that we are forced to the conclusion that whey tends to produce firm bacon.

Again, Group C, though it can hardly be called satisfactory, is decidedly superior to Group A in point of firmness. Both groups received the same ration, but Group C had the run of a half acre lot, while Group A had only the small yards outside of the pens. The outdoor feeding, therefore, proved more satisfactory than the inside feeding when the ration was the same. In spite of lack of exercise, however, the whey group was the best of the lot.

One more comparison remains. Until September 12th, Groups IV., V. and VI. were fed practically the same meal ration as Group A. They were also confined in pens, with even less liberty than Group A. From September 12th until the close of the experiment, Group VI. received exactly the same ration as Group A, but in Groups IV. and V. the rations were different after September 12th. It is therefore of interest to compare the condition of Groups IV., V., and VI. as a whole, with that of Group A. It will be seen that the firmness of these three groups is very much superior to that of Group A, a condition of affairs which is difficult to account for on any other basis than that the superior firmness of Groups IV., V. and VI. is due to the skim milk fed with the meal ration previous to September 12th.

A peculiar feature of the experiment is the much greater development of softness among the Cumberlands, or light, lean sides, as compared with the Wiltshires. From this it would appear that softness is more likely to result from under feeding and from marketing hogs too light and thin, than from marketing more matured and heavier hogs, even though they may be too fat. Thus, if the comparison of Groups A and C is made on the basis of the Wiltshire sides, there is a marked difference in favor of Group C; while in Cumberlands, Group A has the advantage. In justice to Group C, it must be borne in mind that the most unthrifty hogs among the pure breeds were purposely put into this group, because Group C was not used in comparing the gains of the different breeds, and at the time of marketing there were at least four hogs in this group which were decidedly too thin for slaughtering. For this reason it would be fairer to base the comparison of Groups A and C on the condition of the Wiltshire sides.

The principal points brought out in these experiments, may be summarized as follows:

1. Corn apparently produces no evil effects upon the firmness of bacon when used for finishing hogs that have plenty of exercise until they reach about 100 pounds live weight.

2 Neither does corn appear to have any bad effects when used for finishing hogs that have had no exercise, but have been fed skim milk with a mixed grain ration until they reach 100 pounds live weight.

3 What has been said of corn may also apply to rape, when fed with a two-thirds meal ration, though the evidence is somewhat conflicting on this point.

4. Hogs confined in pens and fed on wheat middlings during the early stages of growth, and on peas, barley, and shorts during the finishing period, have a marked tendency to softness.

5. Hogs given plenty of exercise, and fed as just described, produce firmer bacon than those confined in pens.

6. The evil effects arising from lack of exercise can be overcome by the judicious use of skim milk and whey. The amount of whey recommended, is from two to two and one-half pounds of whey to a pound of meal.

7. Whey and skim milk appear to have a greater influence than exercise in producing firm bacon.

8. Unthrifty hogs are more likely to produce soft bacon than growthy, well-fed hogs.

The points mentioned above are not offered as definite conclusions, for the investigation is only well begun. On the whole, however, there seems to be nothing in the results which might not reasonably be expected—a fact which adds to their value in no slight degree.

Acknowledgment. In concluding my report, I wish to acknowledge the assistance and co-operation of other departments, notably the Farm, Dairy, and Experimental departments.

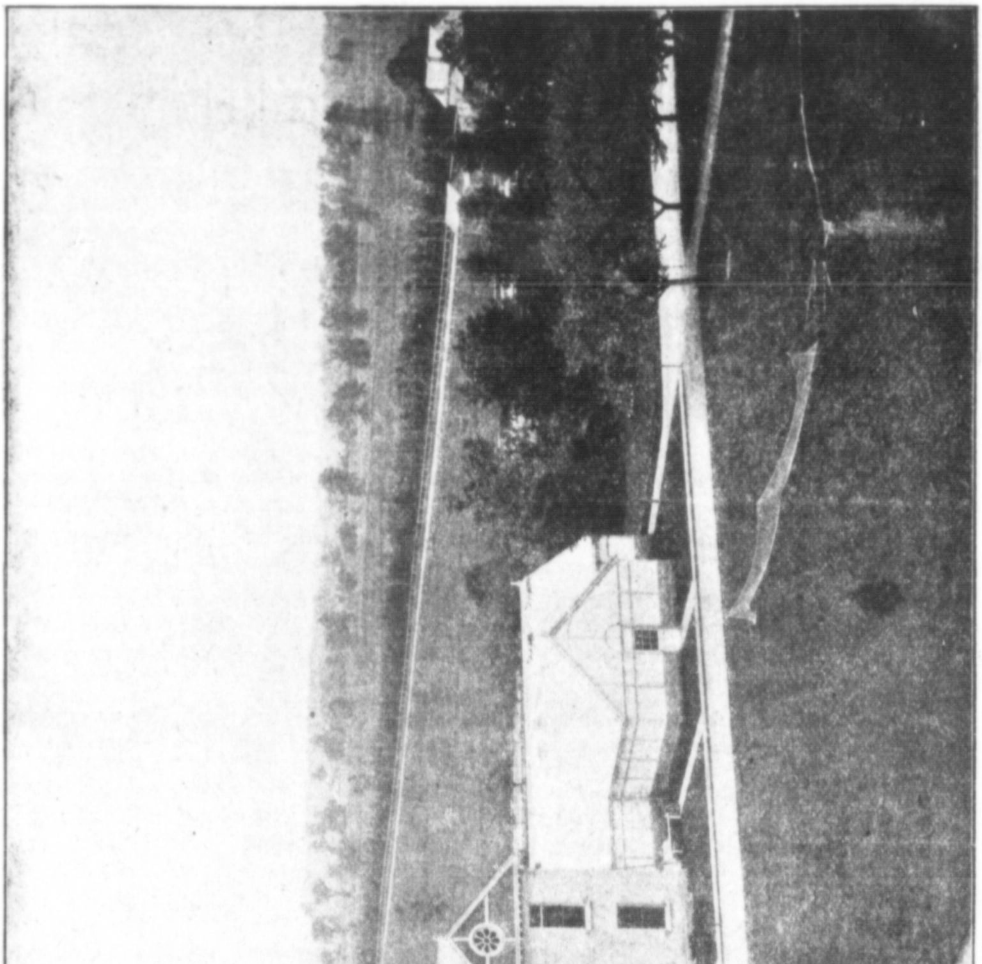
I have the honor to be,

Your obedient servant,

G. E. DAY,

Agriculturist.

GUELPH, Dec. 31st, 1898.



Botanical Laboratory and Greenhouse, O.A.C., Guelph.

Botanical Laboratory and Greenhouse, O.A.C., Guelph.

PART VIII.

REPORT OF THE HORTICULTURIST.

To the President of the Ontario Agricultural College:

Sir,—I have the honor of presenting herewith my sixth annual report of the work of the Horticultural Department. In doing so I take pleasure in noting the progress that has been made in this department during the past five years. Horticulture, from being an almost unknown subject in the College curriculum, covered by a few lectures and a single examination, has been developed into one of the most important departments of the College work, involving an extensive course of lectures, with laboratory and practical work, to students of the first, second and third years; a course in which graduating students now specialize for their University degree, and have to pass a number of examinations set by the College and University examiners in five branches of the subject.

Apart from the work of the class-room, the outside work of the department has been organized, systematized, and advanced in all its branches, and we are now getting into a position not only to be able to teach students more satisfactorily by practical illustrations, but to carry on experiments, the results of which must be of value to farmers, fruit-growers, gardeners, and florists throughout the Province.

The instruction to students has been given in lectures and in laboratory and practical work in the varied branches of the department. This part of the work has been increasing year by year, and during the past year the time taken with classes has been nearly seven times what it was when my duties began here five years ago.

Lectures. To the students of both A and B divisions of the first year lectures were given during the winter term, on the first principles in connection with the growth of trees and plants. Second year students received a full course of lectures, as outlined in the College circular, on Fruit-growing, Vegetable-gardening, Forestry, Landscape-gardening, and Floriculture. A more extended course in the same subjects was given throughout the year to those students of the third year who were specializing in Horticulture for their University degree.

Owing to the illness and death of our esteemed friend and fellow-worker, Prof. Panton, it fell to my lot to carry on, for the year, his work of teaching Entomology to the students of the second and third years. These courses were made as practical as possible, particular attention being given to those insects with which the farmer and fruitgrower have to deal. A short course of lectures was also given to the students of the Winter Dairy School, touching upon Fruit-growing, Floriculture and Entomology in connection with Dairying.

Practical Instruction. The studies taken up in lectures have been supplemented as far as possible by demonstration and practical work, during the afternoons, in the orchard, vineyard, small-fruit plantation, garden, greenhouses, and laboratory. This has been found to be the most satisfactory way of impressing lessons taught in the class and it enables students to acquire some degree of skill in the various operations, in addition to the theories upon which the operations are based.

OUTSIDE WORK. The regular work of this department, apart from that of teaching, is of a varied character, and includes the care and management of: 1, Orchards; 2, Vineyard; 3, Small-fruit plantation; 4, Vegetable garden; 5, Lawn and grounds; 6, Forestry plantations; 7, Conservatories and greenhouses. The work undertaken in each of these branches during the past year will be briefly noted in the order mentioned.

1. THE ORCHARDS.

In the young orchard set out a year ago, made up of apples, pears, plums, and cherries, the trees of most varieties have made an excellent growth during the past season. The pear, plum and cherry trees were given a slight winter protection by wrapping them in straw. This was thought to be advisable in this latitude for the first winter, but now that the trees seem to have become established, no further protection of the kind will be given. So far all varieties have come through the winter uninjured.

The cultivation of the orchard began as early as possible in the spring, which stimulated a vigorous early growth, and although the land was cropped with oats, a strip three feet wide on each side of the trees was kept thoroughly cultivated throughout the season until about the middle of August, when cultivation was stopped to allow the trees to mature their wood.

All vacancies caused by the failure of trees to grow were filled early in the spring The following additional planting was done with a view to finding out what can be accomplished in this section with some of the more tender fruits.

Quinces—20 trees, of 3 varieties: Orange, Champion, and Meech's Prolific.

Dwarf pears—20 trees, of five varieties: Beurre d'Anjou, Bartlett, Clapp's Favorite, Duchesse d'Angouleme, Flemish Beauty.

Peaches—20 trees, 10 varieties: Alexander, Barnard's Early, Crane's Early, Fitzgerald, Golden Drop, Hill's Chili, Ingold's Mammoth, Longhurst, New Prolific, Tyrhurst.

Upon our bearing apple trees there was an excellent crop of apples this year. Many visitors remarked that we had the best crop of clean apples they had seen anywhere, the whole secret of which was that the trees were regularly and thoroughly sprayed. Seven applications were made of the combined Bordeaux and Paris green mixtures, and as a result there was comparatively little scab and very few wormy apples.

2. THE VINEYARD.

This is not, and probably never will be, a good section for growing grapes, as the vines generally require winter protection, and as a rule only the earliest varieties get a chance to mature their fruit before the frost destroys the foliage.

Yet it is desirable that we should have vineyard enough to give our students practice in pruning, training, and caring for the vines, and to give information to the public as to what varieties can be most successfully grown in a section like this.

Our present vineyard consists of about 120 vines, which is altogether too few for our purpose, and it contains a number of varieties which are too late to come to maturity in this section. Already it has been found that varieties ripening with, or later than the Concord, do not mature a crop in more than one season out of four or five.

A new vineyard, which it is hoped will more nearly meet our requirements, was set out last spring. It is made up of 680 vines, and contains the following 18 varieties, all of which should ripen earlier than Concord:

Brighton	Early Ohio	Moore's Early
Brilliant	Green Mountain	Moore's Diamond
Campbell's Early	Hartford Prolific	Massasoit
Champion	Jessica	Moyer
Delaware	Lindley	Worden
Early Victor	Lady	Wyoming Red

3. Small-fruit Plantation.

In the small-fruit plantation set out in the spring of 1896, there were quite a number of failures, owing to the extremely dry weather after the time of planting. The following spring all vacancies were filled with plants of our own raising, and during the past season the plants have made an excellent growth. All pruning was done early in the spring. Cultivation was begun as soon as the ground was fit to work, and was repeated after every heavy shower till the fruiting season.

On most varieties there was an excellent crop, considering the age of the bushes. In the following tabular statements, full particulars are given regarding their fruiting this year, and column two shows their rank for total yield in 1897. Six good representative bushes of each variety were selected, and the crop carefully picked and weighed, the yields given below being the average per bush.

A large number of new varieties of raspberries, blackberries, currants and gooseberries have been obtained during the past two years. We are now propagating plants of these, and all others in our collection, with a view to setting a new plantation where plants of all varieties will be of the same age and growing under the same conditions.

Variety Test of Red Raspberries.

Rank in 1898.	Rank in 1897	Varieties.	First picking.	Last picking.	*Color.	Firmness	Size.	Yield per bush. (ounces)
1	6	Turner	July 7	Aug. 6	like C	S.	small	32.08
2	1	Shaffer	" 16	" 10	very dark	S.	large	30.50
3	2	Loudon	" 13	" 8	like C	V.F	large	29.37
4	4	Marlboro'	" 7	" 3	like C	F.	large	29.12
5	....	Columbian	" 20	" 10	very dark	S.	medium	23.71
6	5	Royal Church	" 16	" 10	dark	S.	large	23.54
7	10	Clarke	" 18	" 6	like C	F.	large	23.12
8	7	Highland Hardy	" 7	" 1	like C	S.	small	22.96
9	3	Cuthbert	" 16	" 10	light red	F.	large	20.17
10	8	Reliance	" 16	" 8	like C	F.	medium	17.75
11	11	Brandywine	" 18	" 8	like C	F.	large	16.46
12	9	Rancocas	" 7	July 27	like C	S.	small	15.58
13	....	Golden Queen	" 18	Aug. 6	yellow	S.	large	14 87
14	12	Hansell	" 7	" 3	like C	S.	medium	9.46
15	13	Thompson's Early.	" 7	" 1	like C	F.	medium	6 29

*Abbreviations used: like C.=like Cuthbert; S.=soft; F.=firm; V.F.=very firm.

Variety Test of Black Raspberries.

Rank in 1898.	Rank in 1897.	Varieties.	First picking.	Last picking.	Size of fruit.	Yield per bush. (ounces).
1	7	Mammoth Cluster	July 7	July 29	small	23.54
2	3	Older	" 9	" 25	very large	18.92
3	11	Gregg	" 16	" 29	large	18.54
4	2	Souhegan	" 7	" 25	small	17.21
5	9	Conrath	" 11	" 25	large	17 08
6	.....	Lucas	" 9	" 22	medium	15.87
7	10	Hilborn	" 9	" 25	medium	15.67
8	5	Ohio	" 16	" 29	small	15 17
9	1	Palmer	" 7	" 25	large	14.00
10	.....	Gault	" 11	" 25	large	11.62
11	6	Eureka	" 9	" 25	large	9.96
12	4	Carpenter's Early	" 7	" 23	small	8.17
13	.....	Cromwell	" 9	" 16	medium	7 00
14	.....	Hopkins	" 9	" 22	medium	6 31
15	12	Johnson's Sweet	" 7	" 18	very small	1.75

Variety Test of Blackberries.

Rank.	Varieties.	First picking.	Last picking.	*Firmness.	*Size of fruit.	Resistance to drouth (scale 1-10).	Yield per bush (ounces).
1..	Kittatinny	July 27.	Aug. 27	M	V.L	10	41.12
2..	Stone' Early	" 27	" 27	V.F	S	9	36.87
3..	Taylor	" 27	" 22	F	M	8	34.21
4..	Western Triumph	" 27	" 22	F	S	9	31.66
5..	Agawam	" 27	" 22	V.F	M	5	26.50
6..	Gainor	" 27	" 25	M	L	9	21.66
7..	Snyder	" 27	" 25	M	L	9	17.29
8..	Ancient Briton	" 27	" 22	F	M	7	14.62
9..	Lovett	" 27	" 22	F	M	4	10.44

*Abbreviations used: Firmness—M.=medium; F.=firm; V.F.=very firm. Size of fruit—S.=small M.=medium; L.=large; V.L.=very large.

Variety Test of Currants.

Rank in 1898.	Rank in 1897.	Varieties.	Color.	Size of berry.	Yie'd per bush. (ounces).
1....	3....	Lee's Prolific	black	large	16.12
2....	2....	Champion	"	"	15.46
3....	1....	Naples	"	"	11.04
1....	2....	North Star	red	small	36.33
2....	4....	La Versailles	"	medium	35.66
3....	1....	Raby Castle	"	"	35.50
4....	8....	Cherry	"	large	26.00
5....	5....	Fay's Prolific	"	"	22.50
6....	6....	Prince Albert	"	medium	22.33
7....	3....	Victoria	"	"	20.66
8....	7....	Belle de St. Giles	"	large	19.83
1....	1....	White Grape	white	large	42.00
2....	2....	White Imperial	"	"	24.00

Variety Test of Gooseberries.

Rank in 1898.	Rank in 1897.	Varieties.	Color.	Weight of 50 berries (oz.)	Mildew.	Yield per bush. (ounces).
1....	1....	Pearl	light green	6.25	none	66.66
2....	5....	Red Jacket	red	9.75	"	55.00
3....	3....	Downing	light green	6.00	"	53.00
4....	2....	Houghton	red	4.75	"	43.62
5....	4....	Champion	greenish white	4.25	"	22.66
6....	9....	Autocrat	green	10.25	"	16.62
7....	6....	Crown Bob	greenish red	8.50	slight	11.29
8....	8....	Smith's Improved	greenish yellow	7.00	none	10.00
9....	7....	Keepsake	red	16.75	slight	7.08
10....	11....	Industry	red	5.50	badly	4.75
11....	10....	Whitesmith	greenish white	12.25	"	1.92
12*...	.....	Dominion	green	10.50	slight	.29
13....	12....	Triumph	greenish yellow	10.00	"	.25

*One year old bushes.

Test of Varieties of Strawberries.

For the past three years we have been carrying on an extensive variety test of strawberries. In 1896, 121 varieties were fruited and reported upon. In last year's report, the results are given of a trial of 150 varieties. This year we have 219 varieties to report upon. The results of three years' trials have shown many of these varieties to be of little or no use, and twenty of the poorest were this year placed on our discarded list. On the other hand, the excellent yields maintained by some of our best varieties, enables us to recommend these with confidence to intending planters.

The treatment given in these experiments may be briefly outlined as follows: The ground on which the strawberries were planted was cropped the previous season with onions, beets, and carrots, during which time it was kept as free as possible from weeds. It was plowed in the fall after the removal of these crops, and top-dressed during the winter with short, barnyard manure. As soon as the land was fit to work in the spring it was plowed again, and put in as fine condition as possible with the harrow and roller. The rows were then marked out four feet apart, and cross-marked with a fifteen-inch hand-marker. Twelve plants of each variety were planted, each variety thus being given fifteen feet of a row. A space of thirty inches was left between the different varieties in the same row, to avoid any mixing of runners.

Those of the plants that were of our own growing were taken from the plantation set out the year before, which had not yet borne fruit. Such plants are much more vigorous and thrifty than plants taken from an old plantation which has fruited for one or more seasons.

The planting was done by means of a spade, which was thrust deeply into the ground and then pressed backwards and forwards. Into the cleft thus made the roots were spread out fan-shaped by a quick slapping motion, and the soil packed firmly about them by the feet of the planters. As soon as possible after planting the surface soil was loosened with the horse cultivator and hand hoes, and thorough cultivation was given through the season.

All blossoms were picked off the first season, so that the plants were not allowed to exhaust themselves in the production of fruit. All runners were allowed to set forming wide-matted rows, but each variety was confined to its own fifteen feet of row.

After the ground had frozen hard in the fall, it was lightly covered with long strawy manure, which helped to hold the snow and protected the plants from injury early in the spring by preventing their alternate freezing and thawing. When growth had commenced in the spring, this covering was raked off the plants and left as a mulch between the rows. This not being heavy enough to keep down the weeds and properly conserve the soil moisture, an additional heavy mulch of coarse grass was put on before the fruit began to ripen. This kept the berries clean and retained the soil moisture while the crop was ripening.

In the following tabular statement the varieties under test are ranked in the order of their yield. In some cases all of the plants set did not live; where only one or two failed, this would not materially alter their yields, particularly in the case of the free running varieties, as their runners filled the fifteen feet of row alloted to them. The greatest number of failures were among the newly added varieties which came from a distance. Many of these will, no doubt, make a better record next year, when their yield will be from plants of our own growing. The number of plants which lived is mentioned for each variety, so that allowance may be made for some good varieties, which, on account of the failure of some of the plants, stand low on the list.

Test of varieties of Strawberries.

Rank in 1898.	Rank in 1897.	Rank in 1896.	Variety.	Sex { B. Bisexual. P. Pistillate.	Number of plants lived.	Vigor of growth. Scale 1—10.	Freedom from rust. Scale 1—10.	Date of first bloom.	Date of first picking.	Date of last picking.	Yield.	Firmness.	Color.	Weight of 50 average berries.
								May.	June.		qts			ozs.
1	2	13	Stone's Early	P	12	10	9	20	17	July 8	268 75	S	L S	6.75
2	....	....	Clyde	B	12	10	9	18	15	" 6	263 75	F	L S	13.25
3	42	3	Edgar Queen	P	12	10	8	23	19	" 11	258.00	S	L S	12 75
4	57	6	Standard	P	12	10	8	23	18	" 6	205.75	F	C	6.75
5	....	....	Glen Mary	P	12	10	9	21	17	" 8	204 75	M	C	14.50
6	....	....	Sadie	B	12	10	6	16	13	" 6	198.00	F	C	4 00
7	....	....	Buster	P	11	10	9	23	18	" 8	197.00	S	B S	10.00
8	16	1	Warfield	P	12	10	7	17	15	" 6	195.50	F	D C	7.25
9	46	31	Williams	B	12	10	6	24	16	" 6	191.50	F	C	13.25
10	....	....	Mammoth	P	12	10	9	23	17	" 4	190.00	S	L S	18.50
11	....	....	Aney's Seedling	P	10	10	10	14	13	" 6	184.25	S	L S	10 25
12	3	8	Saunders	B	9	10	7	31	18	" 6	181.50	F	C	12.75
13	50	14	Boynton	P	12	10	9	16	13	" 6	179.00	M	C	8.00
14	9	....	Ruby	B	11	10	8	16	18	" 4	178 25	F	D C	11.00
15	72	67	Marshall	B	11	9	7	20	15	" 8	177.75	F	D C	19.25
16	49	41	Charlie	P	12	10	7	17	15	" 6	177.75	M	C	6.00
17	....	....	Lincoln	P	7	10	8	21	15	" 8	176.00	M	L S	6.75
18	....	....	Irene	P	10	9	10	21	17	" 6	175.00	V F	D C	8.25
19	19	35	Prince of Berries	B	12	9	5	19	18	" 8	170 25	S	R	8.00
20	44	34	Splendid	B	12	10	6	16	13	" 8	169.75	F	D C	6.75
21	....	....	Ridgeway	B	9	10	8	24	18	" 8	166.00	S	C	12.00
22	....	....	Wesley	P	12	10	7	16	15	" 4	164 00	F	L R	6.00
23	11	....	Dominion	B	12	10	6	20	18	" 11	162.50	S	L S	11.75
24	80	63	Beverley	B	12	10	8	19	17	" 6	162.00	S	D C	7.00
25	1	33	Tennessee Prolific	B	12	10	10	6	13	" 8	161.25	M	S	7.50
26	....	....	Giant	B	12	10	8	24	22	" 6	161.00	F	L R	11.25
27	....	....	Burt	B	11	10	6	20	17	" 8	159.75	F	B C	7.25
28	....	....	Manchester	P	12	10	8	20	13	" 4	158.75	F	C	7.25
29	35	54	Ohio Centennial	B	12	8	8	20	13	" 6	158.50	F	D R	10.25
30	....	....	Naomi	P	12	5	7	20	17	" 6	156.25	M	C	8.50
31	....	....	Satisfaction	B	12	10	6	19	17	" 6	154.00	F	B C	8.75
32	....	....	Holland	P	12	10	8	21	22	" 8	153 50	F	L R	5.50
33	....	....	Little's No. 39	P	12	9	8	20	22	" 8	144.25	M	R	11.00
34	36	22	Belle	B	12	10	8	21	22	" 8	142.75	F	S	8 75
35	66	70	Nehring's Gem	P	12	10	9	23	17	" 6	141.75	M	C	9 50
36	29	16	Lovett	B	12	10	8	20	15	" 6	140 50	F	C	11.00
37	83	2	Afton	P	11	10	7	19	13	" 4	139.75	F	D C	7 00
38	14	....	Liddle	B	12	10	8	20	18	" 6	138.00	F	C	5 00
39	95	88	Watson	P	12	8	4	19	15	" 6	138.00	F	C	7 75
40	26	15	Seedling A	P	12	9	6	17	15	" 6	136 25	S	C	6 25
41	5	52	Woolverton	B	10	9	8	20	17	" 6	136 00	F	L R	13 00
42	....	....	Sunrise	P	10	9	8	21	13	" 4	135.75	S	L S	9 75
43	8	9	Haverland		11	10	10	9	13	" 6	135.25	M	L S	9 00
44	15	26	Jocunda Improved	B	12	9	8	24	17	" 8	134.75	V F	D C	9.50
45	119	29	Martha	P	12	10	8	23	18	" 6	134 75	F	D C	11.25
46	21	37	Northern	B	12	10	7	21	15	" 6	133.25	F	C	10 50
47	39	....	Thompson's No. 40	P	11	10	9	23	18	" 6	126.25	M	L S	8.25
48	78	60	Sunnyside	P	11	10	6	21	18	" 4	124 25	S	L S	7 50
49	85	61	Timbrell	P	11	9	8	21	20	" 11	124.00	S	G R	7.75
50	74	50	Equinox	B	11	10	6	23	20	" 11	123.50	S	D R	6.75
51	....	....	J. C. Hale	B	12	10	8	20	17	" 4	123 25	F	D C	11 50
52	25	58	Princeton Chief	P	12	9	8	17	18	" 8	122.50	F	D C	6.00
53	105	11	Greenville	P	12	10	9	20	15	" 6	122.25	F	C	9.75
54	....	....	Early Idaho	B	12	10	7	20	15	" 6	121.25	F	D C	10.75
55	92	90	Jersey Queen	P	11	6	7	24	19	" 8	120.25	M	C	10.75
56	....	....	Sawlog	P	7	9	7	23	15	" 6	119 25	F	D C	9.25
57	62	86	Beder Wood	B	12	10	5	7	13	" 6	119 25	F	D R	4.75
58	91	73	Gov. Hoard	B	12	10	7	20	15	" 4	118.25	S	C	10 25
59	45	72	Hatch Expt. Station 24	B	12	10	7	23	20	" 8	118.25	F	C	9.00
60	.	....	Brandywine	B	12	10	6	21	17	" 8	118.00	F	D R	5 50
61	....	....	James Vick	B	12	9	8	23	18	" 8	118.00	F	C	6 00

Test of varieties of Strawberries.—*Continued.*

Rank in 1898.	Rank in 1897.	Rank in 1896.	Variety.	Sex { B. Bisexual. P. Pistillate.	Number of plants lived.	Vigor of growth. Scale 1—10.	Freedom from rust. Scale 1—10.	Date of first bloom.	Date of first picking.	Date of last picking.	Yield.	Firmness.	Color.	Weight of 50 average berries.
								May.	June		ozs.			ozs.
62	....	....	Kentucky	P	12	10	8	23	20	July 6	117.00	M	L S	6.50
63	....	....	Fountain	B	12	9	8	24	15	" 6	116.00	F	D C	10.50
64	....	....	Ostego	P	11	10	9	21	18	" 6	115.50	M	L S	8.25
65	....	....	Hayden	B	9	8	8	17	15	" 6	115.00	S	S	9.25
66	....	....	Great Pacific	P	12	10	10	20	13	" 4	114.50	M	C	10.50
67	....	....	Paris King	B	11	9	8	17	13	" 4	114.25	S	L S	8.75
68	104	56	Lady Rusk	P	12	10	8	21	17	" 4	114.25	M	C	7.25
69	64	21	Eureka	P	11	8	7	21	17	" 8	114.00	S	L S	9.75
70	7	....	Wm. Belt	B	12	10	6	20	15	" 6	113.75	M	C	11.25
71	....	....	Louis	B	11	9	7	23	18	" 6	113.00	F	B S	9.00
72	67	....	Kansas Prolific	B	11	10	7	20	15	" 4	111.75	M	C	5.00
73	....	....	Orange County	P	11	9	9	20	15	" 4	111.50	F	C	13.00
74	....	....	Edith	P	12	8	7	24	18	" 8	110.75	S	C	10.00
75	53	4	Bisel	P	12	9	7	20	17	" 6	110.25	F	D C	8.25
76	114	57	Mary	P	12	10	6	21	20	" 8	109.75	V F	L R	8.75
77	....	....	Parry	B	12	10	7	20	17	" 6	109.00	S	L S	8.25
78	58	68	Caughell's No. 2	B	12	10	5	20	15	" 6	109.00	S	D C	8.50
79	....	....	Carrie	P	12	8	9	17	17	" 6	108.75	M	L S	11.75
80	17	62	Aroma	B	12	8	10	25	18	" 4	108.50	F	L S	11.50
81	112	85	Alpha	P	12	8	10	16	13	" 4	108.25	S	L R	10.25
82	....	....	Sparta	B	12	10	4	16	13	" 4	108.00	V F	D C	7.50
83	12	47	Van Deman	B	12	9	9	14	13	June 30	108.00	F	D C	6.25
84	40	....	Cruse's No. 9	B	12	7	9	17	13	July 4	107.50	M	C	11.75
85	....	....	Bouncer	B	12	9	7	20	17	" 6	107.25	F	D C	10.50
86	....	....	Leviathan	B	12	10	9	23	17	" 6	107.25	S	L R	12.75
87	69	19	Gandy	B	12	8	8	17	17	" 4	107.25	F	C	8.00
88	10	40	Isabella	B	12	8	9	20	15	" 4	107.00	F	C	10.25
89	....	....	Thompson's Late	P	8	10	9	21	18	" 6	106.75	M	D C	7.75
90	13	....	Tubbs	B	12	8	8	16	13	" 4	104.25	S	L R	9.75
91	33	5	Prize	P	12	8	7	16	13	" 4	103.50	F	D R	6.00
92	82	....	Westlawn	P	11	10	8	20	15	" 4	102.00	F	D R	8.50
93	31	42	Howard's No. 41	P	12	9	6	20	17	" 4	101.75	V F	D C	8.50
94	....	....	Phipen	B	12	10	9	23	17	" 6	101.50	F	C	6.00
95	94	91	Parker Earle	B	10	9	6	17	13	" 6	100.25	F	D C	9.25
96	70	30	Robinson	B	12	10	7	20	18	" 6	99.00	S	D R	8.75
97	....	....	Princess	P	12	7	8	23	17	" 6	99.00	M	D C	10.25
98	76	9	Mrs Cleveland	P	12	10	8	17	13	" 5	98.75	F	C	5.50
99	84	77	Fremont	B	12	9	8	20	15	" 4	97.50	F	C	7.50
100	48	55	Dayton	P	11	10	9	20	13	" 4	96.50	S	L S	9.75
101	18	7	Barton's Eclipse	P	10	10	8	17	17	" 4	95.75	F	B C	10.00
102	102	89	Oberholtzer No. 2	P	12	10	6	24	20	" 6	95.50	F	D R	9.75
103	27	38	Enhance	B	11	10	9	20	17	" 4	95.25	V F	D R	9.75
104	....	....	Beede's No. 1	B	12	10	9	20	17	" 4	93.75	F	C	8.50
105	....	....	Champion of England	B	12	10	10	23	18	" 6	93.50	S	C	11.00
106	....	....	Longfield	P	10	8	8	16	13	" 4	93.25	F	D C	5.25
107	....	....	Michigan	B	12	8	6	23	20	" 8	93.00	F	D C	12.75
108	81	80	Scarlet Ball	P	12	7	9	25	24	" 8	92.75	F	L R	8.25
109	....	....	Maplebank	P	12	8	6	25	18	" 6	92.75	F	D C	8.75
110	....	....	Victor Hugo	B	10	8	6	19	13	" 6	91.75	S	D C	8.75
111	....	....	Annie Laurie	B	12	10	9	25	17	" 6	90.75	F	D C	11.50
112	20	....	Enormous	P	9	9	8	24	17	" 4	90.25	M	B C	11.25
113	86	106	Anna Forest	B	12	8	7	20	15	" 2	89.00	F	L S	11.25
114	37	....	Gandy Belle	B	10	7	5	21	13	" 6	87.25	F	D C	9.00
115	47	53	Snowball	B	12	10	6	19	15	" 6	86.50	F	C	6.50
116	....	....	World's Champion	B	8	8	9	25	17	" 6	86.50	S	D C	11.25
117	75	23	Gertrude	B	12	10	9	14	13	" 4	86.00	F	C	9.50
118	56	32	Dr. Arp	P	12	8	7	23	20	" 6	85.50	F	C	5.25
119	....	....	Sharpless	B	9	8	9	21	18	" 6	85.25	M	L S	9.50
120	89	71	Beauty	B	12	10	10	16	13	" 4	84.25	F	C	8.75
121	90	28	Crescent	P	12	9	9	14	13	July 4	84.25	F	C	5.50
122	23	....	Beebe	B	12	8	9	20	15	" 6	84.00	S	L C	17.50
123	101	41	Smith's Seedling	B	12	10	7	14	13	June 30	83.50	S	L R	3.75

Test of varieties of Strawberries.—*Continued.*

Rank in 1898.	Rank in 1897.	Rank in 1896.	Variety.	Sex { P. Pistillate. B. Bisexual.	Number of plants lived.	Vigor of growth. Scale 1—10.	Freedom from rust. Scale 1—10.	Date of first bloom.	Date of first picking.	Date of last picking.	Yield.	Firmness.	Color.	Weight of 50 average berries.
								May.	June.		ozs.			ozs.
124	59	43	Rio	B	12	10	7	16	13	July 4	83.50	F	C	9.00
125	51	20	Oberholtzer No. 1	B	12	7	9	9	13	" 4	83.50	S	C	9 25
126	....	....	Jay Gould	P	11	10	8	23	17	" 2	81.00	F	C	6.25
127	6	45	Shuster's Gem	P	12	8	8	11	13	" 6	81.00	F	S	6.75
128	30	....	Arrow	P	12	10	9	16	15	" 4	80.75	F	D C	5.25
129	68	69	Alabama	P	12	8	6	23	15	" 6	80.75	F	D C	8.00
130	100	24	Swindle	P	11	8	4	20	17	" 6	80.00	F	D R	10.25
131	41	51	Bessie	B	8	9	7	19	13	" 4	79.50	F	L S	8.00
132	4	17	No name	B	12	9	8	23	15	" 4	79.25	F	D C	8.75
133	....	....	Hiawatha	B	11	9	10	21	17	" 6	78.75	M	S	9.50
134	71	....	Epping	P	10	8	8	21	15	" 4	78.50	F	L R	8 00
135	....	....	Margaret	B	10	6	8	20	15	" 4	78 50	F	C	10.75
136	....	....	Gov. Fifer	B	12	10	9	19	18	" 6	77.50	S	L S	6.00
137	22	79	Judsonia	B	11	5	8	20	15	" 4	77.25	M	S	6.50
138	72	78	Ivanhoe	B	12	8	9	16	15	" 4	77.00	F	C	6.00
139	43	36	Southard	B	10	8	9	16	13	" 4	76.50	S	D C	9 50
140	54	27	Phillips	B	12	10	7	21	17	" 4	75 25	F	C	7 25
141	....	....	Plow City	P	12	5	9	16	15	" 6	75 50	F	C	8.50
142	..	...	Australian Everbearing	B	9	9	8	20	15	" 4	75.25	F	L S	11.50
143	....	..	Eleanor	B	12	10	9	19	13	" 4	74.75	M	C	7.50
144	....	....	Zulu	B	9	8	9	16	13	" 4	72.75	F	C	6.50
145	108	....	Kossuth	B	12	9	6	9	13	June 30	72 25	F	D R	3.25
146	96	....	Crimson Cluster	P	11	5	6	20	13	July 4	72.50	F	C	10.00
147	110	82	Glenfield	B	12	10	7	11	13	June 30	71.50	S	D C	5.50
148	124	99	General Putnam	P	11	7	8	9	13	July 2	70.25	S	L R	8.75
149	88	....	Jessie	B	11	8	9	14	15	" 4	68.75	F	C	9 75
150	....	....	Berlin	P	7	9	9	19	15	" 2	68.00	F	D C	7.50
151	93	....	Hersey	B	12	10	6	20	15	" 6	67.50	F	D S	4.75
152	24	87	Ona	P	11	9	8	11	13	" 4	67.00	F	C	7.00
153	....	18	Bubach	P	12	8	9	24	15	" 4	66.75	F	C	12 00
154	....	....	No. 1,000	P	8	6	6	23	18	" 4	66.50	F	D C	9 75
155	....	....	Hope	B	12	9	4	19	15	" 4	66 25	S	C	9 50
156	....	....	Anna Kennedy	P	12	10	7	21	13	" 4	65.50	F	B S	6.50
157	....	....	Lady Franklin	B	12	10	9	21	15	" 3	65 25	F	D C	9.00
158	....	....	Mytrotts	B	4	6	8	20	17	" 4	65.00	F	D C	6.75
159	125	83	Oberholtzer No. 4	P	12	10	8	21	22	" 6	64.25	V F	L S	7 75
160	32	39	Leader	B	12	7	8	19	15	" 6	64.00	M	D C	6.50
161	79	74	Klickita	P	12	9	5	20	17	" 6	64.00	S	L S	7.25
162	....	....	Cumberland	B	12	7	8	17	15	" 4	62.50	S	L S	10.75
163	61	46	Effie May	B	11	8	8	9	13	" 4	62.00	S	D R	6.75
164	63	48	Michel's Early	B	12	10	9	9	13	June 30	63.00	M	L R	3.50
165	....	....	Smeltzer	B	11	10	5	16	13	July 2	61.50	F	R	3 75
166	109	84	Stone's No. 7	P	12	10	4	19	17	" 4	58.50	S	C	9.50
167	....	....	Little's No. 7	P	12	4	6	20	15	" 4	58.25	M	D C	7.25
168	123	....	Howard's No. 25	B	11	9	7	17	15	" 4	58 00	M	C	6.50
169	28	65	Muskingum	B	11	6	8	20	17	" 6	58 00	S	D C	9.50
170	106	75	Farnsworth	B	11	8	7	16	13	" 4	56.50	M	L R	4.25
171	65	49	Cyclone	B	12	10	10	16	13	" 4	55.75	S	C	5.75
172	....	....	Child's 1st Season	P	11	7	8	25	20	" 6	55.50	V F	S	7.00
173	....	....	Royal City	B	12	7	8	20	19	" 6	54.00	F	D C	5.00
174	....	....	Della K	B	9	8	7	21	20	" 6	52.75	V F	D S	7.75
175	98	93	Wico nico	P	12	8	8	20	17	" 2	52.00	F	C	6.25
176	....	..	Erie	B	9	10	7	16	13	" 4	52.00	S	L R	4 00
177	116	117	Clark's Early	B	12	7	9	19	13	" 4	51.50	F	D C	5.50
178	....	....	No. 649	B	8	6	8	21	17	" 4	51.25	M	L S	8.50
179	....	....	Noble	B	9	7	5	19	15	" 4	51.00	F	D C	10.50
180	....	....	Lady Thompson	B	12	6	8	20	13	" 4	50.50	M	L R	6 50
181	120	....	Belle of Lacrosse	B	12	9	6	20	17	" 6	50.00	F	D R	5.50
182	....	....	Albert	B	10	6	5	25	22	" 6	49.50	M	L R	7.25
183	....	....	Sandoval	B	8	6	8	20	17	" 6	48.75	F	D C	7.75
184	....	....	Sensation	B	11	5	5	20	17	" 4	47.75	S	D C	19.00

Tests of varieties of Strawberries.—*Concluded.*

Rank in 1898.	Rank in 1897.	Rank in 1896.	Variety.	Sex { P. Pistillate. B. Bisexual.	Number of plants lived.	Vigor of growth. Scale 1–10.	Freedom from rust. Scale 1–10.	Date of first bloom.	Date of first picking.	Date of last picking.	Yield.	Firmness.	Color.	Weight of 50 average berries.
								May.	June.		ozs.			ozs.
185	77	12	Chairs	P	10	8	8	20	15	" 4	47.50	M	D R	6.25
186	87	....	Gillespie	B	10	5	7	20	15	" 4	44.50	M	C	4 25
187	....	..	Mineola	B	10	5	7	23	15	" 2	43.00	F	D C	10.00
188	....	....	Bismark	B	9	6	9	23	15	" 4	41.50	F	L R	6.25
189	103	94	Auburn	P	12	8	9	21	15	" 4	41.50	F	D C	8.50
190	....	....	Leroy	P	6	10	10	23	20	" 6	40.50	S	D R	3.50
191	....	....	Evans	B	10	6	9	20	17	" 4	38.75	M	L S	9.25
192	....	....	Gros Lombard	B	11	3	9	17	17	" 6	38,75	F	C	7.25
193	....	....	Hunn	P	4	7	8	20	24	" 6	37 00	F	D C	13.50
194	....	....	Cameronian	B	11	6	8	20	15	" 4	35.50	M	C	10.50
195	....	....	Brunette	P	5	10	9	21	17	" 6	35.00	M	D C	6.00
196	....	....	Huntsman	B	11	8	7	23	17	" 4	31.25	F	C	5.75
197	38	....	Hunt's No. 3	B	12	4	8	20	17	" 2	28.50	F	D C	5.00
198	....	....	Meek's Early	B	12	8	8	16	13	June 30	27.25	F	D C	3.00
199	....	.. .	Scarlet Queen	B	11	8	4	19	15	July 6	27.00	F	C	7.00
200	....	....	Columbian	B	12	10	7	18	15	" 2	25 50	S	D R	4.50
201	113	....	Edward's Favorite	B	12	2	7	21	15	" 4	23.50	M	D C	7.00
202	130	....	Steven's Early	B	9	6	4	12	13	June 27	21.00	F	D C	1.75
203	....	....	Pres. Carnot	B	11	3	5	17	18	July 4	20.75	M	D C	6.00
204	....	....	Slaymaker	B	6	7	7	14	13	June 30	20.50	F	D C	7.00
205	....	....	Ocean City	B	7	2	9	23	18	" 30	20.50	S	L S	7.00
206	.. .	....	Oriole	P	7	4	8	20	15	July 4	19 00	F	D C	8.00
207	....	....	Quality	B	11	9	10	23	18	" 2	18.75	M	L S	6.25
208	131	....	E. P. Roe	B	6	3	8	21	19	" 4	16.75	M	L R	9.00
209	118	114	Wentzel	B	11	4	8	9	15	June 27	16 50	F	D R	3.50
210	....	....	White Novelty	B	10	10	5	19	22	July 6	16.50	F	W	1.75
211	133	109	Regina		11	6	7	25	22	" 4	13.25	F	D R	5.50
212	....	....	Laxton's No. 1	B	10	5	3	18	13	June 30	12.50	F	D C	4.00
213	....	....	Beecher	B	12	8	9	25	20	July 4	10.50	S	S	6.00
214	139	104	Price	B	5	3	6	16	13	June 27	8.25	F	L R	3 50
215	....	....	Wilson	B	3	4	8	21	17	" 27	6.75	F	D C	6.50
216	142	.. .	Westbrook	P	12	3	9	14	13	" 27	6.75	F	D R	3.00
217	141	103	Accomack	B	12	2	8	21	15	" 30	4.25	M	C	7.00
218	....	....	Allen	B	3	4	9	11	17	" 30	4 00	F	C	5.00
219	....	...	Gunton Park	B	12	4	4	9	13	" 22	3.25	F	D C	3 00

By the term "vigor of growth" is meant the ability of the plant to send out runners and make a full matted row. On ordinary soils the most vigorous varieties, graded ten, might well be planted two feet apart in the row and yet make a full matted row.

Strawberry rust (*Sphærella fragariæ*) may be prevented or held in check by spraying with the Bordeaux mixture; but in our experimental plots the plants were not treated, our purpose being to find out the susceptibility of the different varieties to the disease. By reference to column 6 it will be seen that many of the most productive varieties are the most susceptible to it,

The date of bloom, as noted in column 9 should be carefully noted by planters who wish to select bisexual varieties to fertilize the bloom of pistillates. The former should, if possible, be a little earlier than the latter, to insure the fertilization of all early blossoms.

The yields are recorded in ounces, this having been found to be the most accurate method of recording results. The yield in boxes may be approximately ascertained by reckoning sixteen ounces to a box.

The abbreviations under the heading "*Firmness*" are:—F., firm; V. F., very firm; M., medium; S., soft; V. S., very soft.

Those under the heading "*Color*" are:—R., red, S., scarlet, C., crimson, and the qualifying adjective, L., light, D., dark.

The comparative size of the berries of the different varieties can be most accurately recorded by giving the weight of fifty average-sized berries. To ascertain this point the weighing of each variety was made at its midseason for fruiting, that is at its fourth or fifth picking.

In colums 2 and 3 are given the relative positions of those varieties fruited in 1896 and 1897, which had a full or nearly full stand of plants. The great change in position of many of these shows very clearly how little importance should be attached to the results of but a single test. It is only by the average of a number of trials that we can arrive at a reliable estimate of the value of a variety.

EARLY VARIETIES. In the following table a list is given of the ten varieties which gave the largest yield for the first week ending June 20th :

Rank.	Early Varieties.	Sex : P.—Pistillate. B.—Bisexual.	Date of first picking.	Yield before June 20th.	Total yield.	Rank for total yield.
				ounces.	ounces.	
1	Sadie	P	June 13	71.75	198 00	6
2	Van Deman	B	" 13	65.25	108 00	83
3	Paris King	B	" 13	57.25	114 00	67
4	Splendid	B	" 13	52.75	169.75	20
5	Sparta	B	" 13	52.00	108.00	82
6	Kossuth	B	" 13	48.75	72.25	145
7	Beder Wood	B	" 13	46.00	119 25	57
8	Smeltzer	B	" 13	46.00	61.50	165
9	Glenfield	B	" 13	44.50	71.50	147
10	Sunrise	P	" 13	43.75	135.75	42

LATE VARIETIES. In the following table a list is given of the ten varieties which gave the largest yields after July 1st :

Rank.	Late Varieties.	Sex : P.—Pistillate. B.—Bisexual.	Date of last picking.	Yield after July 1st.	Total yield.	Rank for total yield.
				ounces.	ounces.	
1	Edgar Queen	P	July 11	71.00	258.00	3
2	Scarlet Ball	P	" 8	60.75	92 75	108
3	Holland	P	" 8	58.50	153 50	32
4	Little's No. 30	P	" 8	57 50	144 25	33
5	Ridgeway	B	" 8	55 75	166.00	21
6	Dominion	B	" 11	54 00	162.50	23
7	Equinox	B	" 11	52.50	123.50	50
8	Belle	B	" 8	52.50	142.75	34
9	Buster	P	" 8	47.00	197.00	7
10	Timbrell	P	" 11	46.75	124.00	49

5. VEGETABLE GARDEN.

The plot of ground known as the vegetable garden is five and three-quarter acres in extent. Formerly nearly all of this was required to produce vegetables enough to supply the needs of the College. Since, however, the garden has been underdrained, subsoiled, and a system of close cropping and rotation of crops adopted, we have been able to devote four-sevenths of this area to our strawberry tests, and still grow enough on the remainder to supply an increased demand from the College.

In order to carry on systematically a rotation of crops, the garden has been divided into seven equal-sized plots. The crops grown on each plot is mentioned below, with a few particulars as to its condition.

Plot No. 1. *Early Potatoes and Sweet Corn.* These crops are gross feeders and readily make use of the decaying vegetable matter left in an old strawberry bed, which they follow every year.

Plot No. 2. *Strawberries kept for the second crop.* On the 10th of July, immediately after the last picking of berries, the old bed was turned under, the ground worked fine, and the following mixture of seeds sown for a leguminous catch crop: 1 bus. horse beans, 1½ bus. Prussian blue peas, and 8 lbs crimson clover per acre. Before these were turned under in the fall they had grown as follows: Crimson clover, 6 to 8 inches; horse beans, 2½ to 3 feet; peas, 4½ to 5½ feet. The horse beans stood erect and held up the pea vines until they were about 3 feet high, thus enabling the clover to get a good start.

A heavy crop of this kind, obtained without the loss of any regular crop, should be an economical method of adding fertility and friability to the soil.

Plot No. 3. *Strawberries bearing the first crop of fruit.* It is upon this crop that our record of yields is reported.

Plot No. 4. *Strawberries, new plantation containing 220 varieties.* These were planted this year on the 3rd of May. An extra good stand of plants has been obtained, which promises well for our variety test next year.

Plot No. 5. *Vegetable crops grown for their bulbs or roots, such as onions, beets, carrots, parsnips, and salsify.* Upon this plot all seeds were sown as soon as the ground could be worked in the spring. All of these crops were excellent, the root crops in particular being heavier than they have been for years past.

Plot No. 6. *Cabbage, cauliflower and celery.* The plants for these crops are first grown in seed beds or frames and are transplanted later in the season. These crops afford an excellent opportunity of easily cleaning the land for the crops of the preceding plot, which will be grown here next year. The celery and cauliflower were, without exception, the finest this year that we have ever grown.

Plot No. 7. *Upon this crop were grown all of the vine crops,* such as peas, beans, cucumbers, citrons, pumpkins, squashes, and tomatoes. All of these crops this year were above the average.

Test of Varieties of Tomatoes.

In view of the growing importance of the tomato crop, not only for home use but for canning and export, we conducted this year a small variety test with tomatoes; and, although but eleven varieties were included in the test, yet these are among those most commonly grown.

The treatment given may be briefly outlined as follows: The seeds were sown in flats in the greenhouse about the 1st of April. When the seedlings were about two inches high they were transplanted into boxes 1 ft. x 2 ft. x 3 in. deep, twenty one plants being set into each box. Care was taken to give them plenty of light, moderate heat, and to avoid excessive watering. The plants were thus kept vigorous and healthy and were not spindly or sappy. Early in May the boxes were set out in cold frames, where the plants were gradually hardened off by exposure to outside conditions whenever the weather would permit of it. Thus hardened, they were ready for planting as soon as our cold climate would allow. Every week a sharp knife was used to cut the soil in the boxes into blocks, making each plant well rooted in its own block, so that very little earth fell away from the roots when the plants were set out.

Planting is not usually safe here before the first week in June, and even after that this year we had to lay the plants down and cover them with the boxes to protect them from frost. The plants were set five feet apart in rows six feet apart, and were cultivated frequently to stimulate a rapid growth. As soon as the branches were long enough they were spread out in every direction and pressed close to the ground, in order that they might obtain all the soil heat possible. This we consider an important factor in obtaining early ripening, as the soil is usually from ten to fifteen degrees warmer than the atmosphere.

Thirty-five plants were grown of each variety, seven of each being selected for the test. The yields recorded below are the average per bush from these seven plants.

Variety Test of Tomatoes.

Rank for yield.	Varieties of tomatoes.	Date of first picking.	Average yield per bush of ripe fruit.	Average yield per bush of green fruit.	Yield before Aug. 15.	Yield after Sept. 15.	Weight of 20 average sized tomatoes.	Color.	*Smoothness.	*Firmness.	Amount of rot. Scale, 1-10.
			oz.	oz.	oz.	oz.	oz.				
1	Paragon	Aug. 20.	297.0	6.4	.....	114.0	7.5	Red....	S .	M .	1
2	Atlantic Prize	July 29.	280.7	3.4	22.2	18.7	6.2	"	S ..	M .	2
3	Early Ruby	Aug. 1.	270.7	4.4	13.8	33.4	6.5	" ...	M .	M .	2
4	Golden Queen	" 22.	266.4	7.7	.....	103.1	8.0	Yellow.	M .	M .	2
5	Earliest of All	July 26.	241.4	5.2	24.7	13.2	5.2	Red....	R ..	S ..	4
6	Dwarf Champion	Aug. 10.	200 0	4.7	5.0	47.0	5.5	Pink .	V.S	V.F	1
7	Aristocrat	" 8.	172.2	4.5	3.8	46.0	5.2	Red....	V.S	V.F	1
8	Buckeye State	Sept 7	149.1	7.1	...	75.2	7.5	Pink ..	S ..	F ..	2
9	Ignotum	Aug. 11.	124.8	4.2	1.2	40.5	6.7	Red....	S ..	M .	8
10	Livingstone's Beauty	" 25.	60.1	2.8	.....	17.5	7.2	Pink ..	S ..	F ..	2
11	Honor Bright	" 22.	40.5	5.7	.....	19.7	6 0	Red...	M .	S ..	10

*Abbreviations used:—R.—rough; S.—soft; M.—medium; S.—smooth; F.—firm; V. S.—very smooth, V. F.—very firm.

6. Lawn and Grounds.

Much has been accomplished during the past year in the way of permanent improvements on the lawn and grounds. A much-needed new drive has been made at the rear of the gymnasium; both sides of the long main drive on the east side of the grounds have been paved with cobble stones to prevent washing during heavy rains; screened gravel has been applied to main drives, to put them in good condition; a lot of levelling, grading, sodding, and seeding has been done about the new reservoir, at the back of the old greenhouses, over settled drains, and in a number of rough places on the grounds.

The concrete walk laid along the side of the front main drive has been a great convenience in getting from one building to another, particularly in wet weather; and it has been the means of materially improving the condition of the green sward surrounding the buildings by lessening the walking and wear upon it.

Some additional planting has been done in the shrubbery clumps; and a bed of roses was set out last spring, containing thirty of the leading varieties of the hardy hybrid perpetuals. This collection, it is hoped, will in time give students and visitors some idea of the most desirable sorts for the adornment of grounds.

Geraniums. In last year's report descriptive notes were given on about seventy varieties of geraniums for bedding. Since then our collection has been increased by about 200 varieties, obtained from some of the leading growers on this continent. All of these were grown side by side this year in our trial plots, and careful notes on them were taken throughout the season, a summary only of which can be given here, by mentioning some of the most desirable old sorts and some of the most promising new ones. Most of those mentioned in our last report as having given the best results have maintained the reputation there given them, and may again be mentioned here. These are as follows: *Scarlet*—General Grant, J. J. Harrison, Alfred Tennyson, Alfred Mame and Prokop Daubec. *Crimson*—S. A. Nutt and Sam Sloan. *Magenta Crimson*—Adrien Corret. *Pink*—Madonna and Mons de la Rue. *Salmon*—Mrs. E. G. Hill and John Good. *White*—La Favorite and White Swan. *Bronze-leaved*—Marechal MacMahon. *Silver-leaved*—Mad. Saleroi. *Golden-leaved*—Crystal Palace Gem.

Among the most promising of the new varieties are the following: *Scarlet*—M. A. Bouleaus, Garden Director, Ville de Poitiers, W. P. Simmons, Aceton, Director Marmy, Raspail Improved, C. Morel, M. A. Borie Aine, Marvel, Wm. Kelway and W. A. Chalfant. *Rose*—Phalene, Comtesse de Castries and La Contable. *Salmon*—Mrs. A. Blanc, Rodrigue, Blanche Moulas, Ruy Blas, Beaute Poitevine and Robt. Roland-Gosselin. *Pink*—Mary Hill. *White*—Mad. Buchner and Alpine Beauty.

Coleuses. Out of thirty named varieties of coleuses, grown in our trial plots this year, the following dozen have proven the most satisfactory for bedding purposes: Alhambra, Beckwith's Gem, Blackbird, Burning Bush, Firebrand, Firecress, Golden Bedder, Mosake, Pink Gem, Paroquet, Rob Roy and Shah.

Gladioli. The gladiolus is seldom classed among the bedding plants; but, nevertheless, a good collection of these beautiful flowers in full bloom makes one of the most attractive sights to be seen out of doors. And as an open air cut flower the gladiolus is unsurpassed. Out of about 150 of these grown this year, the following were some of the most attractive: Diamant, E. Souchet, Jubilee, Magenta, Magician, Sunshine, The Queen, Abbe Roucourt H. Veitch, M. de Vilmorin, Pacha, Dr. Regel, Goliath, Mrs. Beecher and S. Pellico.

7. Forestry.

The forestry experiment, in co-operation with the United States Department of Forestry, which was started last year, has been continued this year with seeds of nine different species, received from fourteen States.

Germination and Growth of Forest Tree Seedlings.

States.	Boxelder.	White ash.	Green ash.	Walnut.	Honey locust.	Hackberry.	Pecan.	Chestnut.	Burr oak.
Colorado	v.p.	.....	g.	n.	.....	.....	.....	.....	.....
	5.	.....	4	.....	.....	.....	.....	.....	.....
Connecticut	.....	n.	.....	v.p.	.....	p.	.....	.....	.....
	.....	.....	.....	5.	.....	4.4	.....	.....	.....
Dakato	v.p.	.....	v.p.	.....	.....	.....	.....	.....	n.
	3.3	.....	3	.....	.....	.....	.....	.....	.....
Indiana	n.	.....	.....	v.p.	.....	.....	.....	.....	.....
	.....	.....	.....	3.	.....	.....	.....	.....	.....
Iowa	g.	.....	n.	n.	.....	.....	.....	.....	.....
	7.1	.....	.....	.....	.....	.....	.....	.....	.....
Kansas	.....	n.	g.	n.	v.p.	v.p.	v.p.	.....	v.p.
	.....	.....	7.1	.....	3.7	9.5	3.	.....	2.
Missouri	.....	.....	.....	v.p.	.....	.....	n.	.....	.....
	.....	.....	.....	3.	.....	.....	.....	.....	.....
Nebraska	.....	.....	m.	v.p.	.....	.....	.....	.....	.....
	.....	.....	5.9	3.	.....	.....	.....	.....	.....
Pennsylvania	g.	n.	m.	n.	g.	v.p.	.....	n.	.....
	4.6	.....	4.	.....	5.8	2.	.....	.....	.....
South Carolina	v.p.	.....	g.	n.	p.	p.	.....	n.	.....
	8	.....	6.3	.....	7.6	4.5	.....	.....	.....
Tennessee	.....	n.	.....	v.p.	.....	v.p.	.....	.....	.....
	.....	.....	.....	3.	.....	5.6	.....	.....	.....
Texas	.....	.....	.....	m.	.....	v.p.	p.	.....	n.
	.....	.....	.....	5.	.....	6.	3.	.....	.....
Virginia	p.	v.p.	.....	v.p.	.....	.....	.....	.....	.....
	6.5	6.8	.....	3.	.....	.....	.....	.....	.....
Vermont	.....	n.	.....	.....	.....	.....	.....	.....	n.

Abbreviations used:—v. g.—very good, where seemingly all of the seeds sprouted.
g.—Good, " three-fourths "
m.—Medium, " one-half "
p.—Poor, " one-fourth "
v.p.—Very poor, " very few "
n.—None, " none "

The percentage of seeds which germinated was very low, owing, no doubt, to the drying which the seeds received before they were planted in the spring. If they could have been received and planted immediately after they were gathered much better results would have been obtained. The preceding table shows the States from which seeds were received, the species from each State, the amount of seed which germinated, and the average growth in inches of the seedlings the first year.

The seedlings of last season's growth were taken up early in the spring, and transplanted into nursery rows. The following table shows the average height of each species at the end of last season, and at the end of this. It will be seen that the walnuts, in most cases, were taller last season than this, which is due to their checked growth, after freezing down to the ground last winter.

States.	Box elder.		White ash.		Green ash		Black walnut.		Honey locust.		Hackberry.	
	1897	1898	1897	1898	1897	1898	1897	1898	1897	1898	1897	1898
Alabama	....	....	....	....	....	..	8.4	8.0	5.2	13.2	..	....
California	..	..	....	..	....	....	8.2	7.4	....	....	....	....
Colorado	5.8	12.3	..	..	6 8	13.7	....	....	..	....	....	....
Connecticut	....	....	3.0	8.0	....	..	..	....	....	....	4.4	....
Iowa	11.7	29.0	..	....	....	..	....	....	....	....	5.2	5.5
Illinois	8.8	29.3	3.0	....	6.3	5.0	2.0	....	....	....	....	....
Kansas	8.2	23.9	....	....	6.4	20 4	....	....	4.6	9.5	5.2	6.0
Kentucky	....	....	5.6	7.0	....	....	8.4	8.5	4.6	12.5	5.8	7.1
Nebraska	8.2	24.3	....	....	5.3	16.0	....	....	....	....	....	....
North Carolina	....	....	....	....	....	....	8.6	9.3	....	....	....	....
Ohio	8.8	21.4	....	....	....	....	....	....	3.8	6.5	4.2	5.0
Oklahoma	7.0	....	....	....	....	....	....	....	....	....	3.6	6.5
Ontario	11.0	19.6	4.0	11.8	....	....	7.6	6.5	5.6	9.3	....	....
South Carolina	....	....	....	....	....	....	10.8	11.8	....	....	....	....
South Dakota	6.4	17.4	....	....	6.0	17.0	....	....	....	....	....	....
Texas	....	....	....	....	4.2	9.0	....	....	....	....	3.8	....

8. Greenhouses.

Our collection of greenhouse plants has been increased year by year by additions from various sources, until it is now one of the finest and most extensive in the country. And it affords students and visitors an excellent opportunity of becoming familiar with a great number of useful and ornamental species.

Probably the finest floral display of the year in the greenhouses, is during the Chrysanthemum season. Our Chrysanthemum collection now numbers about 225 varieties, and includes all of the most important types. With a view to getting a concensus of opinion as to the most desirable varieties of the different types, the students were asked to go carefully over the collection when it was in full bloom, and make out a list of the varieties they would prefer for a home collection. In the lists sent in, as many as 90 different varieties were mentioned, the following being the most popular :

Japanese.—Philadelphia, Harry Sunderbruch, Maud Dean, Heron's Plume, Mrs. W. H. Robinson, Viviand-Morel, O. P. Basset, the Queen, Mrs. L. Allen, Autumn Glow, Georgina Pitcher, Pitcher and Manda, Waban, and W. H. Lincoln. *Japanese Quilled*—Iora, L. B. Bird, Kentucky, Mrs. W. H. Rand, Helen Bloodgood, and Good Gracious. *Japanese Hairy*—Mrs. Alpheus Hardy, Leocadie Gentils, R. M. Grey, Louis Boehmer, and Beauty of Truro. *Chinese*—Mrs. L. C. Maderia, Ideality, Cupid, Mrs. Col. Goodman and Major Bonnaffon. *Anemone*—Antonius, Falcion, Surprise, Condor, Mad. Robt. Owen, John Bunyan and Descartes. *Pompons*—Rose Travena, Golden Fleece and Black Douglas. *Single.*—Eucharis and Framfield Beauty.

Inspection of Fruit Experiment Stations.

In addition to my College duties, I have been responsible for the inspection and oversight of the work of the thirteen Fruit Experiment Stations now established in various parts of the Province, all of which were visited this year and were reported upon

to the Board of Control. These trips were made at different times during the summer from July to October, in order to visit each station at the most opportune time for seeing at maturity the particular kind of fruit grown there. At each station there is now an extensive collection of varieties of the fruits under test. The new plantations are becoming well established and valuable reports on the work are now being published, a full account of which may be found in the annual report of the Stations.

Co-Operative Fruit Testing.

The co-operative testing of small fruits, begun five years ago, in connection with the Experimental Union, has now become a work of considerable importance, and entails a lot of correspondence and office work upon this department. We have now on our books the names of about 500 persons to whom plants have been sent for co-operative testing during the past five years. During this time we have distributed 1,020 gooseberry bushes, 1,200 currant bushes, 1,560 blackberry bushes, 2,400 raspberry bushes, 2,400 black raspberry bushes, and 9,840 strawberry plants, making a total of 18,420 plants. The interest in the work is rapidly increasing, as may be judged by the constantly increasing number of applications for plants. For the past two years we have had twice as many applications as we could supply.

In order to give all a chance, and yet deal justly with all concerned, the circulars offering plants for trial last spring were sent out at intervals of about a week (1) to paid members of the Union, who are of course entitled to first choice; (2) to those whose applications arrived too late to entitle them to plants last year; (3) to all past experimenters who have duly reported on the plants sent them; (4) to any others who might wish to join in the work.

The plants were then furnished in the order in which the applications were received until the supply was exhausted. Instructions for conducting the various tests were sent to each experimenter before the plants were sent out from the nurseries, and blank forms were furnished upon which to report the results. The reports upon the growth of plants set out last spring, and also upon the yield of plants set out in previous years, were more satisfactory this year than they have ever been before, and it is to be hoped that they will improve from year to year as experimenters become more familiar with the work and realize the value of such tests.

A fuller account of this work with particulars as to the comparative yields of the varieties under test will be found in the annual report of the Experimental Union.

Meetings Attended.

During the month of January I attended Farmers' Institute meetings at the following places and delivered addresses on various horticultural topics: Jerseyville, Stony Creek, Smithville, Campden, St. Davids, Stevensville, Welland, Marshville, Rainham Centre, Nanticoke, and Vittoria.

Addresses on Floriculture and Window-gardening were given before the Orillia and Walkerton Horticultural Societies.

Two lectures were delivered before the teachers in training at the Normal School, Toronto—one on "Floriculture in the Home and School," and the other on "Beautifying School Grounds."

At the last annual meeting of the Ontario Fruitgrowers' Association, held at St. Catharines, I gave a report upon the "New and Seedling Fruits" received during the year. This will appear in the next annual report of that Association.

Just here I may add that I shall be pleased to receive samples of all promising new and seedling fruits, that they may be taken note of and be reported upon at the next annual meeting of the Fruitgrowers' Association.

Correspondence.

Tho extensive correspondence devolving upon the heads of the various departments of the College is one of the means by which the education of the College reaches out beyond the students in attendance The questions asked by correspondents are increasing from year to year. Last year the correspondence of this department was nearly doubled on account of the vacancy in the Biological Department, and its falling to our lot to answer the numerous questions relating to all kinds of injurious insects. The answering of such questions requires a good deal of time, and often much thought and research ; yet we hope this source of information will be more and more made use of by those interested, consequently we invite correspondence upon all branches of Horticulture, and we will endeavor to answer fully and clearly all questions sent to us. To do this work justice in the future, however, provision will soon have to be made for regular assistance in the office, which we trust will soon be arranged for.

Acknowledgements.

I beg to acknowledge with thanks the followings donations of this department :

F. W. Porter, Mount Forest, Ont.—Seedling gooseberry and currant bushes.

A. E. Sherrington, Walkerton, Ont.—Raspberry plants.

Geo. Nicol, Cataraqui, Ont.—Seedling dahlia.

Thos. Southworth, Toronto, Ont.—100 Burbank's " Royal Hybrid " walnuts.

The Spramotor Co., London, Ont.—Spramotor outfit No. 1.

Henry Gowling, Wandin Yallock, Victoria, Australia.—Strawberry plants.

W. O. Isaacs, Jamaica.—Seeds of several tropical species.

C. E. Farm, Ottawa, Ont.—24 varieties currants, 55 cannas, 13 coleuses, 9 hyd rangeaus, and 5 hybiscuses.

A. W. Peart, Freeman, Ont.—Collection of currant cuttings.

R. B. White, Ottawa, Ont.—Plants of three seedling raspberries.

E. H. Shuttleworth, Guelph, Ont.—Pumpkin seeds.

F. N. Pitts, Welland, Ont.—New style of hand hoe.

E. Cunningham, Guelph, Ont.—Plant of Farfugium grande.

Dr. E. Bromley, Barkerville, B. C.—Seeds of British Columbia blueberry.

My thanks are also due to the heads of the other departments who have rendered kindly assistance in various ways, and to the foremen and men of this department who have faithfully contributed their share towards making the work of the year a success.

Respectfully submitted,

H L. HUTT,
Horticulturist.

Guelph, Dec. 31, 1898.

PART IX.

REPORT OF THE BACTERIOLOGIST.

To the President of the Ontario Agricultural College:

SIR,—I have the honor to submit herewith my third annual report of the work done in my department.

TEACHING. Owing to the illness of Prof. Panton during the fall term of 1897, and his subsequent death, and also to the fact that all the special courses offered in the third year were filled, the teaching work of this department was exceptionally heavy during the session of 1897-98.

In brief, we may say that the instruction given was as follows:

Bacteriology. II. Year. A course of 26 lectures on bacteria and their relation to agriculture, dairying and the industrial arts; the disinfection of rooms, stables and buildings; the diagnosis of tuberculosis by tuberculin, etc.

Bacteriology. III. Year. Dairy Specialists. A course of 36 lectures on dairy bacteriology; the bacteriological analysis of milk, butter and cheese; pasteurization of milk; milk as an agency in the conveyance of disease, etc. These lectures were supplemented by laboratory practice, fifteen hours a week being devoted to the practical work.

Bacteriology. III. Year. Specialists in Bacteriology. A course of 60 lectures on the life-history of the bacterial cell; form and classification, requirements and chemistry of bacteria; staining; preparation of culture mediæ; pathogenic and non-pathogenic micro-organisms; preparation of toxins; immunity and serum-therapy. Laboratory work two afternoons a week during the fall term, and every day from two to five hours during the winter and part of the spring term.

Bacteriology. Special Dairy Class. A short course of lectures, with demonstrations, diagrams and lantern slides, for the special dairy class which comes here in January. In this class no laboratory work is attempted, except in pasteurization.

Vegetable Histology. A course of fifteen lectures and two afternoons of laboratory work per week during the fall term for all third year students. In addition, the specialists in biology and horticulture had an extra afternoon per week and more lectures.

Animal Histology. A course of seven lectures on the cell, and fifteen on animal histology, for the third year specialists in biology and bacteriology, together with one afternoon a week during the winter term for laboratory work.

Cryptogamic Botany and Plant Pathology. A microscopic study of the diseases of plants induced by cryptogamic parasites, with instruction as to remedies, collection, etc. This course is taken by the specialists in horticulture and biology, involving two lectures a week and two afternoons per week of laboratory work during the winter and part of the spring term.

The horticultural specialists take up a little of this work and have special lectures on those fungi which affect farm crops. They devote but one afternoon a week to laboratory work.

Systematic Botany. II. Year. Two lectures and four hours' laboratory work per week during the spring term were devoted to morphology—the study of seeds and seedlings, description and analysis of plants, etc. As this was a large class we had to divide it into two sections, thus increasing the work.

Physiological Botany. One lecture per week during the spring term for second year students.

Plant Breeding. A course of fifteen lectures on the origin of cultivated plants, evolution of modern varieties, laws of heredity, causes of variation, influence of environment, function of sex, crossing and hybridizing, to specialists in horticulture.

Of the work above outlined, Mr. Wm. McCallum, B.S.A., Fellow in this department, has taken the physiological botany, plant breeding and a portion of the cryptogamic botany. The rest of his time has been fully occupied in preparing material for the practical classes in histology; and I hereby acknowledge his efficient assistance.

Two lectures were delivered to the Normal School teachers in Toronto in October—one on "Bacteria and their relation to agriculture and dairying," and the other on the "Collection and preservation of insects, and the life history of a typical insect, with hints how to make the subject interesting to children."

From the above outline it will readily be seen that very little time has been left for research work, consequently but little has been done. It is hoped, however, that hereafter we may be in a position to add something to the store of knowledge.

CORRESPONDENCE. A large amount of information has been given by means of correspondence during the year. Inquiries have been made on many subjects, such as disinfection, taints in milk, tuberculosis, the temperature reactions of animals inoculated with tuberculin, foul brood, etc. In all about 800 letters have been received and answered. In addition to the foregoing, I have answered many letters relating to weeds and insects for the botanical department.

EQUIPMENT. It was thought advisable this year to remove the incubators and other apparatus used in the manufacture of tuberculin downstairs, so as to have it at some distance from the students' laboratory. The room in which this work is now done is connected by a staircase (built by the College carpenter) with the back of the laboratory. Several new and much needed pieces of apparatus have been added during the year—for instance, a cool incubator for gelatine cultures and a centrifuge.

LABORATORY WORK A number of examinations of milk, cream and cheese have been made for the Dairy department; and also of samples of various milk products, wax, blood, etc, sent or brought by different persons for examination and diagnosis. In such cases a written report has been sent to each inquirer, giving the results of the investigation. Nineteen samples of water have been bacteriologically analysed during the year.

SUMMER WORK As director of the committee of economic botany of the Ontario Agricultural and Experimental Union, I was engaged during the summer vacation in gathering information on weeds, making photographs, collecting weed seeds, etc. The results of this work will be published in bulletin form.

FRUIT PRESERVATIVES FOR EXHIBITION PURPOSES.

Early in the year 1897 I was asked several times for information regarding the best preservative to use in putting up fruit for exhibition purposes. On inquiry I found that there was very little reliable information on the subject: and Mr. L. Woolverton, M. A., Secretary of the Fruit Growers' Association, thought it would be a good plan to undertake some experiments along this line.

Fruit was collected and placed in various mixtures during the month of June, 1897, and the report made of these results in November, 1898, a period of one year and four months afterwards. Gooseberries, (red and white), Raspberries, Strawberries, Currants, (red and white), were the fruits selected; and over 25 different mixtures were tried.

The mixtures were made up with tap water, and the metric system was used for measuring and weighing the different substances used. For instance, with solid substances, like Boracic Acid, 2 per cent. means 2 grams of Boracic Acid in 100 cubic centimetres

of water, 2 per cent formalin means 2 cubic centimetres of formalin in 100 c. c. of water, and so on The syrup was made by dissolving 1 lb of sugar in a quart of water. The glycerine had a specific gravity of 1.260. The mixtures were not renewed in any case.

The formalin used was Schering's, as much of the formalin sold throughout the Province is not up to the required strength, and great care should be taken in ascertaining this important point.

It seems to be a very hard matter to find a mixture which does not take the color out of soft fruits, like strawberries or raspberries ; for the former, coal oil has been used very generally: but, judging from the exhibit in the experiment station's collection of fruits, we cannot speak of it as an ideal mixture, viz., a clear colorless liquid, which will preserve, for at least a period of one year, the color and shape of the fruit as it was when growing on the tree or bush. All the fruit herein referred to has been judged by the above standard as to color and shape.

The best mixtures for the different kinds are as follows :

For Raspberries,—Formalin 1 c.c. ; glycerine 10 c.c., and water 89 c.c. but this is not an ideal mixture as the color of the fruit changes somewhat.

For Strawberries.—Formalin 2 c.c., potassium alum 4 grains, glycerine 10 c.c., and water 100 c.c. The only objection to this mixture is the slightly yellowish tint of the liquid ; but the fruit in it is of a better color and firmer than fruit pickled in coal oil. For this fruit a saturated solution of common salt makes a fairly good preservative.

For Red Currants.—Several mixtures are fairly satisfactory, as may be seen by reference to the report in the following table. One of the best was 1 gram of mercuric chloride, 10 c.c. glycerine and 90 c.c. water.

For White Currants.—Two solutions did well ; one with mercuric chloride alone, and the other with mercuric chloride and common salt.

For Gooseberries.—A number of mixtures are satisfactory (see the detailed report in table) ; one per cent formalin gave very good results, as did also 2 per cent zinc chloride.

Further experiments are in progress with fruit grown in 1898.

Of course, it is hardly neccessary to add that fruit taken out of any of these mixtures is unfit for use ; many of the substances used, as mercuric chloride, are deadly poisons.

Fruit.	*Mixture.*	*Remarks.*
Raspberry—		
Cuthbert.	Acetic acid, 2 per cent. Gelatine, $\frac{3}{4}$ per cent. in water.	Shape, good. Color, bleached. Liquid, reddish.
	Boracic, 2 per cent. Gelatine, $\frac{3}{4}$ per cent. in water.	Shape, bad ; rather shrunken. Color, mottled. Liquid, murky.
	Formalin, 1 part. Chrome alum, 4 parts. Glycerine, 10 parts. Water, 100 parts.	Shape, good. Color, deep purple. Liquid, opaque. *Note.*—A good preservative, but opaque and therefore no good for exhibition.
	Acetic acid, 2 per cent. Glycerine, 10 per cent. in water.	Shape, good. Color, bleached. Liquid, pink but clear.
	Iodine in Potassium iodide, $\frac{1}{8}$ per cent. Glycerine, 10 per cent.	Shape, fair. Color, good. Liquid, dirty, with much deposit.
	Potass. alum, 2 per cent. Formalin, 2 per cent. Syrup, 5 per cent.	Shape, fair ; a little shrunk. Color, purple. Liquid, red wine color.
	Zinc chloride, 2 per cent. Glycerine, 10 per cent.	Shape, excellent. Color, bleached. Liquid, bright red and very clear.

Fruit.	*Mixture.*	*Remarks.*
Raspberry, Cuthbert	Boracic acid, 2 per cent. Glycerine, 10 per cent.	Shape, good. Color, bleached. Liquid, dirty red and liquid very bad.
	Formalin, 1 per cent. Glycerine, 10 per cent.	Shape, good. Color, purple red. Liquid, clear but red.
	Mercuric chloride, $\frac{1}{2}$ per cent. Salt, 2 per cent.	Shape, shrunk. Color, bleached. Liquid, dirty.
	Salicylic acid, $\frac{1}{2}$ per cent. Glycerine, 10 per cent.	Shape, good. Color, entirely bleached. Liquid, clear, yellowish red.
	Chromic acid, 2 per cent. Glycerine, 10 per cent.	Shape, very fair. Color, bleached. Liquid, much deposit.
	Saturated salt solution	Shape, shrunk a little. Color, purple. Liquid, red but clear.
	Mercuric chloride, 1 per cent. Glycerine, 10 per cent.	Shape, good. Color, bleached. Liquid, clear but colored.
	Calcium chloride, 10 per cent.	Shape, a little shrunken. Color, purple. Liquid, dirty and very red.
	Mercuric chloride, 1 part. Acetic acid, 5 parts. Water, 300 parts.	Shape, fair. Color, dirty. Liquid, clear yellowish red.
	Formalin, 6 parts. Syrup, 100 parts. Water, 200 parts.	Shape, fair. Color, purple. Liquid, deep red.
	Alcohol, 30 per cent. Glycerine, 10 per cent.	Shape, fair. Color, bleached. Liquid, yellowish red.
	Mercuric chloride 1 : 500. Syrup, 33 per cent.	Shape, fair. Color, bleached. Liquid, opaque.
Strawberry— Woolverton	Saturated solution of salt	Shape, somewhat shrunk. Color, fair, although some is lost. Liquid, yellowish red. *Note.*—A fairly good mixture.
	Acetic acid, 2 per cent. Gelatin, $1\frac{1}{2}$ per cent.	No good at all.
	Acetic acid, 2 per cent. Glycerine, 10 per cent.	Shape, slightly shrunk. Color, bleached. Liquid, clear, but light red in color.
	Zinc chloride, 2 per cent. Glycerine, 10 per cent.	Shape, good. Color, a little bleached. Liquid, clear, but yellowish red.
	Mercuric chloride, 1 per cent. Glycerine, 10 per cent.	No good.
	Alcohol, 30 per cent. Glycerine, 10 per cent.	Shape, fair, Color, bleached. Liquid, clear, but reddish.
	Calcium chloride, 10 per cent.	Shape, fair. Color, fair but somewhat bleached. Liquid, clear, but reddish. *Note.*—A fair mixture.

Fruit.	*Mixture.*	*Remarks.*
Strawberry— Woolverton.....	Salicylic acid, ½ gram. Glycerine, 30 c.c. Water, 200 c.c.	Shape, fair, but a little shrunk. Color, entirely bleached. Liquid, yellowish red, but clear.
	Chromic acid 2 per cent. Glycerine, 10 per cent.	A good preservative, but the mixture is opaque.
	Boracic acid, 4 grams. Gelatin, ¾. Water, 200 c.c.	Shape, good. Color, a little bleached. Liquid, somewhat precipitated.
	Formalin, ½ per cent. Chrome alum, 2 per cent. Glycerine, 10 per cent.	No good ; mixture is quite opaque.
	Formalin, 2 per cent. Potass. alum, 2 per cent. Glycerine, 10 per cent.	Shape, good. Color, darkened. Liquid, reddish, but clear.
	Formalin, 2 parts. Potass. alum, 4 grams. Glycerine, 10 parts. Water, 100 parts.	Shape, excellent. Color, very fair. Liquid, yellowish. *Note.*—This mixture is the best of the lot. Fruit has been in it 1 year and 4 months, and is still in a good state of preservation. It is better than coal oil, which is very generally used for preserving.
Red Currant— Victoria.....	Mercuric chloride, 1 gram. Acetic acid, 5 parts. Water, 300 parts.	Shape, somewhat shrunken. Color, bleached. Liquid, red.
	Iodine in potass. iodide ⅛ per cent. Glycerine, 10 per cent.	Shape, good. Color, very fair. Liquid, colorless and clear. A fairly good mixture.
	Formalin, 2 per cent. Potass. alum, 2 per cent. Syrup, 25 per cent.	Shape, shrunk. Color, very dark. Liquid, clear but reddish.
	Mercuric chloride, 1 part. Salt, 4 parts. Water, 200 parts.	Shape, good. Color, bleached. Liquid, yellowish but clear.
	Potass. bichromate, 1 per cent. Sulfate soda, ½ per cent. Glycerine, 10 per cent.	Shape. Color. Liquid. } Quite opaque.
	Acetic acid, 2 per cent. Glycerine, 10 per cent.	Shape, good ; a few split. Color, bleached. Liquid, yellowish but clear.
	Boracic acid, 2 per cent. Glycerine, 10 per cent.	Shape, good. Color, very fair ; slightly bleached. Liquid, clear, but slightly yellow. A very good mixture.
	Alcohol, 30 per cent. Glycerine, 10 per cent.	Shape, good. Color, darkened. Liquid, clear but yellowish.
	Formalin, 2 per cent. Syrup, 25 per cent.	Shape, shrunken. Color, dark. Liquid, colorless and clear.
	Mercuric chloride, 1 per cent. Glycerine, 10 per cent.	Shape, good. Color, good. Liquid, quite clear. A very good mixture ; fruit is very natural.

Fruit.	*Mixture.*	*Remarks.*
Red Currant—		
Victoria	Lime chloride, 2 per cent	No good.
	Formalin, 1 per cent	Shape, good. Color, darkened. Liquid, clear and colorless. This mixture is all right, except that the fruit is much darker than it should be.
	Chloral hydrate, 1 per cent. Syrup, 25 per cent.	No good.
	Chromic acid, 2 per cent.	Shape, fair. Color, bleached. Liquid, slightly colored but clear.
	Formalin, 1 part. Chrome alum, 4 parts. Water, 200 parts.	Opaque, but a good preservative.
	Salicylic acid ½ per cent. Glycerine, 10 per cent.	Shape, good. Color, somewhat bleached. Liquid, reddish yellow but clear.
	Calcium chloride, 10 per cent.	Shape, good. Color, unnatural. Liquid, slightly tinted but clear.
	Formalin, 2 per cent. Patass. alum, 4 per cent. Glycerine, 10 per cent.	Shape, good. Color, deepened. Liquid, colorless and clear. A good mixture.
White Currant—		
White Grape.	Formalin, 1 per cent. Glycerine, 10 per cent.	Shape, good. Color, darkened. Liquid, perfectly clear.
	Mercuric chloride, 1 part. Syrup 10 per cent. Water, 500 parts.	Shape, shrunken. Color, dark. Liquid, clear.
	Salicylic acid, ½ per cent.	Shape, good. Color, slightly changed. Liquid, clear.
	Boracic acid, 2 per cent.	Shape, good. Color, fair. Liquid, clear.
	Mercuric chloride, 1 part. Salt, 4 parts. Water, 200 parts.	Shape, good. Color, good (natural). Liquid, clear. A good mixture.
	Mercuric chloride, 1 per cent.	Shape, good. Color, natural. Liquid, clear. A good mixture.
Gooseberry—		
Downing.....	Formalin, 2 per cent. Potass. alum, 2 per cent. Syrup, 25 per cent.	Shape, shrunken. Color, natural. Liquid, clear.
	Boracic acid, 2 per cent. Gelatin, ¾ per cent.	Shape, good. Color, slightly bleached. Liquid, slightly colored.
Houghton.....	Formalin, 2 per cent.	Shape, shrunk. Color, good. Liquid, clear.

Fruit.	*Mixture.*	*Remarks.*
Gooseberry—		
Downing.....	Boracic acid, 2 per cent.....	Shape, good. Color, good, natural. Liquid. clear. A good mixture.
Houghton .....Mercuric chloride, 1 per cent..		Shape, good. Color, good. Liquid, clear. A good mixture.
Downing.....Formalin, 1 per cent		Shape, good. Color, natural. Liquid, clear. A good mixture.
Houghton	Mercuric chloride, 1 part. Salt, 4 parts. Water, 200 parts.	Shape, good. Color, slightly bleached. Liquid, clear.
Pearl	Zinc chloride, 2 per cent.....	Shape, good ; a few burst. Color, excellent. Liquid, clear. A good mixture.
Downing.....	Salicylic acid, $\frac{1}{2}$ per cent.	Shape, good ; a few burst. Color good. Liquid, clear. A fair mixture.
White Currant—		
White Grape	Mercuric chloride, 1 part. Acetic acid, 5 parts. Water 300 parts.	Shape, good. Color, yellow. Liquid, clear.
	Formalin, 2 per cent. Syrup, 25 per cent.	Shape, shrunk. Color, yellow. Liquid, clear.
	Formalin, 2 per cent. Potass. alum, 2 per cent. Syrup, 25 per cent.	Shape, shrunk. Color, good. Liquid, clear.
	Zinc chloride, 2 per cent. Glycerine, 10 per cent.	Shape, good. Color, very natural. Liquid, clear. A good mixture.
Gooseberry—		
Pearl	Iodine in potassium iodide, 1 per cent.	Shape, good. Color, not natural. Liquid, clear.
Houghton	Saturated salt solution. Mercuric chloride, a trace.	Shape, shrunk. Color, natural. Liquid, clear.
	Calcium chloride, 10 per cent.	Shape, some burst. Color, slightly darker. Liquid, clear.
Red Jacket	Acetic acid, 2 per cent. Gelatin, $\frac{3}{4}$ per cent.	Shape, good. Color, bleached. Liquor, slightly tinted.

Tuberculin.

During the year (1st December, 1897 to 1st December, 1898), 2,800 doses of tuberculin have been manufactured and distributed from our laboratory. The market price for the product is about 15c. per dose, and at this rate our tuberculin would have cost $420.

We now have facilities for making 15,000 doses a year ; and we have manufactured a small amount of mallein, but there has not been much demand for this product except from the North-west Territories.

This year our tuberculin has been sent out either concentrated or diluted at the option of the person applying. Many farmers seem to prefer it in the diluted form.

Water Analysis.

Recognizing the importance of both chemical and bacteriological methods of water analysis, we have thought it advisable to analyze by both methods all samples sent to the College, Therefore we wish to make the announcement that hereafter water will be analyzed in our laboratories both chemically and bacteriologically and no charge will be made for the analysis; but the sender will be expected to pay the express charges, and before any analysis is made a proper sample, taken according to the directions given below, must be sent; for unless excessive care is excercised in water-sampling, no faith can be placed on the analytical results.

Container. A large bottle of about half gallon capacity should be used, preferably one with a glass stopper. If a glass stopper is not used the bottle should at least be fitted with a *new* cork.

Preparation. The bottle should be thoroughly cleaned, scalded out with boiling water and then allowed to drain and cool.

Taking the Sample. If the sample is taken from a well the water should be pumped for about five minutes, or long enough to empty all the pump connections. If from a tap it should be allowed to run for ten minutes or so before the sample is taken. Water standing in pipes in a house is under very favorable conditions for the multiplication of bacteria, and if proper precaution is not taken an erroneous idea of the number present may be formed. If from a lake or stream, the sample must be taken some distance from the shore, by plunging the sampling vessel, say a foot and a half below the surface, so as to avoid surface scum, Samples should not be taken immediately after rain or a wind storm. Do not fill the bottle quite full, but leave a small space for possible expansion of the water. Cork and tie a piece of cloth over the neck to hold the cork in place. Do not use sealing wax.

Packing. The bottle should be packed in ice, if the weather is warm. During the winter, sawdust may be employed. The water should not arrive at the laboratory at any higher temperature than when the sample was taken.

Notification. Send a notice by mail, stating by what Express Co. you are sending the water and date when you shipped. Also give as fully as possible the history and source of the water, and remarks on the sanitary surroundings.

Note. On application a suitable bottle, properly prepared, will be sent to the applicant.

The Library.

The library is growing slowly, as I remarked last year, owing to the expense of most of the scientific works needed by the technical departments, the ever increasing number of journals and periodicals, and the small amount voted annually for the purchase of books. The library, especially, needs complete sets of periodicals; for instance, the Chemical department needs a set of Biedermann's Centralblatt für Aqukultur Chemie and a set of the Journal of the Chemical Society. The Botanical department needs sets of the Annals of Botany, the Journal of the Royal Microscopical Society, etc. The Bacteriological department sets of the Zeitschrift für Hygiene, Baumgeurten's Jarresbericht, etc.; and the Department of Physics, a set of Gebriete der Forschung in Aquiel Physik. The above and some other periodicals are greatly needed, as the reader meets many references to them which he is unable to verify. The change of the academic course from October-June to September-April and the lengthening of the three years to four, will have three effects on the different departments; and as they reflect on the library, I should like to point them out. Firstly. The heads of the departments will have a longer time for investi-

gational or research work. During the summer experimental work will be done, and before any such line of work is undertaken the library will be consulted, and it will, I am afraid, be a case of Tekel, Tekel—weighed and found wanting. For research or experimental work, a good library is of as much importance as a well equipped laboratory.

Secondly. By lengthening of the course the educational standard is raised, and the extreme specialization along a few lines of study during the fourth year will necessitate the use of a larger literature and more advanced works to encourage greater depth of study by intending graduates.

Thirdly. The more advanced character of the work will mean that the teacher has to be of better scholarship and more widely read in the subjects he teaches.

These reasons all urge for a better library, and a more modern library; and I trust that these suggestions may be taken into consideration when the annual estimates are made out.

We would record our appreciation for all our exchanges, notably those from the United States Department of Agriculture, the various State Experiment Stations, and the publications of many of the departments of agriculture of the British colonies and possessions.

Papers and Periodicals. The following are provided by the College for the use of the students in the reading room:

Daily Globe, Daily Mail and Empire, Guelph Daily Mercury, Guelph Daily Herald, Farmers' Advocate, Journal of Veterinary Archives, Gardening, American Gardening, Florists' Exchange, Review of Reviews, Scientific American, Nature, The Canadian Magazine, Appleton's Popular Science Monthly, and Live Stock Journal.

The following are provided by the Students' Literary Society: Outing, Cosmopolitan, Pall Mall, Argosy, Harper's, Munsey, McClure's, and Standard Magazines, and The Illustrated London News.

The following gives the list of exchanges:

Religious Papers: Presbyterian Review, Congregationalist, Christian Guardian, Evangelical Churchman, Northern Messenger, Canadian Baptist, Choir Leader,—sent free by the publishers,

Weeklies: The Weekly Times (Melbourne, Victoria); Montreal Witness, Family Herald and Weekly Star, Acton Free Press, and Weekly Sun.

Dairy: American Cheesemaker, Hoard's Dairyman, Chicago Produce, Dairy World (Chicago); The Dairy, Dairy World, (London, Eng); Molkerci-Zeitung, Milck-Zeitung, La Laiterie, Holstein-Friesian Register, Creamery Gazette, Jersey Bulletin, Jersey Hustler, Elgin Dairy Report, and The Canadian Cheese and Butter Maker.

Agriculture: Swine Breeders' Journal, American Swineherd, Farm Students' Review, Farm Journal, O. A. C. Review, Practical Farmer, Co-operative Farmer, Journal of Agriculture, Farmers' Gazette, American Cultivator, Farmers' Home, Livestock Report, American Agriculturist, American Horsebreeder, Skordemannen, Farm Stock and Home, Nor' West Farmer, Northwestern Agriculturist, American Sheep Breeder, Farmers' Review, American Fertilizer, American Fancier, Breeders' Gazette, Canadian Bee Journal, Canadian Entomologist, Canadian Horticulturist, Connecticut Farmer, Dakota Field and Farm, Farm, Field and Fireside, Farming, Field, National Single Tax, Nebraska Farmer, Ohio Farmer, Oregon Agriculturist, Practical Farmer, Prairie Farmer, Western Rural, Wisconsin Agriculturist, New South Wales Agricultural Gagette, Queensland Agricultural Journal, Agricultural Journal (Cape of Good Hope); Journal of the Jamaica Agricultural Society, Journal of Agriculture and Industry (South Australia); The Agricultural Gazette (Tasmania); The Journal of the Bureau of Agriculture (West Australia); and Bulletin des Séances de la Société Nationale D'Agriculture de France.

Books added to the Library During the Year.

Agriculture	65	Economics	2
Apiculture	15	Entomology	16
Bacteriology	24	Fiction	6
Biography	10	Forestry	2
Biology	23	Geology	17
Botany	37	Herdbooks	35
Chemistry	39	Hygiene	4
Dairying	3	Horticulture	29

Books added to the Library during the year.—Continued.

Literature	69	Reports	27
Mathematics	1	Sessional Papers	9
Ornithology	4	Theology	9
Poultry	13	Technology	3
Physics	13	Veterinary Science	18
Photography	2	Number of books bound	72

Some of the above were expensive works—for instance, Encyclopedia of Canada, (C. Hopkins); Warner's Library of the World's Best Literature, 30 vols.; Library of Historic Characters and Famous Events, 10 vols.; Queen Victoria, 5 vols.

In conclusion, I desire to acknowledge the meritorious services of A. T. Wianacko, B. S. A., and to testify to the fidelity and cheerfulness with which he has attended to his duties in the Library.

Respectfully submitted,

F. C. HARRISON.
Bacteriologist.

December 31st, 1898.

PART X.

REPORT OF THE EXPERIMENTALIST.

To the President of the Ontario Agricultural College:

SIR,—I have the honor of herewith submitting for your consideration the report of the Experimental department for the year 1898.

I am pleased to state that the work of this department for the past year has, on the whole, been quite satisfactory. The experiments throughout have been conducted with great care and accuracy. The writer has much confidence in the reliability, and in the real practical value of the results herein submitted, and hopes that they will be carefully studied by those engaged in the practical agriculture of Ontario. I have reason to believe that the work of this department is being appreciated more and more by the farming community. Since submitting the last Annual Report of this department, I have come into personal contact with a good many thousand farmers, in delivering about forty addresses at meetings of Farmers' Institutes and Agricultural Conventions; in accompanying about 25,000 farmers through our Experimental grounds; and in explaining our work, and illustrating the results therefrom at the Industrial Exhibition in Toronto last autumn, and I do not remember hearing a single complaint from any farmer regarding either our system of practical field experiments or the condition of our experimental grounds during the growing season. The aim throughout has been to do good work, and it is sincerely hoped that the results may prove of real practical value to the farmers of Ontario.

THE WEATHER. Maximum and minimum thermometers and a rain gauge are read at 8 a.m. each day, in order to determine the highest and lowest temperatures and the total amount of rain-fall for each month. The following table indicates the extreme temperatures, and the amount of rain which fell in each of the months from April until October inclusive, for the past summer:

Months.	Minimum temperatures.	Maximum temperatures.	Total amount of rainfall.
	Above zero. Degrees.	Above zero. Degrees.	Inches.
April	13	65	1.47
May	32	77	2.29
June	41	84	3.39
July	34	93	1.36
August	44	87	1.90
September	32	92	2.62
October	24	83	4.20

The figures in the foregoing table show that the highest temperatures were reached in the months of July and September, when the thermometer, which was placed according to directions issued by the Meteorological Service of Canada, showed readings of 93 and

92 degrees above zero, respectively. On the night of July 10th, a cold wave passed over a considerable portion of the Province; and although the minimum thermometer indicatd two degrees above the freezing point at the College, nevertheless, the effects of frost were seen upon tender plants on lower portions of the farm. Not much damage, however, was done to the crops in the Experimental department, as only one or two experiments showed any marked effects from the frost. It will be observed that there was a difference in the extremes of temperature of 59 degrees in the months of July and October, and of 60 degrees in the month of September.

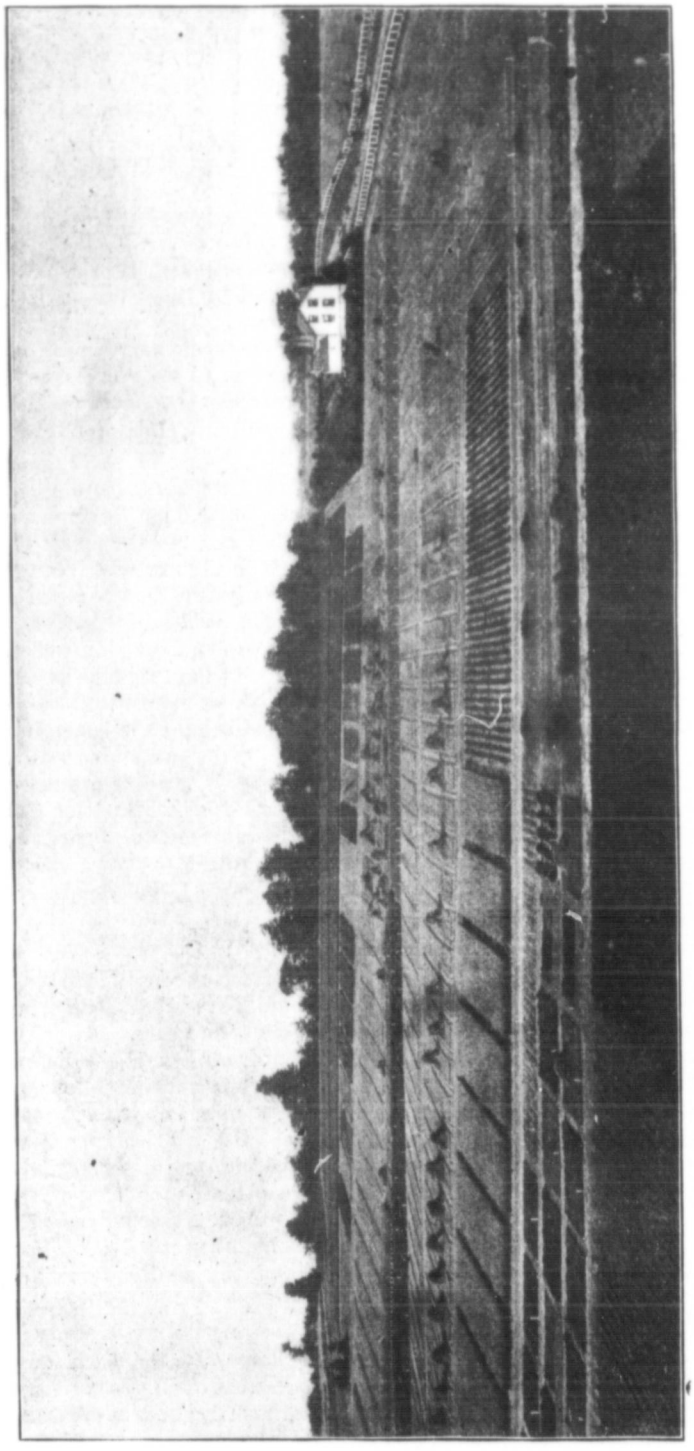
The smallest amount of rain-fall in any month during the summer was in July, when only about $1\frac{1}{3}$ inches of rain fell on the level, while in July of 1897 nearly five inches of rain fell. Hence it will be seen that the season was much more favorable for harvesting the crops in good condition in 1898 than in the previous year: 6.7 inches of rain fell during the three summer months of this year, while upwards of 10 inches fell in the corresponding season of 1897.

Experimental Plots. The section of land now used for experimental plots consists of about fifty acres, which is located north-east from the main college building. The land has a gentle slope to the south-west, and the soil is what might be called an average clay loam. The plots used in 1898 varied in size from $\frac{1}{4}$ to 1.160 of an acre, but the majority of them were uniform in both size and shape, being 10 links wide by 100 links long, thus forming an area of 1-100 of an acre each. The paths, 5 links in width, separated the grain plots from one another. There were, in all, upwards of 2,000 plots devoted to experiments of various kinds in the experimental grounds in 1898. This included experiments with varieties, selection of seed, dates of seeding, application of fertilizers, methods of cultivation, etc.

Grain Experiments. In all instances the grain plots were of a rectangular form, and a stake was driven at each of the four corners of every plot. In most cases the grain was sown broadcast. A line was drawn around the outside of the plots, and the packages of grain, which had been previously weighed out in the experimental building, were sown upon their respective plots inside the enclosure made by the line. When the crops reached an average height of about two inches the line was again placed around each plot, and all plants outside of this line were cut off. All those inside of the line were allowed to remain growing. This made the area devoted to each plot an exact fraction of an acre, and also made the different plots belonging to the same experiment exactly uniform in both shape and size.

The growth and special characters of the various crops were watched throughout the season, and the necessary notes taken from time to time. When each variety of grain reached the proper stage of maturity it was cut with a cradle, and, in order to have the work done with uniformity, the cutting was nearly all done by one man. As soon as the grain became sufficiently dry it was hauled to the experimental barn in a wagon with a tight rack made especially for the purpose. The whole crop was immediately weighed and thrashed, great care being taken that no grain was lost and that no mixing occurred.

Several new varieties of grain were imported from foreign countries in the spring of 1898. Within the past twelve years we have received leading varieties of grain from France, Germany, Italy, Sweden, Russia, England, Scotland, Hungary, Greece, Austria, Egypt, Japan, New Zealand, Australia, Switzerland, and the United States. These have been grown under the same conditions as those secured throughout the Dominion of Canada. Most of these varieties have now been carefully tested in the Experimental department for several years in succession. All varieties are grown for a period of at least five years, unless they show themselves very inferior within a shorter time. The ones which give the most satisfactory results are continued for a much longer period. In fact, a considerable number have now been grown for ten years in succession. Some of the varieties which have proved the most successful are now grown quite extensively throughout the Province, and are amongst the most highly prized grains under general cultivation. The leading varieties will be referred to when we are considering the results of the various experiments in the results to follow.



Experimental Plots at the Ontario Agricultural College Farm, Guelph.

EXHIBIT AT THE INDUSTRIAL FAIR. An exhibit from the Experimental department was placed in the Agricultural Hall at the Industrial Fair, Toronto, in the autumn of the present year, The chief objects of this exhibit were (1) To show in a general way the extent of our experimental work with varieties of grains at the Ontario Agricultural College; (2) To draw particular attention to the varieties which have given the best results; and (3) To illustrate the results from sowing seeds of different selections. The following quotations with reference to this exhibit are taken from two of our Agricultural papers:

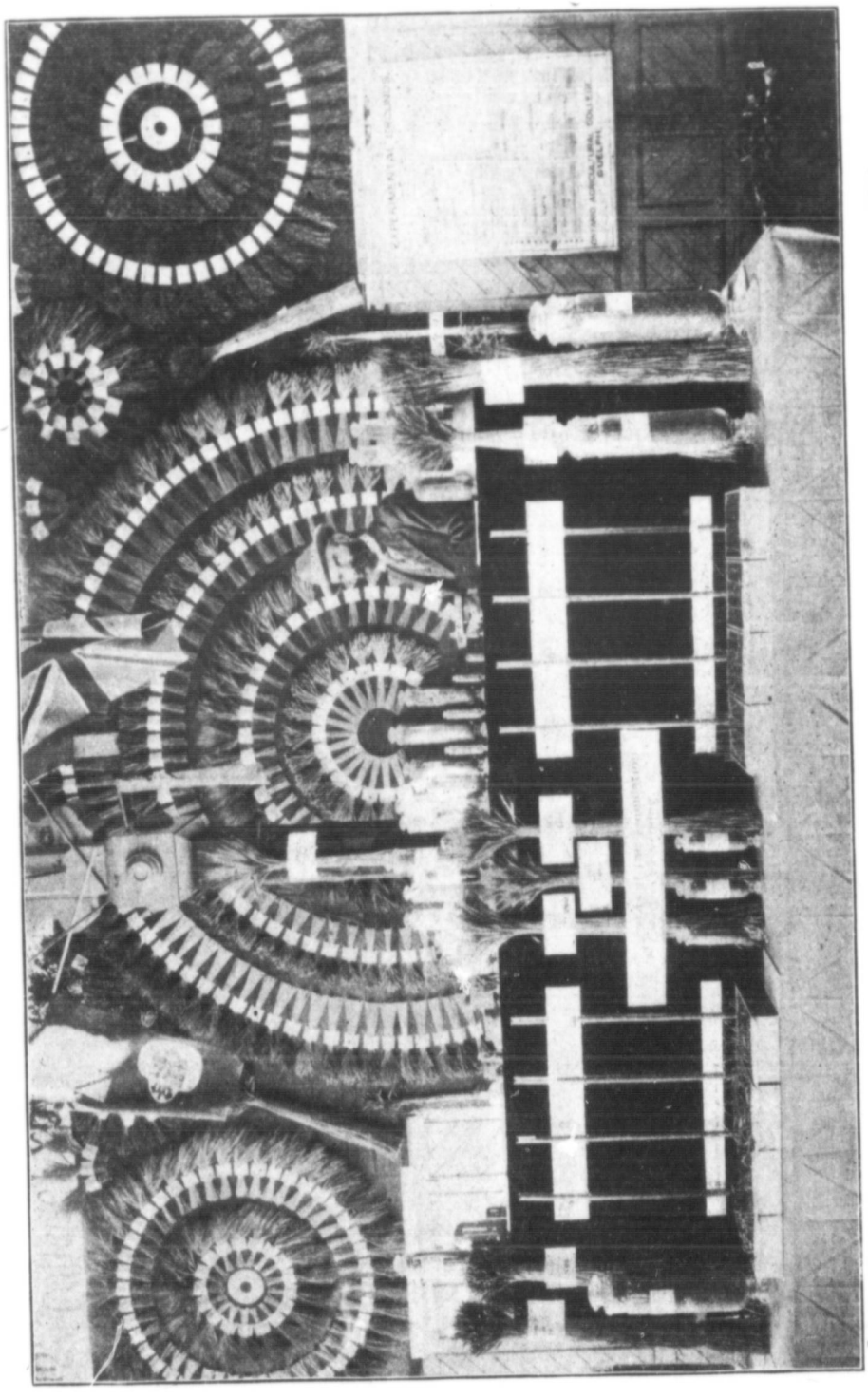
"Among the most interesting exhibits at the Fair were those of the Ontario Agricultural College. The exhibit in the Agricultural building was in charge of Mr. Zavitz, Experimentalist at the Farm, and consisted of an excellent display of grains in the straw, and arranged in the form of a circle at the south end of the building. In this display there were 160 varieties of spring and fall wheats, 80 varieties of oats, and 80 varieties of barley, and the arrangement of this was such as to make one of the most attractive exhibits on the grounds. . . . In addition to this, several tests were shown of the growth of good and poor seed, all proving conclusively that only the best quality of seed should be sown in any case."—"Farming," Toronto, Ont., Sept. 13th, 1898

"The authorities of the Ontario Agricultural College are preparing one of the most instructive exhibits ever seen in connection with modern agriculture. In Agricultural Hall, close to the Dufferin street entrance, there are being put up samples of practically all the grains sown in Ontario. In a place where they can be seen by all visitors, will be samples of the best varieties—as proven by tests at the College and through the Experimental Union—both in the ear and threshed. Not only this, but boxes of growing grain will be placed on view for the purpose of showing the relative value of good, bad and indifferent seed. Some of the boxes will show plants grown from plump seed; others from shrunken seed, and others again from broken grain, or grain injured by an insect. The boxes of growing plants in short, will show the relative value of all possible qualities of seed of the same variety. In addition there will be behind the boxes tubes giving the yeild per acre of the different qualities, and printed cards containing still more detailed information. The whole will be an object lesson in seed such as has never before been given in Ontario. The exhibit will be in charge of O. A. Zavitz, the College Experimentalist, one of the most efficient and enthusiastic exponents of modern agriculture in Ontario, and any information desired by visitors, in addition to that given by the exhibit itself, he will be glad to supply.—"" Farmers' Sun," Toronto, Ont., Sept. 1st, 1898.

BARLEY—COMPARATIVE TEST OF 34 VARIETIES.

In 1889, sixty-one varieties of barley, many of which were imported from foriegn countries, were grown side by side in the experimental grounds. The comparative tests of these varieties were repeated in each of the four following years. After the experiment had been carefully conducted for five years in succession, all the inferior varieties were dropped, and those which gave the best satisfaction were included in the experiments of the following years. Eight of these most promising varieties of barley were grown in the experimental grounds this year for the tenth season. Besides these, five leading varieties have been grown for nine years in succession, eight varieties for eight years, three varieties for seven years, four varieties for six years, three varieties for five years, two varieties for three years, and one variety for two years. The barley was all sowed broadcast at the rate of one hundred pounds of seed per acre on plots exactly 1-100 of an acre in size. Equal amounts were sowed on the different plots, and the seeding took place on April 16th of the present year. The land was manured in the spring of 1897, and produced a crop of turnips the same year.

The yield of barley per acre in 1898 was very large, the Mandscheuri producing as high as 77.6 bushels of grain per acre. The average yield of all the varieties was twenty-seven bushels per acre greater than in 1897, sixteen bushels per acre greater than in 1896, and eight bushels per acre less than in 1895. The weight of grain per measured bushel in 1898 was also high, the average being 53.3 pounds. This weight is over five pounds per measured bushel above the standard for barley, and is nearly four pounds per measured bushel greater than the average weight for 1897.



Ontario Agricultural College Exhibit of Cereals at the Toronto Industrial Exhibition, 1898.

The average yield per acre of the two-rowed varieties in 1898 was 65 bushels, and that of the six-rowed 67½ bushels. This shows an average of 2½ bushels per acre in favor of the six-rowed barleys. By examining the results of the two-rowed and six-rowed varieties for the number of years for which they have been grown, as indicated in the last column of the table, we find that, while some of the two-rowed varieties have given very good results, still, on the whole, the six-rowed barleys have given the best general satisfaction. In weight per measured bushel for the past year, the two-rowed barleys weighed on the average 1⅔ pounds more than the six-rowed barleys.

Varieties of Barley.	Number of rows per head.	Results for 1898.			Average results for number of years grown.		
		Weight per measured bushel.	Yield per acre.		Weight per measured bushel.	Yield per acre.	
			Straw.	Grain.		Straw.	Grain.
		lbs.	tons.	bush.	lbs.	tons.	bush.
Grown for Ten Years.							
1. Mandscheuri	6	52.75	2.12	77.63	50.86	1.83	**65.02**
2. Oderbrucker	6	53.75	1.97	68.08	53.31	1.64	**57.14**
3. Scotch Improved	6	53.25	2.05	72.85	52.14	1.53	**55.57**
4. French Chevalier	2	54.75	2.27	66.02	52.38	1.93	**54.82**
5. Empress	2	54.25	2.30	67.90	52.36	1.74	**53.51**
6. Common Six-Rowed	6	54 00	1.74	62.90	52.53	1.44	**53.33**
7. Two-Rowed Italian	2	52.63	2.41	70.35	52.67	1.95	**49.70**
8. Kinna Kulla	2	52.50	2.28	68.08	51.79	1.78	**48.99**
Grown for Nine Years.							
9. New Zealand Chevalier	2	53.88	2.24	66.08	52.60	1.98	**54.52**
10. Mensury	6	53.75	1.99	70.08	51.73	1.43	**53.05**
11. Early Minting	2	54 25	2.35	66.56	52.50	1.88	**52.84**
12. Australian	2	53.75	2.34	67.29	52.99	1.80	**51.00**
13. Italian	2	52.75	2.19	67.02	53.42	1.77	**48.27**
Grown for Eight Years.							
14. Imperial Six-Rowed	6	53.13	1.99	70.42	51.99	1.49	**58.23**
15. California Brewing	6	48 88	2.00	64.58	46.55	1 51	**57.56**
16. Six-Rowed Baxter's Improved	6	54.00	1 97	61.79	52.00	1 56	**54.07**
17. California Chevalier	2	54.00	2.56	59.04	52.29	2.04	**52.40**
18. Highland Chief	2	54.00	2.25	58.27	52.56	1.71	**50.65**
19. Duckbill	2	53.38	2.30	66.67	52 30	1.64	**48.84**
20. Salzer's California Prolific	2	53.88	2.27	62.85	52.41	1.61	**48.54**
21. Carter's Goldthorpe	2	54.25	2.26	59.12	52.16	1.86	**47.90**
Grown for Seven Years.							
22. Gold Foil Hansfords	2	54 00	2 77	65.90	52.64	1.98	**53.60**
23. Two-Rowed Canadian	2	53.00	2.33	65.56	52.05	1.70	**49.15**
24. Selected Canadian Thorpe	2	53.88	2.08	62.31	51 84	1.62	**45.93**
Grown for Six Years.							
25. Four-Rowed	6	53.38	2.10	72 85	51.58	1.41	**57.57**
26. Vermont Champion	2	56 63	2.29	68.00	53.93	1.75	**52.79**
27. Jarman's Selected Beardless	2	56.50	2.35	69.75	53.05	1.78	**51.87**
28. Jarman's Golden Champion	2	53.88	2.33	59.21	51.50	1.73	**40.78**
Grown for Five Years.							
29. North-Western	6	51.88	2.13	73.90	50.55	1.54	**53.49**
30. Scotch	6	52.63	1.98	67.52	50.62	1.49	**53.27**
31. Success	6	48.88	1.62	55.54	46.73	1.25	**36.25**
Grown for Three Years.							
32. Silver King	6	52 50	2.13	73.77	50.81	1.46	**51.99**
33. Manitoba Six-Rowed	6	52.63	1 84	65 06	51.46	1.35	**47.28**
Grown for Two Years.							
34. Dakota Silver Beardless	6	50.13	1.76	55.67	47.76	1.46	**45.26**

By an examination of the foregoing table, it will be noticed that the best yields have been produced by some of the varieties which have been grown for the greatest length of time at the College. In 1898, the Mandscheuri variety gave nearly four bushels per acre more than the next highest yielding variety. The eight varieties standing at the top of the list have all been grown on the same farm for ten years in succession without changing seed from other localities, or from other soils. It will be noticed that the lightest weight per measured bushel produced from any of the eight varieties grown for ten years

in succession is 52½ pounds, which is 4½ pounds over the standard for barley. The barley which gave the heaviest weight per measured bushel in 1898 was the Vermont Champion, which produced a grain that weighed 56.6 pounds per measured bushel, and an average of 53.9 pounds per measured bushel in the experiments of six years. One of the most important columns of figures is the one at the right hand side of the table, which gives the average yield of grain per acre for the number of years in which the varieties have been under experiment at the College. It will be seen from this column that the Mandscheuri has given decidedly the largest average yield, the average being a trifle over sixty-five bushels per acre for the ten years' experiments. The Oderbrucker, which is also a six-rowed barley, and stands second in the list of yield of grain per acre, has given an average of about eight bushels per acre less than the Mandscheuri; but, at the same time, it will be observed that the weight of grain per measured bushel is nearly 2½ pounds greater than that of the Mandscheuri in the average results for ten years.

Hulless Barley—Comparative Test of Eleven Varieties.

Five varieties of hulless barley were sown in the spring of 1898 for the ninth season in succession. Besides these, six other varieties, which have been tested in our experimental grounds for a less number of years, were also sown. As in the case of the two-rowed and the six-rowed varieties, the seeding took place on April 16th, on plots of exactly the same shape and size as those used for the two-rowed and the six-rowed varieties.

Varieties.	No. of rows per head.	Results for 1898.			Average results for number of years grown.		
		Weight per measured bushel.	Yield per acre.		Weight per measured bushel.	Yield per acre.	
			Straw.	Grain.		Straw.	Grain.
		lbs.	tons.	bush.	lbs.	tons.	bush.
Grown for nine years:							
1 Black Hulless	6	66.50	1.87	50.28	63.33	1.51	**40.41**
2 Guymalaya	6	62.00	1.91	48.07	58.46	1.44	**38.70**
3 Hungarian	6	62.00	1.85	46.67	59.29	1.53	**38.48**
4 Large Skinned	2	63.75	1.88	44.07	59.74	1.54	**33.64**
5 Three-Rowed	6	63.13	2.12	46.13	60.56	1.34	**28.87**
Grown for six years:							
6 Guy Mayle	6	64.13	1.59	50.47	61.45	1.37	**44.69**
7 Purple	6	66.50	1.84	50.48	63.32	1.64	**41.99**
8 Smooth hulless	6	63.00	1.85	41.67	60.28	1.57	**33.66**
Grown for five years:							
9 Winnipeg No. 2	6	63.00	1.96	44.68	60.07	1.71	**38.**
Grown for three years:							
10 New White Hulless	6	63.00	2.10	43.48	59.09	1.56	**29.88**
Grown for two years:							
11 Hog	2	63.88	2.25	50.97	60.19	2.02	**41.72**

The grain of the hulless varieties of barley resembles that of wheat or rye, weighing on the average about sixty pounds per measured bushel. We have therefore adopted sixty pounds as the standard weight per measured bushel in calculating the yields per acre. It will be observed from the foregoing table that all of the varieties produced grain in 1898 which weighed upwards of sixty pounds per measured bushel, and that two of the varieties produced grain which weighed sixty-six and a half pounds per measured bushel. These weights are certainly high. In the average results for the number of years grown, it will be seen that the Black Hulless and the Purple varieties each produced grain which weighed an average of sixty-three pounds per measured bushel. The average yield per acre of the eleven varieties grown in 1898 was nearly twenty-four bushels per acre greater than the average yield of 1897, and twelve bushels per acre greater than that of 1896. The Black Hulless variety, which stands at the head of the list in the yield of grain per acre, produces a grain which weighs remarkably well,

but possesses a straw which is very weak, and is apt to become badly lodged in many localities. The Hungarian variety possesses a straw which usually stands up well, and in that respect is a much more satisfactory variety to grow than the Black Hulless.

Barley—Broadcasting and Drilling at Six Different Dates.

An experiment has been conducted for four years in succession by sowing barley, peas, spring wheat, and oats on six different dates; and for three years the grain was broadcasted and also sown with a grain drill on each of these dates. The plots were all similar in size, and the same quantity of seed was used in all cases. The land used for this experiment in 1898 was manured at the rate of twenty tons of farm yard manure per acre in the spring of 1897, after which it produced a crop of potatoes in the same year. The crop on each plot was harvested when it reached its proper stage of maturity. The following table gives the average results of the experiments conducted for four years in succession with barley, and also the results of the experiment conducted in 1898.

Date of Seeding	Average results from different methods of seed ng		Average Results from Different Dates of Seeding.			
	Broadcasted or Drilled	Yield of grain per acre. Average 3 years 1896-98	Weight per measured bushel		Yield of grain per acre	
			1898	Average 4 years 1895-8	1898	Average 4 years 1895-8
		bus.	lbs.	lbs.	bus.	bus.
April 18—19 ...	Broadcasted	43.87	53.94	51.52	34.67	**46.27**
	Drilled ...	47 09				
April 22—25....	Broadcasted ..	48.61	53.38	51.66	40.04	**46.97**
	Drilled . .	45.46				
May 1—4.....	Broadcasted ..	35 47	52.97	50.25	30.04	**37.96**
	Drilled	37.29				
May 9—11	Broadcasted ..	28.36	50.69	47.59	23.80	**32.80**
	Drilled	33.68				
May 18.....	Broadcasted ..	23.09	49.19	46.36	24.91	**25.54**
	Drilled.	22.97				
May 25—29.....	Broadcasted ..	12.09	48.28	43.33	11.24	**14.45**
	Drilled	10.07				

The average yield of grain per acre produced from broadcasting the seed on six different dates is 31.9 bushels, and that from sowing the grain with a grain drill is 32.8 bushels, which is an advantage of about 1 bushel per acre in favor of sowing barley with the grain drill. The largest individual yield, however, was produced from sowing barley broadcast on the 25th of April, the yield in this instance being 48.6 bushels per acre. The lowest yield was produced by sowing the grain with a grain drill on the last date of seeding.

The results from sowing grain at six different dates for four years in succession showed the advantage of early seeding in the case of barley. In three out of the four years, there were only three or four days between the first and the second dates of seeding. The average results from the two first dates of seeding are quite similar, but a marked decrease both in yield per acre and in quality of grain took place as the season advanced from the second date of seeding. The yield of grain from the last date of seeding is less than one-third of that produced from the seeding which took place on the 18th and 19th of April. In the average of four years' experiment the best all-round results were reached from sowing barley on or about the 22nd of April.

Peas—Comparative Test of 52 Varieties.

Of the 52 varieties of peas which were grown in the experimental grounds in 1898, 41 varieties have been grown for at least five years in succession, and the remaining 11 varieties have been grown for a less number of years. Five new varieties were obtained

in the spring, and were sown in the experimental grounds in 1898 for the first time. The land upon which the peas were grown in the past season was an average clay loam, which was manured at the rate of twenty tons of farmyard manure per acre in the spring of 1897, and produced a crop of corn the same season. The seed of the different varieties was sown on April 27th, except that of the Crown, Lakefield, and Baltimore, which was sown two days later. The plots were exactly 1-100 of an acre in size throughout. The grain was sown with an ordinary grain drill having ten tubes—the tubes being 7.92 inches apart. The amount of seed used was regulated according to the size of the grain and the manner of growth of the various kinds, and varied from 2 to 4½ bushels per acre.

The fifty-two varieties of peas grown in 1898 gave an average yield of 24.4 bushels per acre, and an average weight per measured bushel of sixty pounds. This record is somewhat below the average of the past few years. The highest yields produced this year were by the following varieties: Waterloo 31.9 bus., Early Frame 31.1 bus., White Wonder 30.5 bus., and Tall White Marrowfat 30.2 bus. In the average results of eight years' experiments it will be seen that the White Wonder stands at the head of the list in yield of grain, producing an average of a little over thirty seven bushels per acre. The grain of this variety weighs very heavy; the average for the eight years being over sixty-three pounds per measured bushel. The White Wonder variety is best suited to a comparatively rich soil, as the straw is not so long as that of many other varieties. The seed was originally imported by the College from New Zealand. The Early Britain, which stands second on the list in yield of grain per acre among the varieties grown for eight years, was imported from England, and is giving very good satisfaction in the comparative results. It has been distributed throughout Ontario, in connection with the co-operative experiments, along with three other varieties in each of the past three years. When the returns were received from the different experimenters and the results of the successfully conducted experiments were summarised, it was found that the Early Britain gave the highest yield per acre of the four varieties sent out in each of these three years. As the Early Britain variety is slightly wrinkled, it does not give so large a weight per measured bushel as some of the smooth varieties. The foregoing results show that the Early Britain weighs 3½ pounds per measured bushel less than the White Wonder. It will be noticed that the Mummy variety, which stands fourth on the list in yield per acre, produced grain which weighed over sixty-four pounds per measured bushel in the average of eight years. The Chancellor variety of peas has now been grown in the experimental grounds for six years in succession, and stands at the head of the list in yield per acre among the varieties which were grown for the first time in 1893. It is a small white pea, and ripens about ten days earlier than the Golden Vine, and about two weeks earlier than the Prussian Blue variety. In the co-operative work throughout Ontario in 1898, the Chancellor came second in the list in the yield of grain per acre, the highest place being taken by the Early Britain.

Special attention is drawn to the first column of figures in the following table, as the injury caused by the ravages of the pea weevil (bruchus pisi) are enormous in some parts of the Province. In order to glean such information as we can regarding the injury caused by the pea-weevil to the different varieties of peas when sown side by side, we have closely examined the peas for the last two years, in order to find out the percentage of each variety which had been injured by the pea-weevil. The figures in the column give the exact percentage of peas which were infested with the pea weevil. From general appearance the peas would not indicate nearly so much injury done as is recorded in the foregoing table, as in many instances the weevil was still located in the central part of the peas, owing to the pea having been treated with carbon bisulphide as soon as possible after harvest, and before the weevil had done much damage. Among all the varieties of peas that have been grown during the last two years, the Oddfellow variety has been the freest from the ravages of the pea-weevil in each of these years. By a close examination of all the varieties of peas which we grow from year to year, we hope to obtain valuable information regarding the extent to which they are injured by the weevil. From our present knowledge, the Oddfellow and the Mummy are among the least, and the Nimble Taylor among the most affected.

Peas—Comparative test of 52 varieties.

Varieties of Peas.	Results for 1898.				Average weights for number of years grown.			
	Percentage of peas injured by weevil.	Weight per measured bushel.	Straw per acre.	Grain per acre.	Number of days from time of seeding until maturity.	Weight per measured bushel.	Straw per acre.	Grain per acre.
Grown for Eight Years:		lb.	tons.	bush.		lbs.	tons.	bush.
1 White Wonder (New Zealand)	20	62 75	1.49	30.45	92	63.38	1.16	**37.09**
2 Early Britain	49	58.63	1.36	26.30	98	59.89	1.24	**36.11**
3 Field (New Zealand)	29	60.50	1.13	29.95	124	61.83	1.25	**35.91**
4 Mummy	11	63.25	2.17	24.32	96	64.01	1.56	**34.93**
5 Brown (New Zealand)	44	55.75	1.32	24.20	98	59.16	1.45	**34.27**
6 Blue (New Zealand	36	60.25	1.57	26.10	92	62.28	1.18	**32.45**
7 Prussian Blue	40	60.38	1.54	25.27	100	62.19	1.55	**32.29**
8 Glory	36	61.00	1.02	26.07	96	61.34	1.19	**31.94**
9 Princess Royal	35	58.75	1.26	21.20	96	60.15	1.18	**31.68**
10 White-Eyed Marrowfat	43	61.38	1.58	25.55	100	62.14	1.43	**31.20**
11 Early Race Horse	45	58.50	1.39	28.67	98	61.28	1.21	**30.72**
12 Black-Eyed Marrowfat	50	60.13	1.42	24.20	98	61.43	1.34	**30.16**
13 Multiplier	42	60.25	1.97	21.12	107	61.79	1.61	**28.26**
Grown for Seven Years:								
14 Tall White Marrowfat	54	58.88	1.65	30.15	98	61.50	1.58	**34.51**
15 New Canadian Beauty	36	61.00	1.45	26.58	97	62.09	1.38	**31.03**
16 Canada Cluster	23	61.25	1.53	25 75	96	62.88	1.48	**30.87**
17 Golden Vine	33	62.38	1.50	27.55	104	62.25	1.23	**30.05**
18 Centennial White	43	60.75	1.55	24.30	104	61.53	1.33	**29.93**
19 Potter	40	60.13	1.60	28 43	96	61.40	1.31	**29.82**
20 Cleveland's Advancer	46	61.25	1.74	27 03	104	61.33	1.40	**29.24**
21 Royal Dwarf Marrowfat	39	60.38	1.45	22.40	104	61.40	1.40	**29.22**
22 McLean's Advancer	40	61.13	1.24	25.33	96	56.44	1.04	**28.81**
23 Sword	49	59.75	1.42	22.78	104	61.73	1.38	**28.31**
24 Scotchman	34	61.50	1.19	16.28	104	62.44	1.71	**27.56**
25 Canada Field	45	61.25	1.78	23.07	105	61.55	1.41	**27.02**
26 Prince Albert	45	60.75	1.57	17.65	107	61.92	1.55	**26.85**
27 Striped Wisconsin Blue	42	61.00	1.70	17.63	104	62.51	1.56	**24.44**
28 Oakshott Field	62	53.00	1.90	15.93	105	54.30	1.67	**22.53**
29 Pride of the North	37	59.00	.87	6.77	98	59.65	.98	**19.30**
Grown for Six Years:								
30 Chancellor	54	57.50	1.29	20.37	96	62.35	1.30	**32.35**
31 Common Grey	29	59.13	1.67	23.52	98	58.84	1.42	**31.62**
32 William 1st	64	56 38	1.29	19.63	100	58.56	1.09	**31.54**
33 Nimble Taylor	65	54.88	1.26	18.83	100	58.59	1.31	**31.40**
34 D'Auvergne	36	60.25	1.72	29.32	98	61.77	1.22	**31.09**
35 Nine Pod	41	58.00	1.60	20 15	100	59.31	1.41	**31.05**
36 White Imperial	34	61.38	1.74	28.60	98	61.33	1.38	**29.28**
37 Early June	36	61.13	1.44	22.82	100	62.11	1.36	**29.11**
38 Tall Turkish	40	60.63	1.64	24.62	96	60.91	1.26	**28.91**
Grown for Five Years:								
39 Improved Grey	55	57.63	1.61	27.13	98	59.16	1.18	**32.17**
40 Crown	34	60.13	1.68	26.57	96	60.09	1.34	**29.73**
41 Coffee	32	60.13	1.72	17.77	99	60.11	1.48	**23.00**
Grown for Four Years:								
42 White Hundredfold	39	59.50	1.58	28.13	100	61.38	1.47	**35.60**
Grown for Three Years:								
43 Lindsay	54	55.13	1.75	29.85	96	55.60	1.28	**26.50**
44 Waterloo	44	55.13	1.72	31.90	96	55.21	1.18	**24.27**
Grown for Two Years:								
45 Harriston Glory	37	60.63	1.47	26.15	99	62.07	1.29	**29.63**
46 Elephant Imperial Blue	41	59.25	1.52	27.63	99	61.38	1.16	**27.57**
47 Oddfellow	10	64.75	1.53	19.02	98	65.07	1.25	**18.00**
Grown for One Year:								
48 Early Frame	27	62.00	1.04	31.12	99	62.00	1.84	**31.12**
49 California Creeper	25	62.00	1.95	26.82	104	62.00	1.95	**26.82**
50 Bismark's Hog Food	21	62.50	2.03	26.63	104	62.50	2.03	**26.63**
51 Lakefield	13	64.00	1.85	25.75	98	64.00	1.85	**25.75**
52 Baltimore	30	60.88	1.72	22.96	101	60.88	1.79	**22.96**

For three years in succession the peas grown in the Experimental department have been treated for the pea weevil as soon as possible after harvesting. We used carbon bisulphide for this purpose in each of the three years, and as the results proved very satisfactory, and a number of our readers may not have seen any bulletin on this subject, I give a very concise summary of the treatment of weevily peas which is simple in method and effectual in results. The treatment which we recommend from our three years' experience is as follows: The peas containing the weevil should be placed in a comparatively air-tight box, barrel, bin, or room, either in bulk or in cloth bags. Flat dishes should then be placed on top of the grain, and after the carbon bisulphide is poured into them, the compartment containing the peas should be closed and allowed to remain undisturbed for forty-eight hours, in order that the vapors, which are 2½ times heavier than air, may penetrate every portion of the receptacle and do effective work. The weevil can be destroyed at any stage of their growth; but the treatment should not be attempted when the thermometer stands lower than ten degrees below zero, as it is claimed that the liquid would not vaporize sufficiently to work satisfactorily. I would strongly recommend treating the peas immediately after they are harvested and threshed in the autumn, to destroy the weevil when they are small and entirely enclosed in the peas. The vapors of the carbon bisulphide will penetrate the skins of the peas and destroy the weevil before they have completed their work of destruction and made their escape. Peas which are not treated in the autumn should be treated in the warm days of the winter or in the spring, to check the spread of this troublesome insect.

Carbon bisulphide is a clear liquid which volatilizes very rapidly, and, as the vapors are very inflammable, great care should be taken to keep fire away from them. Carbon bisulphide can be purchased in small quantities from most druggists, or in larger quantities from the manufacturers. It has been estimated that 1½ pounds of the liquid is sufficient for each ton of the grain to be treated, if used to the best advantage possible. We usually, however, use about one pound of the liquid to each ten bushels of grain, as it is important to have the work thoroughly done without the necessity of repeating it.

Peas—Broadcasting and Drilling at Six Different Dates.

As in the case of barley, peas were sown in the spring of 1898 by hand and with a grain drill on six separate dates. The plots were all 1-100th of an acre in size, and equal quantities of seed were used for the various plots.

Date of seeding Peas.	Average results from different methods of seeding.		Average results from different dates of seeding.			
	Broadcasted or drilled.	Yield of grain per acre. Average 3 years 1896-98.	Weight per measured bushel.		Yield of grain per acre.	
			1898.	Average 4 years 1895-98.	1898.	Average 4 years 1895-98.
		bus.	lbs.	lbs.	bush.	bush.
April 18-19	Broadcasted	22.66	61.54	58.94	14.05	25.72
	Drilled	24.21				
April 22-25	Broadcasted	28.80	60 97	58.83	25.11	30.81
	Drilled	29.59				
May 1-4	Broadcasted	22.85	60.32	59.55	20.93	27.73
	Drilled	23.27				
May 9-11	Broadcasted	18.12	59.00	59.36	13.29	24.69
	Drilled	18.59				
*May 18	Broadcasted	10.05	57.78	58.35	9.58	19.87
	Drilled	10.90				
*May 25-26	Broadcasted	7.88	53.88	58.19	6.74	17.97
	Drilled	8.54				

* The average results from the seeding of May 18th and of May 25th and 26th are for one year less than for those of the seeding of the first four dates.

The grain which was sown with a drill gave an average of one bushel per acre more than that which was sown broadcast with the hand. When the average results of the six dates of seeding are taken into consideration, it will be observed that the largest average yield for three years was produced by sowing the peas with a grain drill on or about the 22nd of April. It will also be observed that the smallest average yield for three years was produced from the peas which were sown broadcast on the last date mentioned.

In comparing the results from sowing peas on the different dates enumerated in the foregoing table, it will be seen that the largest average yield per acre for four years was secured from the second date of seeding, and also that there was a larger yield of peas per acre from sowing on the first three or four days of May than from sowing on the 18th or 19th of April. As the seedings advanced beyond the 4th of May, however, the decrease in the yield of grain per acre was quite marked. The average results of these experiments seem to indicate that the best returns have been secured from sowing peas with the grain drill, on, or shortly after, the 22nd of April.

Spring Wheat—Comparative Test of Forty-Eight Varieties.

Eighty-seven varieties of spring wheat have been tested in the trial grounds within the past ten years. After five years careful experimental work, however, a number of the poorest varieties were dropped from the experiments, and only the most successful ones were retained. In 1898, forty-eight varieties were tested. Four of these were grown in 1898 for the first time. The soil on which the experiments with wheat were conducted was situated in the northern portion of the experimental grounds, and was quite uniform in character. It was manured in the spring of 1897 with twenty tons of farm yard manure per acre, and produced a crop of roots in the same year. The seed was sown broadcast on April 15th, with the exception of the Thick Set variety, which was sown one week later, and the Imperial, which was sown about the 22nd. The grain was sown broadcast at the rate of two bushels per acre, excepting the large coarse varieties, as Bart Tremenia, Wild Goose, Medeah, Sorentine, Algiers and Ontario, which were sown at the rate of two and a half bushels per acre.

The average yield of the forty-eight varieties of spring wheat grown in 1898 was thirty-two bushels per acre, which was double that of the previous year, and about equal to the average yield of 1894. The quality of spring wheat grown in the plots in the last season was good, the average weight per measured bushel of the forty eight varieties being 60.17 pounds. But little interest has been taken in the spring wheat crop of Ontario for a good many years. The interest, however, has revived considerably during the past two or three years, as shown by the greatly increased number of applications for the best varieties of spring wheat. When it is seen that varieties of spring wheat which are grown in experimental plots give a yield of from twenty-eight to thirty-four bushels per acre in the average of nine and ten years' experiments, and at the same time produce grain which weighs from 60 to 62½ pounds per measured bushel, it seems evident that spring wheat can still be grown quite successfully in some parts of Ontario at least. Those varieties of spring wheat which give the best satisfaction under varied conditions, extending through several years' experiments, are the varieties from which we may hope to receive the most satisfactory results in general cultivation.

In weight of grain per measured bushel, it will be observed from the foregoing table that the Medeah, Bart Tremenia and Sorentino gave the largest number of pounds. These, however, are coarse wheats, somewhat resembling the Wild Goose variety in character. It will be observed, however, that the Herison Bearded gave 63¼ pounds per measured bushel, and this is a wheat recommended by the Dominion Millers' Association as being one possessing good milling qualities. When driving through the county of Prince Edward in July of the present year I observed several fields of the Herison Bearded variety, and some of the farmers of that county informed me that the millers would pay the highest price for that wheat. I understand that the variety is giving good satisfaction. The Herison Bearded has given an average of forty one bushels per acre in our plots this year, and has produced an average of twenty-eight bushels per acre for the past ten years. When we realize that the weight per bushel of the Herison Bearded for

Spring wheat—Comparative test of varieties.

Varieties of Spring Wheat.	Nature of heads.	Results for 1898.			Average results for number of years grown.		
		Weight per measured bushel.	Yield of straw per acre.	Yield of grain per acre.	Weight per measured bushel.	Yield of straw per acre.	Yield of grain per acre.
Grown for ten years:		lbs.	tons.	bush.	lbs.	tons.	bush.
1. Bart Tremenia	Bearded	64.63	1.79	37.17	62.40	1.71	**28.89**
2. Herison Bearded	"	63.75	2.22	41.07	62.50	1.82	**28.02**
3. Pringle's Champion	"	62.50	2.21	37.12	60.05	1.72	**25.37**
4. Saxonka	"	63.25	2.11	37.23	60.51	1.68	**25.10**
5. Konisburg	"	62.13	1.82	31.77	61.10	1.57	**24.39**
6. Holben's Improved	Bald.	59.63	1.85	30 68	58.15	1.66	**22.62**
Grown for nine years:							
7. Wild Goose	Bearded	62.13	2.38	48.29	61.23	1.96	**34.13**
8 Red Fern	"	62.88	2.14	36.02	60.68	1.91	**30.04**
9. Medeah	"	65.00	2.00	42.55	60.91	1.74	**29.78**
10. Sorentino	"	64 13	1.92	38 62	59.78	1.83	**28.14**
11. White Russian	Bald.	59.88	2.11	36.25	58.13	1.80	**28.09**
12. Algiers	Bearded	63 38	1.87	36 02	58.13	1.80	**26.99**
13. Red Fife	Bald.	61.00	1.95	34.22	60.12	1.79	**26.85**
14. White Fife	"	61.13	2.24	37.72	55.99	1.64	**25.34**
15. Colorado	Bearded	63.25	2.21	38.72	59.22	1.67	**24.31**
Grown for eight years:							
16. Rio Grande	Bearded	61.00	2.15	31.67	59.23	1.82	**25.67**
17. McCarlin	"	62.00	1.88	28.90	59.04	1.83	**25.07**
18. Manitoulin	Bald.	61.13	1.77	30.10	58.66	1.55	**24.06**
19. Okanagan Valley Velvet Chaff	"	57.88	2.09	32.88	54.96	1.68	**23.83**
Grown for seven years:							
20. Weliman Fife	Bald.	61.00	2.32	37 83	58.52	1.84	**27.14**
21. Lost Nation	"	60.50	2.20	37.50	58.09	1.72	**25.38**
22. Velvet Chaff Blue Stem	"	57.38	2.02	32.55	56.31	1.65	**23.85**
23. New York	Bearded	59.50	1.92	31.75	57.44	1.58	**22.26**
24. Dakota Marvel	Bald.	57.88	2.01	33.90	56.13	1.64	**21.73**
25. Hayne's Blue Stem	"	59.00	1.89	31.90	55.96	1.63	**21.51**
26. Manitoba Red	"	60.63	1.62	28.37	58.38	1.54	**21.39**
27. Campbel.'s White Chaff	"	60.00	1.68	28.18	54.63	1.32	**16.36**
Grown for six years:							
28. Blue Democrat	Bearded	61.13	2 34	32.83	59.15	1.87	**25.18**
29. Champion bearded	"	61.38	1.96	29.55	59.00	1.64	**21.68**
30. French Imperial	Bald.	61.00	2.03	33.90	58.29	1.45	**21.19**
31. Amethyst	"	60.63	1.76	28.90	58.14	1.43	**20.91**
32. Ontario	Bearded	59.00	2.47	34.40	57.18	1.85	**20.83**
33. Early Scotch Bearded	"	60.25	2.31	27 92	57.32	1.59	**18.54**
34. Scotch Fife	Bald.	60 50	1.81	29.80	57.86	1.24	**17.52**
35. Canadian Club	"	61.00	1.35	20.73	56.27	1.35	**15.38**
36. Niagara	"	59.00	1.42	19.38	54.23	1.15	**12.95**
Grown for five years:							
37. Salzer's Marvel	Bald.	57.38	1.85	32.40	56 07	1.32	**20.76**
38. Red North Dakota	"	61.00	1.50	31.70	57.95	1.19	**19.74**
39. May's Early Wonder	"	60.88	1.72	30.37	59.88	1.19	**18.52**
Grown for four years:							
40. Manitoba Hard	Bald.	60.50	1.51	26.33	57.14	.98	**14.99**
Grown for three years:							
41. Preston	Bearded	61.88	1.67	32.83	56.94	.98	**17.01**
42 Percy	Bald.	61.63	1.75	27.65	56.38	1.05	**14.26**
43. Stanley	"	60.88	1.55	26.75	56.55	.94	**14.07**
44 Seven Headed	"	56.25	1.99	24 67	53.00	1.34	**11.20**
Grown for one year:							
45. Speculation	Bearded	63.00	1.76	27 87	63.00	1.76	**27.87**
46. Warren	"	62 13	1.74	27.08	62.13	1.74	**27.08**
47. Thick Set	"	62.88	1.55	25.68	62.88	1.55	**25.68**
48. Imperial	"	60.63	1.60	18.47	60.63	1.60	**18.47**

ten years is 62½ pounds, we are forced to the conclusion that this variety should receive the attention of the farmers who are still interested in the production of spring wheat upon their own farms. The Red Fern variety of spring wheat proves to be one of the very

best of all the varieties in yield per acre, although it weighs about two pounds per measured bushel less than the Herison Bearded. The greatest fault with many of the varieties of spring wheat is their light weight per measured bushel. It will be observed that the White Russian, which has been grown quite largely throughout Ontario, weighs only a little over fifty-eight pounds per measured bushel in the average of nine years' growing. The last four varieties mentioned on the list were all grown this year for the first time, and the seed was obtained from different parts of Ontario. These wheats are all very similar in their characteristics, and might be classed as one variety. The Imperial gave much poorer results than any of the other three, but this no doubt occurs from its being sown about one week later than the rest of the varieties.

Spring Wheat—Broadcasting and Drilling at Different Dates.

Spring wheat was sown with an ordinary grain drill and was broadcasted by hand on six different dates in the spring of 1898. The plots used for this experiment were each 1-100 of an acre in size, and the soil was very uniform throughout in regard to elevation, previous cropping and previous manuring. The seed was sown at the rate of two bushels per acre in every instance, and the yields given in the following table were determined from the actual yields of the plots.

Date of seeding Spring Wheat.	Average results from different methods of seeding.		Average results from different dates of seeding.			
	Broadcasted or drilled.	Yield of grain per acre. Average 3 years 1896 8.	Weight per measured bushel.		Yield of grain per acre.	
			1898.	Average 4 years 1895-8.	1898.	Average 4 years 1895-8.
		bush.	lbs.	lbs.	bush.	bush.
April 18-19	Broadcasted	18.70	61.28	59.99	16.66	**20 21**
	Drilled	18.89				
" 22-25	Broadcasted	17.44	60.91	58.92	19.13	**17.42**
	Drilled	17.66				
May 1- 4	Broadcasted	12.73	60.51	58.59	12.20	**14.23**
	Drilled	14.06				
" 9-11	Broadcasted	10 90	60.60	58.28	12.18	**11.60**
	Drilled	9.58				
" 18	Broadcasted	6.05	60.56	54.41	10.47	**7.35**
	Drilled	5.46				
" 25-26	Broadcasted	3.56	59.32	53.65	5 90	**6.04**
	Drilled	2.87				

The average yield from the two methods of seeding, when the results of three years are taken into consideration, do not vary more than ten pounds per acre. It must be understood that the land was in a good state of cultivation when the seeding took place. Had the land been very rough and poorly worked, it is likely that there would have been a much more decided difference between the methods of seeding.

The great advantage of the early seeding of the spring wheat shows itself in this experiment. It will be seen from the foregoing results that the largest yield per acre and the best quality of grain were produced from the first date of seeding; and as the season advanced there was a decrease in both quantity and quality of the grain produced.

Winter Wheat Experiments.

Bulletin 108 was issued in August giving the results of experiments with winter wheat As this bulletin was distributed in large numbers it will not be repeated in this report. The conditions of the experiments and the conclusions therefrom will be briefly stated.

A good deal of attention has been given to the testing of winter wheat in the Experimental department of the Ontario Agricultural College. Varieties obtained from the United States, England, Scotland, Germany, France and Russia have been carefully tested along with those secured from the wheat-growing sections of Canada. Besides variety tests, there have been experiments conducted in different dates of seeding, methods of soil preparation, methods of seeding, selection of grain for seed, quantities of seed per acre, application of fertilizers, treatment of smut-infested seed, the yield and quality of wheat cut at different stages of maturity, and the value of seed from wheat cut at different stages of maturity. These experiments have occupied over twelve hundred plots within the last nine years.

The two hundred and three plots used for the experiments with winter wheat in 1898 were situated in the southern portion of the large experimental field which lies at the rear of the main College building. The land used for one of the experiments had a gentle slope towards the south, and that used for the other experiments was comparatively level. No manure had been applied to the land since the spring of 1896, when it received a dressing of twenty tons of farmyard manure per acre. Commercial fertilizers had not been used for at least ten years. The land produced a crop of spring grain in 1895, a crop of roots in 1896, and a crop for green manuring in 1897, which was plowed under during the first week in August of that year. No other plowing was done, but the land was well stirred on the surface up to the time of sowing the winter wheat. The land was very carefully measured and divided into plots, which were made exactly uniform in size and shape for the separate experiments. The smallest plots were each 1-100 of an acre in size, and were used for the smut-infested grain, which had been treated in different ways; and the largest plots were each 1-28 of an acre in size, and were used for the different preparations of soil for winter wheat.

Ninety-two varieties of winter wheat were sown in the autumn of 1897. The plots were situated side by side, and were separated from each other by paths three feet wide. All the plots were sown by hand at the rate of two bushels per acre. The varieties were sown on September 3rd, with the exception of two which were sown on September 4th and one which was sown three days later. The ripening of the varieties took place between the 14th and the 21st of July, which was about eight days earlier than in 1896, and four days later than in 1895. The crops were all harvested separately.

Conclusions.

1. The average results of winter wheat growing on the experimental plots for nine years in succession are as follows: weight of grain per measured bushel, 60.2 pounds; yield of straw per acre, 2.7 tons; and yield of grain per acre, 39.5 bushels.

2. Dawson's Golden Chaff gave the largest average yield of grain per acre among seventy varieties of winter wheat grown at the Ontario Agricultural College for five years; also among eleven leading varieties tested over Ontario in 1893, nine varieties in 1894, 1895 and 1896, and seven varieties in 1897.

3. The Early Genesee Giant variety of winter wheat was a close rival of the Dawson's Golden Chaff variety in the small plots in the Experimental department, and in the large fields of the Farm department of the College, and also in the Co-operative experiments conducted throughout Ontario.

4. Winter wheat which did not lodge until cut produced a crop more than double the value of that which became lodged before it was ripe.

5. In the five years' experiments with varieties of winter wheat the American Bronze, Dawson's Golden Chaff, and Early Genesee Giant varieties produced the stiffest straw of all the large yielders of grain.

6. Seed consisting of large, plump kernels of winter wheat gave much better results than that consisting of small, plump, shrunken, or broken grains.

7. In the average of six years' experiments in sowing winter wheat at different dates, it was found that when the wheat was sown later than September 9th the crop was usually much poorer than when the seeding took place on or before that date.

8. As a crop for green manure to plow under in preparation for winter wheat, peas gave the best, and buckwheat the poorest results.

9. In an experiment in cutting winter wheat at different stages of maturity for several years in succession, it was found that the largest yield of grain and the best quality of seed were produced from the crop which was allowed to ripen fully before cutting.

10. Winter wheat badly infested with "stinking smut" has been very effectually treated for three years in succession by the use of either copper sulphate or hot water, as was briefly described in Bulletin 108.

COMPARATIVE HARDNESS OF WINTER WHEAT.

Varieties of Winter Wheat.	Comparative pressure required to break the grain. 100 greatest pressure.			Average result for 5 years.			Color of grain.
	1896.	1898.	Average 2 years.	Percentage of crop standing.	Weight per measures bushel.	Yield of grain per acre.	
					lbs.	bush.	
1. Dawson's Golden Chaff	57	70	63.5	83	59.7	52.6	White.
2. Early Genesee Giant	66	78	72.0	81	59.8	48.7	"
3. Egyptian	70	76	73.0	58	60.6	48.6	Red.
4. Imperial Amber	71	80	75.5	58	59.8	48.5	"
5. Early Red Clawson	66	71	68.5	59	58.9	48.5	"
6. Reliable	68	74	71.0	56	61.2	48.0	"
7. Golden Drop	68	70	69.0	61	61.2	46.9	"
8. Russian Amber	74	76	75.0	61	60.9	46.7	"
9. Egyptian Amber	66	87	76.5	59	61.4	45.3	"
10. American Bronze	72	72	72.0	96	60.1	44.8	"
11. Poole	68	78	73.0	62	60.9	44.7	"
12. Tasmania Red	78	89	83.5	42	61.6	44.4	"
13. Early Ripe	72	88	80.0	67	61.2	43.8	"
14. Tuscan Island	85	86	85.5	55	60.6	42.8	"
15. Ruby	80	81	80.5	58	60.6	42.8	"
16. Red May	70	78	74.0	71	62.2	42.5	"
17. Arnold Hybrid	72	77	74.5	72	61.8	42.4	"
18. Bulgarian	70	69	69.5	74	60.2	42.3	White.
19. Pride of Genesee	83	100	91.5	70	60.8	42.1	Red.
20. Emporium	79	89	84.0	65	59.8	41.9	"
21. Siberian	79		79.0	63	61.8	41.5	"
22. Stewart's Champion	76	81	78.5	84	59.0	41.4	White.
23. Red Velvet Chaff	84	83	83.5	70	58.3	41.3	Red.
24. Zimmerman	78	81	79.5	78	61.4	41.2	"
25. Standard	67	73	70.0	80	58.5	41.1	White.
26. Geneva	77	86	81.5	60	62.4	41.0	Red.
27. Bissell	78	81	79.5	54	61.6	40.8	"
28. New Columbia	73	87	80.0	80	59.4	40.6	"
29. McPherson	83	88	85.5	73	62.1	40.3	"
30. Bonnell, or Landreth	76	76	76.0	76	58.4	40.2	White.
31. Golden Tankard	83	72	77.5	58	60.8	39.8	Red.
32. Longberry Red	88	73	80.5	37	60.3	39.8	"
33. Golden Cross or Volunteer	83	86	84.5	65	59.5	39.5	"
34. Andrew's No. 4	81	92	86.5	74	60.1	39.3	"
35. Kentucky Giant	89	85	87.0	59	60.0	38.8	"
36. Hindostan	78	74	76.0	58	61.1	37.7	"
37. Soules	60	76	68.0	82	57.8	37.5	White
38. Simcoe Red	69	82	75.5	84	59.2	37.5	Red.
39. Treadwell	63	72	67.5	85	60.1	37.3	White.
40. Jones' Winter Fife	73	80	76.5	67	58.7	37.0	Red.
41. Currell	81	87	84.0	64	61.3	37.0	"
42. Turkish Red	100	100	100.0	56	61.5	36.8	"
43. Penquit's Velvet Chaff	79	84	81.5	83	61.7	36.1	"
44. Velvet Chaff	77	88	82.5	86	62.5	36.0	"
45. Surprise	59	72	65.5	70	57.3	35.6	White.
46. Early White Leader	67	68	67.5	79	56.1	33.8	"
47. Jones' Square Head	72	77	74.5	79	57.9	33.2	"
48. Bullard's Velvet Chaff	82	82	82.0	76	60.4	31.9	Red.

In order to ascertain the best variety of winter wheat to grow it is necessary to take many things into consideration. The power to withstand the cold winters of Ontario, the character of growth of the plants during the spring months, the freedom from rust, the strength of straw, the yield of grain per acre, the weight per measured bushel, and the quality of grain, are all important items in determining the varieties best suited to general cultivation. The bulletins issued from the Experimental department have given a large amount of information in reference to most of these points. The comparative hardness of some of the varieties has been referred to in one or two instances.

Some attention has been given to the comparative hardness of the different kinds of winter wheat since the publication of the bulletin last autumn. Mr. G. H. Clark, B.S.A., who completed his course in the College in the summer of 1898, took for the subject of his thesis "The hardness of wheat and its relation to milling qualities." With the assistance of Mr. F. C. Harrison, B.S.A., College Bacteriologist, an apparatus was made for determining the power required to break the grains of wheat under direct pressure, and the Experimental department furnished Mr. Clark with the seed of a large number of varieties which were grown in the experimental plots in 1896, in order that he might determine the comparative pressure required to break the grain of the different varieties. Mr. Clark is now employed in the Experimental department, and we have recently tested all the varieties grown in 1898 with the same apparatus. As this appears to give some useful information in regard to the comparative hardness of the different varieties, we have embodied in the foregoing table the comparative results in this respect, as well as the strength of the straw, the weight per measured bushel, the yield of grain per acre, and the color of the grain of the different varieties which we have grown in our experimental plots for five years in succession.

The fifteen hardest wheats produced an average of seven and one-fifth bushels per acre less than the average of the fifteen best yielding varieties, and two and nine-tenths bushels per acre more than the average of the fifteen poorest yielding varieties. The average yield per acre of the fifteen softest wheats was between four and five bushels greater than the average of the fifteen hardest varieties, according to the results presented in the foregoing table. Among the ten varieties of wheat which have given the largest yield of grain per acre in the average of five years' experiments, it will be observed that the Egyptian Amber possesses the hardest grain, the hardness being represented by the numbers 76.5. It will be noticed, however, that this variety is surpassed in point of hardness by twenty-four other varieties which come below it in yield of grain per acre. The grain of the Turkish Red variety will be seen to be the hardest of any of the varieties mentioned in the above table in the crop of 1896, and the grain of the Turkish Red and Pride of Genesee varieties the hardest in the crop of 1898. The Turkish Red variety, however, stands forty-second in average yield per acre among forty-eight varieties grown for five years in succession, producing an average yield of 36.8 bushels of grain per acre. In comparison with this the Dawson's Golden Chaff, which is a white wheat with softer grain but very much stiffer straw, gives an averages of sixteen bushels per acre more. The Pride of Genesee, which stands nineteenth in the list in yield of grain per acre for five years, possesses grain which stands in point of hardness in the average of two years' crops. This variety has been distributed throughout Ontario in connection with the co-operative experiments for four years in succession. In yield of grain per acre it stood fourth among nine varieties tested in 1895 on one hundred Ontario farms; third among nine varieties in 1896 on ninety farms; fourth among seven varieties tested in 1897 on two hundred and thirty one farms; and sixth among seven varieties in 1898 on one hundred and ninety-one farms. As a rule, the grain of the red wheats is harder than that of the white wheats. This, however, will not apply to all varieties, as the Early Red Clawson, which is the softest of the red wheats, is not so hard as the Stewart's Champion, which is the hardest of the white wheats. From an examination of the foregoing table, and from what has already been said, it will be quite clear that there is no one variety which possesses all the desirable qualities of a good wheat. It appears that many of the varieties which yield the greatest amount of grain and possess the stiffest straw, furnish

a grain which is softer than many of the other varieties, and that these varieties which furnish the hardest grain are, as a rule, light yielders and possess a light straw. Some millers are anxious to get red wheat that will produce a strong flour, while others are anxious to get white wheat to mix with the dark colored, hard, flinty, western wheat, in order to secure a flour of a lighter shade. The varieties which the farmers are likely to grow are those which they can usually harvest with the least amount of labor, and that will produce the greatest financial returns for the time and labor in growing the crop. The requirements of the market, however, should be closely watched, and the aim should be to grow those varieties which will give the best results, and at the same time furnish that quality of grain for which there is the greatest demand. A careful study of the results of our experiments with winter wheat will greatly aid in this selection Work is now being done in the Experimental department with the object of improving the best varieties of winter wheat by means of careful selection and cross fertilization.

OATS--COMPARATIVE TEST OF NINETY-ONE VARIETIES.

Varieties of Oats.	Nature of head.	Color of grain.	Results for 1898.				Average results for number of years grown.		
			Percentange of hull	Weight per measured bushel.	Yield of straw per acre.	Yield of grain per acre.	Weight per measured bushel.	Yield of straw per acre.	Yield of grain per acre.
Grown for ten years:				lbs.	tons.	bush.	lbs.	tons.	bush.
1 Joanette	Spreading	Black	22	32.72	3.84	106.85	35.30	2.88	**88.16**
2 Siberian	"	White	29	35.08	3.25	107.65	34.63	2.75	**82.69**
3 Oderbrucker	"	"	33	33.19	2.92	101.59	31.46	2.57	**81.52**
4 Probsteier	"	"	32	34.13	2.89	104.79	32.33	2.50	**80.31**
5 Waterloo	"	"	31	30.00	3.76	93.76	31.17	2.66	**79.22**
6 Improved Besthorne	"	Yellow	32	32.48	3.38	106.85	32.49	2.29	**77.92**
7 Danebrog	"	White	34	34.20	3.10	95.91	32.70	2.51	**77.64**
8 Bavarian	"	"	37	27.48	4.31	97.62	30.98	2.87	**77.22**
9 Poland White	"	"	31	35.66	3.76	108.18	36.69	2.63	**76.25**
10 Georgian	"	"	42	29.16	3.99	87.35	32.21	2.83	**72.25**
11 Egyptian	Mane	"	36	36.63	3.36	89.29	35.23	2.83	**71.38**
12 Yellow Gigantic	"	Yellow	35	27.31	2.22	84.32	28.68	2.62	**71.26**
13 Black Poland	"	Black	38	24.88	3.53	79.32	28.76	2.89	**67.01**
14 Victoria White	Spreading	White	31	41.58	2.75	80.82	39.26	2.53	**66.25**
15 Rosedale	Mane	"	35	37.14	2.65	77.79	34.71	2.74	**66.16**
16 Black Champion	"	Black	35	30.69	2.75	79.50	29.15	2.55	**65.90**
17 Black Tartarian	"	"	34	32.13	2.30	77.00	30.65	2.62	**64.03**
Grown for eight years:									
18 Vick's American Banner	Spreading	White	34	32.41	3.06	108.26	30.89	2.38	**82.76**
19 White Schonen	"	"	31	34.88	2.58	98.35	32.20	2.30	**82.26**
20 Holstein Prolific	"	"	32	33.61	2.83	105.41	31.96	2.22	**79.86**
21 Danish	"	"	32	32.14	2.69	96.41	29.46	2.28	**79.44**
22 White Mane	"	"	31	32.44	2.76	99.32	31.59	2.58	**79.39**
23 Wide Awake	"	"	33	33.91	2.88	93.79	33.06	2.34	**78.85**
24 Early Calder	"	"	32	33.35	2.66	89.24	32.07	2.36	**75.55**
25 Golden Giant	Mane	Yellow	31	28.14	2.97	87.09	28.05	2.50	**75.07**
26 Early Gothland	Mane	White	34	36.70	3.02	91.44	35.68	2.44	**68.90**
27 Clydesdale	Spreading	"	34	40.08	2.77	80.97	38.09	2.48	**66.53**
Grown for seven years:									
28 White Baltic	"	"	31	35.31	2.47	92.91	34.61	2.24	**71.46**
29 Abyssinian	Mane	"	34	39.06	2.65	74.85	36.42	2.51	**64.21**
30 Thousand Fold	"	"	32	38.11	2.99	96.09	35.57	2.43	**63.61**
31 American Beauty	"	"	33	39.55	2.46	78.85	30.53	2.37	**63.35**
32 Badger Queen	Spreading	"	36	39.56	2.70	79.35	39.39	2.30	**59.63**
33 New Wonderful	"	"	35	41.94	2.63	77.85	39.38	2.17	**58.48**
Grown for six years:									
34 New Zealand	"	"	31	34.92	2.44	97.44	31.86	2.33	**75.23**
35 Improved American	"	"	34	33.88	2.23	92.65	31.64	2.21	**75.19**
36 Green Mountain	"	"	33	32.50	2.52	99.03	30.94	2.09	**73.80**
37 Black Beauty	"	Black	29	31.73	3.06	95.18	32.34	2.21	**70.19**
38 Lincoln	"	White	34	35.22	2.02	76.71	33.25	2.07	**68.47**
39 High Bred	"	"	31	36.16	3.24	74.59	36.92	3.24	**67.29**
40 Royal Prize Cluster	"	"	34	42.98	2.27	72.12	38.99	2.19	**61.29**

OATS—COMPARAVITE TEST OF NINETY-ONE VARIETIES.

Varieties of Oats.	Nature of head.	Color of grain.	Results for 1898.				Average results for number of years grown.		
			Percentage of hull.	Weight per measured bushel.	Yield of straw per acre.	Yield of grain per acre.	Weight per measured bushel.	Yield of straw per acre.	Yield of grain per acre.
				lbs.	tons.	bush.	lbs.	tons.	bush.
Grown for five years:									
41 Peerless	"	"	32	33.16	2.91	96.50	31.00	2.62	**85.03**
42 Bolton	"	"	33	33.27	2.66	93.29	31.28	2.30	**79.34**
43 Bonanza King	"	"	31	36.39	2.49	87.50	32.86	2.17	**76.39**
44 Surprize	"	"	32	36.70	2.03	73.47	32.96	2.38	**75.15**
45 Improved White Russian	Mane	"	33	34.19	1.95	81.09	32.09	2.35	**73.08**
46 Negro Wonder	Spreading	Black	28	31.72	2.76	70.68	31.55	2.40	**72.34**
47 White Swede	Mane	White	30	34.75	2.42	78.50	32.50	2.62	**69.80**
48 Pride of America	"	"	35	36.64	2.51	77.21	36.04	2.55	**69.77**
49 Hull	"	"	30	32.66	2.57	72.44	30.87	2.59	**68.97**
50 Australian Square Head	"	Yellow	31	30.03	2.32	72.53	29.22	2.42	**67.25**
51 Lousinee	Spreading	White	32	34.61	2.03	91.12	31.54	1.76	**65.08**
52 Salzer's Great Northern	"	"	29	35.59	1.88	83.82	32.02	1.70	**61.51**
53 Mammoth Cluster	Mane	Black	34	31.53	2.00	69.38	28.56	2.37	**60.47**
54 Red Tamworth	Spreading	Dun	32	26.70	1.40	51.38	26.09	1.76	**46.89**
Grown for four years:									
55 Salzer's Silver Mine			32	34.91	1.92	78.21	30.86	2.14	**77.62**
56 New Electric	Spreading	White	32	34.48	1.75	76.41	31.08	2.07	**77.27**
57 Daubeney	"	"	27	33.09	1.91	84.47	34.62	1.61	**76.02**
58 White Bedford	"	"	32	34.64	1.86	70.26	28.39	2.25	**73.57**
59 Black Diamond	"	Black	38	31.67	2.27	69.18	32.36	2.27	**73.08**
60 Mexican Grey	"	Mixed	27	32.92	2.47	81.06	31.86	2.23	**71.80**
61 White Superior Scotch	"	White	35	40.94	2.43	71.97	40.17	2.10	**64.57**
62 Prolific Side	Mane	"	35	36.38	2.16	64.29	35.55	2.33	**60.09**
63 Royal Doncaster	Spreading	"	34	40.17	2.03	74.91	36.20	2.15	**59.34**
Grown for three years:									
64 Illinois	Mane	"	30	34.39	1.62	67.91	32.32	1.70	**62.49**
65 Early Golden Prolific	Spreading	"	31	34.95	1.54	66.91	31.99	1.74	**60.77**
66 Danish Island	"	"	31	33.25	1.60	64.94	29.75	1.78	**59.17**
67 Abundance (O.A.C.)	"	"	31	34.70	1.47	63.32	30.40	1.76	**58.52**
68 Michigan University	"	"	33	34.64	1.87	70.85	31.90	1.87	**57.87**
69 Abundance (D.E.F.)	"	"	32	33.31	1.44	62.27	28.94	1.76	**56.77**
70 Pearce's Black Beauty	"	Black	38	30.88	1.83	60.23	31.13	1.82	**56.12**
71 White Star	"	White	33	33.14	1.71	64.03	31.94	1.85	**56.02**
72 Improved Ligowa	"	"	31	35.88	1.62	69.44	30.94	1.98	**55.93**
73 White Dutch	"	"	36	41.94	1.94	60.88	38.13	2.60	**49.78**
74 Fife	Mane	"	35	37.13	2.33	61.21	32.29	2.12	**47.06**
75 Black Irish	"	Black	35	31.15	1.43	50.97	28.01	1.91	**42.18**
Grown for two years:									
76 Tyrolian	Spreading	White	37	34.09	1.79	65.18	32.11	1.67	**57.55**
77 Salzer's Gold Mine	"	"	33	34.20	1.48	60.06	29.85	1.63	**55.36**
78 Newmarket	"	"	31	35.66	1.63	67.18	31.96	1.63	**54.78**
79 Golden Tartarian	Mane	Yellow	32	28.23	1.85	60.06	25.62	1.87	**48.97**
80 New Seizure	"	"	31	29.42	1.76	56.79	25.96	1.80	**46.65**
81 Whiteside	Spreading	White	33	42.46	1.84	57.82	38.42	1.63	**45.87**
82 Mortgage Lifter	"	"	35	41.72	1.97	60.77	38.36	1.64	**45.58**
83 Washington	"	"	38	40.51	1.89	59.41	36.00	1.74	**45.08**
Grown for one year:									
84 Early Blossom		"	37	33.52	2.03	77.47	33.52	2.03	**77.47**
85 Carter's Golden		Yellow	34	30.36	1.94	74.27	30.36	1.94	**74.27**
86 Black Mesdag		Black	34	33.45	2.04	73.94	33.45	2.04	**73.94**
87 White Giant		White	32	32.23	1.85	71.79	32.23	1.85	**71.79**
88 Unknown		"	33	34.72	2.14	71.32	34.72	2.14	**71.32**
89 Early Dawson		"	35	41.31	2.28	63.06	41.31	2.28	**63.06**
90 French Hybrid		Yellow	34	28.42	2.02	60.79	28.42	2.02	**60.79**
91 New Nameless		White	34	32.95	1.80	58.74	32.95	1.80	**58.74**

Two hundred and ten varieties of oats have been grown in our experimental grounds within the past ten years. More than half of these varieties were dropped before the

spring of 1898. Very few, however, were dropped in our experiments until we had given them a thorough test for five years in succession. After five years' testing, the least promising varieties were discarded, and those which gave the best all round results were retained for future growing. In this way all the best varieties were retained, and the poorer ones were gradually dropped from the list. The number of varieties grown in 1898 was ninety-one. Of this number seventeen were grown this season for the tenth year in succession; and these seventeen were the chief varieties among eighty-one kinds which were grown from 1889 to 1893 inclusive. Eight new varieties were tested in the plots in 1898 for the first time.

The grain was sown broadcast at the rate of seventy-five pounds per acre, and the seeding took place on the 26th and 27th of April. The plots were exactly the same in size and shape—each plot being ten links wide by one hundred links long, thus making 1-100 of an acre. The land on which the oats were sown was an average clay loam, which was manured in the spring of 1897 with twenty tons of farm yard manure per acre, after which it produced a crop of corn.

It will be observed that the yield of oats in 1898 was higher than usual. Seven of the varieties yielded upwards of 100 bushels per acre on the plots. The average of the ninety-one varieties for 1898 was a little over 79 bushels per acre, and the average weight per measured bushel 34.4 pounds. The quality of the grain, therefore, for the past year was slightly above the standard.

The reader's attention is directed to the three columns to the right of the table, which represent the average results for the number of years that each variety has been grown in the Experimental department. These results should carry with them much weight, as they are from experiments conducted each year on plots which are the same in cultivation, state of fertility, etc. If a person has a soil which naturally produces a large amount of straw, it will be well for him to select a variety which produces a straw somewhat below the average in yield per acre. Any person having a soil which naturally produces a smaller amount of straw will be wise in selecting a variety which the average results show to be capable of producing straw in abundance.

The varieties keeping the highest place on the list in the average results for ten years are the Joanette and Siberian—the Joanette giving an average of 88.16 bushels, and the Siberian 82.69 bushels per acre. The Joanette, however, is a very short-strawed variety, and not well adapted to a soil which naturally produces a small amount of straw. Upon rich land, however, it frequently gives excellent results, when sown at the rate of about four pecks per acre early in the season. The Siberian variety has given the best all round results of the different varieties of oats tested at this place, and also among the varieties grown in the co-operative experiments throughout Ontario. For seven years in succession from five to six varieties of oats were sent to about three hundred farmers, about one-third of whom reported the results of satisfactorily conducted experiments in each of the seven years; and when the results were averaged, it was found that the Siberian occupied the highest place in yield per acre throughout Ontario in each of five years, and second place in each of the other two years. In the two years in which the Siberian occupied second place, the Oderbrucker made the highest record in yield. The Oderbrucker seems very well adapted to some sections of Ontario, but on the whole is not giving quite so good satisfaction as the Siberian. It weighs about four pounds per measured bushel less than the Siberian, and is much weaker in the straw. It will be noticed that the Vick's American Banner stands the highest among the varieties grown for eight years in succession. If we drop off the results of the first two years in which the Siberian was grown, in order to get an exact comparison between the Siberian and the American Banner, it will be found that the Siberian surpasses the Banner in yield per acre of about five bushels, and in weight per measured bushel of about three pounds.

With the exception of the Joanette variety, it will be noticed that comparatively few of the black oats rank high in the average results. As the Black Tartarian has been grown over Ontario for a good many years, and as it has not given so good results as

many of the varieties in our experiments, we sent out, in connection with the co-operative work this year, both the Joanette and the Black Tartarian varieties, and the results of carefully conducted experiments on one hundred and eight Ontario farms show that the Joanette gave an average of about two bushels per acre more than the Black Tartarian variety. Among the five varieties used for this experiment the Black Tartarian came lowest on the list in yield of grain per acre; and it will also be noticed that it stands the lowest in yield per acre among seventeen varieties grown in our experimental grounds for ten years in succession.

The reader's attention is also directed to the column of figures under the heading of "Percentage of Hull" in the results for 1898. For these results, one hundred grains of each variety were carefully selected, and the hulls and inside portions or kernals were carefully separated and then weighed with fine chemical balances. It will be noticed that there is a great difference in the amount of hull in the different varieties of grain. For instance, one hundred pounds of grain of the Joanette variety would have twenty-two pounds of hull, while that of the Georgian variety would have forty-two pounds of hull, a difference of about twenty pounds. It will be observed also that the Joanette has the smallest percentage of hull of all the varieties, and that the Siberian, Black Beauty, Negro Wonder, Salzer's Great Northern, Daubeney, and Mexican Grey varieties have all less than thirty per cent. of hull.

It will be seen from a study of the foregoing table that the Victoria White, Clydesdale, New Wonderful, Royal Prize Cluster, White Superior Scotch, Royal Doncaster, White Dutch, Whiteside, Mortgage Lifter, Washington, and Early Dawson, each produced grain which weighed upwards of forty pounds per measured bushel. It will also be noticed that the Black Poland and Red Tamworth varieties produced grain which weighed less than twenty-seven pounds per measured bushel.

As there are about two and a half million acres sown with oats in Ontario each year, it is of the utmost importance that the varieties best suited to the different soils and localities be secured. Information is placed in the foregoing table in such a way that any person can glean a large amount of valuable information regarding the characteristics and the results of the different varieties of oats therein mentioned. It has been stated that the part which the College has taken in the importation, testing and distribution of varieties of oats, has added much more to the wealth of the Province than the entire amount of the annual expenditure; and we do not hesitate to say that the statement is correct. An average increase of one bushel per acre for the Province means a total increase of 2,500,000 bushels of oats for Ontario; and this, valued at twenty cents a bushel, amounts to $500,000, or about the entire cost of the College in all its departments for a period of ten years.

Oats—Broadcasting and Drilling at Different Dates.

This experiment has occupied twelve plots this year, and has been conducted in a smaller way for four years in succession. The oats were sown by hand and with a grain drill on six different dates in each of the four years. The plots were 1/100 of an acre in size in every instance, and the seed was sown at the rate of seventy-five pounds per acre. The land produced a crop of potatoes in 1897, after receiving a dressing of twenty tons of farm yard manure per acre in the spring of the same year.

Without a single exception the oats sown with the grain drill on six different dates, for three years in succession, gave a larger yield of grain per acre than that which was sown broadcast with the hand. The average yield from the broadcast seeding of 1898 was 48.3 bushels per acre, and that from the drilled grain was 51.6 bushels per acre, or a little over three bushels per acre in favor of the drill, as compared with the broadcast seeding.

In comparing the results from sowing oats on six different dates, with an average of about eight days between the different periods, it will be seen that in the average of four years' experiments, the largest yield of grain per acre and the heaviest weight per

measured bushel were produced from the seed sown on or about the 22nd of April. After this date there was a considerable decrease in both quantity and quality of grain.

Date of seeding Oats.	Average results from different methods of seeding.		Average results from different dates of seeding.			
	Broadcasted or Drilled.	Yield of grain per acre. Average 3 years 1896 98.	Weight per measured bushel.		Yield of grain per acre.	
			1898.	Average 4 years 1895-98.	1898.	Average 4 years 1895-98.
		bush.	lbs.	lbs.	bush.	bush.
April 18-19	Broadcasted.	68.75	33.89	33.37	67.18	**79.01**
	Drilled.	74 02	.....	.....	.....	
April 22-25	Broadcasted.	76.72	35.82	33 40	71.78	**85.32**
	Drilled.	77.93	.....	.....	.....	
May 1-4	Broadcasted.	59.36	30.90	30.78	59.15	**70.36**
	Drilled.	61.77	.....	.....	.....	
May 9-11	Broadcasted.	39.31	26 91	28.05	41.25	**54.86**
	Drilled.	45 45	.....	.....	.....	
May 18	Broadcasted.	30.34	24.45	25.54	39.50	**39.66**
	Drilled.	30.68	.....	.....	.....	
May 25-26	Broadcasted.	15.47	18.14	21.34	18.02	**31.63**
	Drilled.	19.97	.....	.....	.....	

That which was sown on May 25th and 26th gave a yield of only 31.6 bushels per acre, and an average weight of only a little over 21 pounds per measured bushel. These results are very marked, and worth a good deal of attention, as the experiments have been very carefully conducted for four years in succession, and should give a good index of the comparative averages of sewing oats at different periods in the spring of the year. When we compare the results from the first and second dates of seeding, it seems to indicate that it is better to let the land get fairly well settled before the seed is sown; but just as soon as it is sufficiently warm and in a condition for the best cultivation, the oats should be sown. It will be noticed that the first seeding in May produced about 15 bushels per acre and about 2½ pounds per measured bushel less than that of the last seeding in April. There was about the same reduction in both quantity and quality between the first two seedings in May; in fact, the results between several of the dates show that there is a decrease of nearly 2 bushels per day in yield, and ¼ of a pound per day in weight per measured bushel as the dates of seeding advanced after the 22nd of April.

Spring Rye—Comparative Test of Three Varieties.

Varieties of Spring Rye.	Results for 1898.			Average results for number of years grown.	
	Weight of grain per measured bushel.	Yield per acre.		Weight of grain per measured bushel.	Yield of grain per acre.
		Straw.	Grain.		
	lbs.	tons	bush.	lbs.	bush.
Grown for four years:					
1 Dakota Mammoth	60.75	2.30	42.11	58.49	**35.46**
2 Prolific Spring	59.38	2.56	39.93	57.14	**35.42**
Grown for two years:					
3 Colorado Giant	57.75	1.89	27.07	55.35	**21.69**

Two varieties of Spring Rye have been grown for four years in succession in the Experimental department, and one variety has been grown for only two years. The varieties were all sown upon plots 1/100 of acre in size, on April 15th. The grain was sown broadcast at the rate of two bushels per acre on land which was manured in the spring of 1897 with twenty tons of farmyard manure per acre, after which a crop of roots was grown in the same season.

In the average yield per acre of the Dakota Mammoth and the Prolific Spring Rye grown for four years in succession, it will be observed that there is practically no difference in yield of grain per acre, and only a little more than one pound in weight per measured bushel, the little difference there is in these two respects being in favor of the Dakota Mammoth. The Colorado Giant Rye, also sometimes called Polish Wheat, has been grown for two years in succession. This variety possesses a very large head; and the grain, when well developed, is also very large. It will be seen, however, that the yield is less than twenty-two bushels per acre, and the weight per measured bushel about three pounds less than that of the Dakota Mammoth. The St. John's variety of rye has also been grown, but is not mentioned in the above list. This variety is spoken of as being suitable for either spring or summer sowing. The spring sowing, however, has so far given very unsatisfactory results, as less than five bushels per acre have been produced in each experiment.

Winter Rye—Comparative Test of Three Varieties.

Three varieties of winter rye were sown in the autumn of 1897 on plots similar in size, cultivation, etc., to those used for the winter wheat. Although winter rye has been grown in our plots for several years, still the results of only the three varieties grown in 1898 are here presented in tabulated form, as the varieties have changed considerably from one year to another, and it has been found difficult to give the average results in the table. The following table gives one year's results from growing the three varieties:

Varieties of Winter Rye.	Weight of grain per measured bushel.	Yield of straw per acre.	Yield of grain per acre.
Grown for one year:	lbs.	tons.	bush.
1. Mammoth Winter Rye	60.69	4.3	57.50
2. Monster Winter Rye	59.88	4.0	57.02
3. Common Rye	59.63	4.1	52.57

There is practically no difference in the results from the Mammoth winter rye and the Monster winter rye; and these two varieties may be considered as really the same variety There was, however, some difference in the height of the rye represented by the two names. It will be seen by the foregoing results that the Common rye gave about 5 bushels per acre less than either the Mammoth or the Monster varieties, and that the weight per measured bushel was also less than that of either of these kinds. These three plots of rye were greatly admired by the many excursionists who visited the grounds in the month of June, as some of the rye stood over six feet and the plots certainly had a very handsome appearance.

Winter Barley.

We have grown winter barley more or less in our experimental grounds for the last ten years, the seed of which was obtained from Germany and the United States. It is found, however, that it is not a reliable crop at this station. In favorable years it usually produces a very large yield, but in severe winters the crop is generally very badly winter-killed—in fact, so badly that some years there are practically no plants alive in the

spring of the year. The variety sown in the spring of 1897 was the Nevada Six-Rowed winter barley, which gave a yield about the same as the average of thirty-four spring varieties. The average weight per measured bushel this year was about forty-eight pounds, or nearly five pounds per measured bushel less than the average of the spring varieties. Although the winter barley looked so very promising when the excursionists visited the College in 1898, still we wish to emphasize the fact that, taking one year with another, it is not a very safe crop to grow in a temperature similar to that of Guelph.

Winter Oats.

A good deal has been said in the past regarding the advisability of growing winter oats. No doubt this has been said owing to the success attained in growing the winter oats in some of the States in the American Union to the south of us. We have secured the seed of winter oats on several occasions and have sowed them in our plots, but I have never had the pleasure of seeing a live plant of this class of grain in the spring of the year. It is quite likely that winter oats would come through the winter season successfully some years, as we have frequently noticed that where spring oats have been grown one year, plants are sometimes seen to thrive the following season. The fact remains, however, that we have not yet found any variety of winter oats which is likely to give good satisfaction in Ontario.

Beans—Comparative Test of Thirty Varieties.

Varieties of Beans.	Stage of maturity.	Results for 1898.		Average results for two years.	
		Weight per measured bushel.	Yield of grain per acre.	Weight per measured bushel.	Yield of grain per acre.
		lbs.	bush.	lbs.	bush.
1. White Wonder	Early	65.38	18.15	66.18	27.46
2. Schofield Pea	"	66.57	19.38	67.04	25.48
3. Burlingame Medium	"	64.63	15.18	66.32	25.21
4. Pearce's Improved Tree	"	66.31	17.92	67.03	24.57
5. Medium, or Navy	Medium to early	65.50	15.05	66.50	24.24
6. Snowflake	Early	66.63	13.75	67.69	22.61
7. Wisconsin Tree	"	66.25	14.53	66.94	22.13
8. Boston Pea	Medium	65.00	12.68	66.00	21.41
9. Day's Improved Leafless	Medium to early	65.13	14.77	65.94	21.36
10. Great Western	Medium to late	66.13	10.78	66.51	20.29
11. Buckbee's Electric Tree	"	66.50	17.23	66.82	20.23
12. Marrowfat	"	60.50	4.67	64.00	17.80
13. Small White Field	Late	59.75	8.90	63.75	16.64
14. Boston Favorite	Medium to late	49.38	3.88	53.51	15.83
15. Zealand Haricots	"	62.13	10.00	63.26	15.65
16. Extra Early Field	Early	60.06	8.13	63.47	15.64
17. Dwarf Horticultural	"	59.00	8.47	60.82	15.14
18. Eureka	Medium to late	66.63	8.43	66.82	14.68
19. Russian Horticultural	Early	55.00	5.88	58.38	14.56
20. Prolific Dwarf Tree	Late	68.63	11.52	67.41	14.54
21. Golden Wax	Early	60.00	8.00	61.57	13.26
22. Wilson's Yellow Eye Pea	Medium	65.25	6.98	65.50	13.01
23. Giant Dwarf Wax	Medium to early	53.00	6.17	55.25	13.00
24. White Valentine	Early	63.63	7.30	64.88	12.98
25. Yellow Eye, or "Boston Favorite"	Medium	61.63	4.73	63.26	12.62
26. Red Kidney	"	54.2	8.28	56.76	12.29
27. Crimson Beauty	Early	54.25	6.17	56.88	11.54
28. Mexican Tree	Late	68.38	7.78	66.88	10.31
29. Large White Haricots	"	45.25	5.32	52.07	8.96
30. Dwarf Kidney	Medium to late	61.25	4.82	61.25	8.77

For two years in succession, thirty varieties of beans have been grown under simila conditions in our experimental grounds. As the growing of beans is of considerabl importance in some portions of Ontario, it was thought advisable to secure a considerabl

number of the most promising varieties in the spring of 1897 for systematic experimental work in order to find out which ones would be the best suited for general cultivation. In 1897 the beans were sown on the 10th of June, but in 1898 they were not sown until June 17th, owing to the rains which occurred between the 8th and the 14th of the month. The plots were of an acre in size, there being three rows of each variety four rods in length. The different varieties of horse beans and Soya beans will be reported on elsewhere.

It will be seen from the foregoing table that the yield of beans was very light in 1898; in fact it was only about one-half as much as in the previous year. The experiment, however, was quite satisfactory, and the results now show the average of the different varieties for two years, which varied considerable in weather conditions. The highest yield of beans in 1897 was 37 bushels per acre, and the highest yield in this year was only about 19½ bushels per acre. The average yield of all the varieties for 1898 was 10.16 bushels per acre, and the average weight per measured bushel was 61.74 pounds. It will be observed, however, that nine varieties gave a weight per measured bushel of upwards of 66 pounds; and two of the varieties produced grain which actually weighed over 68 pounds per measured bushel. It will also be observed that two varieties produced grain which weighed less than 50 pounds per measured bushel. The White Wonder variety, which stood first in yield per acre in 1897, comes second in the results of the the present year; the largest amount of grain being produced in 1898 by the Schofield Pea variety. The variety of beans under the name of Dixon's White Field was grown in 1898 for the first time, and gave very good results indeed—the yield per acre being 19.47 bushels, and the weight per measured bushel 65.63 pounds. As this variety has been grown for only one year it is not included in the foregoing table. Three varieties of beans, under the name of Zealand Hericots, Giant Hericots, and Large White Hericots, which were reported by an English firm in the spring of 1897 as likely to give excellent results in Canada, have so far given very poor results. A quantity of each of these varieties was imported from England in the spring of 1897, and the seed was sown in each of the past two years. The Giant Hericots, however, did so very poorly in the experiments of the present year that the results are not given in the foregoing table; and it will be seen that the Large White Hericots stand second last in yield of grain per acre, producing only about 9 bushels in the average of two years, and the grain weighing only 52 pounds per measured bushel. The Zealand Hericots gave the best results of these varieties, but at the same time stands fifteenth in yield per acre among the thirty varieties grown for two years in succession. It will be observed that the best of these three English beans has given an average of about 12 bushels per acre less than the White Wonder variety. The three English varieties were also tested in Kent County last year, and the report shows that they did not give satisfactory results because of their lateness in maturing. These results go to show the great importance of thoroughly testing different varieties under Ontario conditions before growing them in large areas for commercial purposes. We find it very necessary to test carefully all foreign crops, in order to find out whether those varieties which give good satisfaction in other countries will prove to be a success or a failure in this Province.

Besides giving results of the thirty varieties grown for two years, we also present the results from growing seven varieties for five years in succession, which are as follows:

Varieties of Beans.	Weight per measured bushel		Yield of grain	
	1898	Average 5 years	1898	Average 5 years
	lbs	lbs.	bush.	bush.
Medium or Navy	65.50	65.10	15.05	**19.73**
Boston Pea	65.00	65.32	12 68	**19.34**
Small White Field	59.75	64.35	8.90	**17.62**
Prolific Dwarf Tree	68.63	66 05	11 52	**16.70**
Marrowfat	60 50	63 78	4.67	**13.25**
Yellow Eye, or "Boston Favorite."	61.63	62 01	4.73	**11.59**
Giant Dwarf Wax	53.00	53.96	6.17	**11.55**

The California Pea bean made a high record for three out of the five years which it was grown, but the results from this variety were dropped in 1897, owing to poor germination of the seed. The results of this variety, therefore, are not included in the foregoing table. It will be seen that the medium, or Navy variety of beans, keeps the highest place in yield per acre among the seven varieties grown for five years in succession; and this variety is very closely followed by the Boston Pea variety. The heaviest average weight per measured bushel was produced by the Prolific Dwarf Tree, which is sixty-six pounds in the average of five years' experiments, and was 68.6 pounds in the experiment of the present year. The Marrowfat variety has large white beans, but it will be seen that it is a light cropper, producing about 6½ bushels per acre less than the Medium or Navy in the average for the number of years during which these beans have been grown. The varieties which give the best satisfaction over a number of years are the ones which are likely to give the best all round results in general cultivation.

Buckwheat—Comparative Test of Four Varieties.

Four varieties of buckwheat were sown this year, but the crop was a very poor one and the tabulated results are not given here. As three of the varieties were grown for three years previous to 1898, it might be proper to mention that the Japanese produced an average of 22 bushels, Silver Hull, 18, and Common Grey 15.7 bushels per acre. In average weight per measured bushel Silver Hull went 50.8 pounds, the Common Grey 49.5 pounds, and the Japanese, 45.8 pounds. Thus it will be seen that the Japanese has given the best yield of grain per acre, but the Silver Hull has produced a grain which weighs the heaviest per measured bushel.

Grain Grown in Mixtures for the Production of Grain and Straw.

For six years in succession a very interesting experiment has been conducted by growing oats, spring wheat, barley and peas separately and in various combinations for the production of grain and straw. Six mixtures, having two classes of grain in each mixture, four having three classes of grain in each mixture, and one having all four classes of grain in combination have been used each year. This would make in all eleven mixtures, besides the four grains grown separately, forming in all fifteen plots. This experiment was conducted in duplicate, thus making thirty plots each year, or 180 plots in the six years. The plots were 1/100 of an acre in size in every instance. In 1898, the seed for one set was sown on April 28th, and for the duplicate on April 29th. The varieties were cut when they reached the proper stage of maturity, and, when dry, were taken to the experimental barn and threshed. The grain was then cleaned; and the results are placed in tabulated form, which gives the number of pounds of grain, instead of the number of bushels per acre, owing to the grain being in various combinations

Varieties of grain grown in mixtures.	Yield of straw per acre.		Yield of grain per acre.	
	1898.	Average six years.	1898.	Average six years.
	tons.	tons.	lbs.	lbs.
1. Barley and oats	1.83	1.74	2,575	2,261
2. Barley, peas and oats	1.91	1.67	2,379	2,101
3. Barley, wheat and oats	2.00	1.72	2,546	2,067
4. Peas and oats	2.10	1.77	2,419	1,988
5. Barley, peas, wheat and oats	1.82	1.71	2,114	1,955
6. Wheat and oats	1.97	1.68	2,269	1,921
7. Peas, wheat and oats	1.99	1.73	2,172	1,860
8. Barley and peas	1.94	1.56	2,122	1,760
9. Barley, peas and wheat	1.79	1.57	1,750	1,665
10. Wheat and barley	1.63	1.41	1,856	1,558
11. Peas and wheat	1.42	1.37	1,257	1,322

The foregoing results show that a mixture of barley and oats gave an average of 2,261 pounds of grain, and that a mixture of peas and wheat gave a yield of only 1,322 pounds; or a yield of 939 pounds of grain less than that produced by the mixture of barley and oats. Three of the mixtures produced upwards of one ton of grain per acre. In yield of straw per acre in the average of the six years' experiments, it will be seen that the peas and oats produced the greatest yield and the peas and wheat the lightest. From the general results it will appear that the different classes of grain exert an influence upon the yield of grain in the following order, namely: oats, barley, peas, and wheat, the oats having the greatest influence, and the wheat the least. When a comparison is made between the different grains grown separately, and the same grains grown in mixture, it is found, in about ninety per cent of the experiments, that the mixtures produced a larger yield per acre than the same grains grown separately.

Grain—Selection of Seed.

Within the last six years a large amount of very careful work has been done in order to determine the influence of different selections of seed upon the resulting crop. The reader's attention is directed to the results of these experiments, which are becoming more valuable from year to year, owing to the increasing length of time during which the experiments have been conducted. The Mandscheuri barley, Herison Bearded spring wheat, Siberian oats, and Prussian Blue peas were the varieties used for this experiment. Fresh seed has been taken each year from the grain grown in the farm department. It will, therefore, be understood that what ever difference there is from the influence in the selection of seed, that difference is attributed purely to the size and the selection of the seed. For the large plump seed none but well developed grains were selected; for the small plump sample the grains selected were of a uniform character; and for the shrunken sample none but shrunken grains were used—the last selection being made regardless of the size of the kernels. The sample of cracked grain in the case of barley contained nothing but grains which were broken crosswise, as is frequently done by the grain separator in threshing. In the selection of the large plump seeds, one-half pound was carefully weighed from each class of grain. The number of large plump seeds of each kind of grain was then counted, and a corresponding number was taken of the medium sized grain, the small plump grain, the shrunken grain, and the broken grain. The different selections were sown upon plots exactly one rod square. The following table gives the results of this experiment in 1898, and also the average results for three, four, five, and six years in succession, as indicated in the table.

Class of grain.	Selection.	Number of years tested.	Weight per measured bushel.		Yield per acre.			
					Straw.		Grain.	
			1898.	Average for number of years grown.	1898.	Average for number of years grown.	1898.	Average for number of years grown.
			lbs.	lbs.	tons.	tons.	bush.	bush.
Mandscheuri barley	Large plump seed	4	48.81	48.63	1 61	1.47	56.27	**46.73**
	Small plump seed	4	49.13	47.61	1.58	1.50	52 50	**43.30**
	Shrunken seed	4	47.69	47 56	1.58	1.42	47.40	**39.30**
	Cracked seed	4	47.00	46.80	1.47	1 33	45 57	**36.45**
Herison bearded spring wheat.	Large plump seed	6	59.00	58.68	1.43	1.36	18.96	**21.25**
	Small plump seed	6	57 88	57.93	1.25	1.20	14.45	**17.27**
	Shrunken seed	6	57 69	56.07	1.16	1.19	14.80	**17.14**
Siberian oats	Large oats	5	28.98	31 60	1.75	1.81	54.49	**52.38**
	Medium oats	5	29.23	30.73	1.65	1.76	39.44	**46.61**
	Small oats	5	26.14	30.37	1.42	1.74	29.69	**37.96**
Prussian blue peas	Large seed	3	60.19	59.73	1.53	1.27	19 68	**24.03**
	Small seed	3	61.56	59.65	.75	.94	8.45	**17.88**

On examining the average results for the number of years during which this experiment has been conducted, the reader will see that the large plump seed gave the largest yield of grain per acre with barley, spring wheat, oats, and peas; and also that large plump seed produced grain which weighed more per measured bushel than any other selection with each of the grains under experiment. The large plump seed produced an average of 7.4 bushels per acre more than the shrunken seed in the case of barley, 4.1 bushels more in the case of spring wheat, and 6.15 bushels in the case of peas. The large plump oats gave an average yield of about fourteen bushels per acre more than that produced from the small oats.

Sound and Cracked Peas for Seed.

A large quantity of the peas grown throughout the Province is threshed with a machine, which in many instances cracks a considerable portion. More or less of the peas thus cracked are used in the seed the following year, and, in order to obtain information regarding the influence of the splitting of the peas upon germination of the same, experiments have been conducted for six years in succession, and the results show that the whole peas give more than three times the yield per acre that the seed which was split in the threshing gives. In many instances, the germ becomes separated from the split peas, and the grain is thus made useless for seed purposes.

Seed Peas Injured by the Weevil.

There seems to be a great difference of opinion in regard to the value of weevily peas for seed, as seedsmen and others, who have seed for sale, sometimes claim that weevily peas will grow nearly as well as sound ones. In some parts of Ontario, especially in the south-western portion of the Province, the injury by the pea weevil is considerable. Careful experiments have been made by using weevily and sound peas of two leading varieties, namely, the Marrowfat and the Golden Vine. The results of the tests have been very uniform, and the average results go to show that about 59 per cent. of weevily peas of the Marrowfat variety and 87 per cent. of weevily peas of the Golden Vine variety do not grow. Those of the Marrowfat variety, being larger in size than those of the Golden Vine, were not injured so much. Taking the average results of all the experiments with the two varieties, we find that only about one-quarter of weevily peas will grow.

Selections of Seed for Five Years in Succession.

Different qualities of seed of oats, barley, and spring wheat, were very carefully selected in 1894. The selections made were sown on plots of exactly the same size, which were situated side by side. From the crop produced in 1894 seed was again selected in the same manner, and was sown on similar plots in the spring of the following year. From the crops produced from the different selections of seed in 1895 a similar selection was again made in the spring of 1896. The selection was repeated in each of

Selections.	Average number of grains per ounce of crop.											
	Barley.			Spring wheat.				Oats.				
	1895. 2nd yr.	1896. 3rd yr.	1897. 4th yr.	1895. 2nd yr.	1896. 3rd yr.	1897. 4th yr.	1898. 5th yr.	1895. 2nd yr.	1896. 3rd yr.	1897. 4th yr.	1898. 5th yr.
Large plump	600	782	621	958	1,043	949	795	1,143	1 874	1,309	1,253
Small plump	704	844	724	1,137	1,147	1,112	1,028	1,161	1,845	1,292	1,325
Shrunken	807	897	842	1,161	1,306	997	830	1,196	1,917	1,434	1,291

the next two years, and the selections of seed thus secured were sown upon plots each of which was one rod square. Exactly the same number of grains were used on the plots with the experiment of each class of grain. As this experiment is especially concerned with the quality of grain produced, a table has been arranged giving the number of grains per ounce, and the crop produced from the different selections of barley, spring wheat, and oats, in each of the past three years. The smallest number of grains per ounce, of course, means the largest sized grains. The following table does not indicate the exact selection made in the case of oats, as the experiment was, in this case, large plump grains, medium-sized grains, and small-sized grains. This fact should be considered in examining the table.

Owing to a mixture which occurred in connection with the experiment with barley, we are unable to give the results of this class of grain for 1898. It will be observed that the results of spring wheat for 1898 show that it took about two hundred and thirty-three more grains grown from the small plump seed to weigh an ounce, than it did of those produced from the large plump grains; and it will be seen, from an examination of the foregoing table, that, with two slight exceptions, large plump seed produced larger grains than those produced by either small or shrunken seed.

Selection of Seed Oats for Six Years in Succession.

For six years in succession an experiment has been conducted with Joanette oats, by selecting large plump well-developed seeds, light-weighing and light-colored seeds, and also seeds from which the hull had been removed by the separator. The experiment was begun in the spring of 1893 by selecting seed from the general crop of the Joanette oats of the previous year. The selection made in each of the following years was from the product of the selected seed of the previous year. The number of grains used on each plot was carefully counted, and an equal number was used of each selection in each of the years in which this experiment was conducted.

Selection.	Number of grains per oz. 1898.		Weight of grain per measured bushel.						Yield of grain per acre.				
	Total.	Hulled.	1893.	1894.	1895.	1896.	1897.	1898.	1893.	1894.	1896.	1897.	1898.
			lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	bush.	bush.	bush.	bush.	bush.
Dark plump ..	1,474	120	32.3	34.5	32.9	27.9	34.8	35.9	45.7	67.3	43.4	53.4	80.1
Light	1,601	34	30.2	32.8	31 1	24.0	32 4	31 3	38.0	50.9	28.7	49.3	73.7
Hulled	1,494	160	33.8	34.9	33.4	26 6	33.0	36.2	34.4	57.4	41.5	57.9	78.5

On examining the comparative size of kernels produced in the crop of 1898, we found that the light seed produced the smallest grain, the hulled seed the next smallest, and the large plump seed the largest and the heaviest grain. The seed which was hulled by the separator, produced good results in yield of grain per acre, but the table shows that there were a greater number of hulled grains from this selection than from any of the others in the crop of 1898. In weight per measured bushel, the crop produced from the hulled grain was the heaviest, and that produced from the light grain was the lighest in the results of the past year.

It will be noticed that the hulled grain has given very good results throughout. This seems a little strange; but when it is considered that it is only well developed seed having a large kernel and thin hull that will be hulled in the threshing, and that the hulling seems to have but little injury upon the germination of seed, the good results from the hulled seed appears to be quite reasonable.

Spring Grain—Different Dates of Seeding.

For seven years in succession, barley, spring wheat, and oats, and for six years in succession peas, have been sown on three dates, beginning on April 21st and ending on May 11th. The experiments were conducted in duplicate in each case. The plots in every instance were 1/100 of an acre in size, and the seeding was done broadcast with the hand. The following table gives the average weight per measured bushel and yield of straw and grain per acre for each of the crops for six and seven years.

Date of seeding.	Average weight per measured bushel.				Average yield of straw per acre.				Average yield of grain per acre.			
	Barley 7 years.	Peas 6 years.	Spring wheat 7 years.	Oats 7 years.	Barley 7 years.	Peas 6 years.	Spring wheat 7 years.	Oats 7 years.	Barley 7 years.	Peas 6 years.	Spring wheat 7 years.	Oats 7 years.
	lbs.	lbs.	lbs.	lbs.	tons.	tons.	tons.	tons.	bush.	bush.	bush.	bush.
April 21-25	50.55	59.62	59 46	33.44	1.23	1.15	1.14	2 01	40.62	31.48	17.99	71.93
May 1-4	49.08	59.97	58.84	31.48	1.17	1.09	.99	1.80	35.62	29.67	14.09	63.19
May 9-11	46.75	60.16	58.04	28.85	1.04	.98	.87	1.57	28.25	25.93	10.76	51.73

The results of an experiment, such as the one under consideration, which has been conducted for seven years in succession, should be of much value in showing the real difference in sowing grain at different dates in the spring of the year through a variety of seasons. Some years this experiment commenced earlier than the 21st of April; but the results are not here given owing to the impossibility of having the experiment conducted in full at a much earlier date than the 22nd of April in all of the years. If the results from earlier sowing appear to be more satisfactory than those from later sowing, by an increase in both the yield and the quality of grain in the county of Wellington, it is quite likely that the same will hold good in other sections of the Province, althongh the exact dates may not be the same in all cases. In average weight per measured bushel it will be seen that the barley, spring wheat, and oats produced the heaviest grain from the seeding of the first date, the second heaviest from that of the second date, and the lightest from that of the third date. In the case of the peas, however, such was not the case, as exactly the reverse was true. As the season advanced from April 21st to May 11th, the quality of peas improved.

On examining the yields per acre from sowing the different grains on the three dates it will be found that, without a single exception, the yield of grain decreased as the dates of seeding advanced. In a period of only about two weeks, there was a decrease in the yield of grain per acre by $12\frac{1}{2}$ bushels in the case of barley, $5\frac{1}{2}$ bushels in the case of peas, $7\frac{1}{8}$ bushels in the case of spring wheat, and $20\frac{1}{16}$ bushels in the case of oats. These results are too striking to be allowed to pass by unheeded. Taking all things into consideration, the reader will see that *oats*, *spring wheat*, and *barley* give decidedly the best results from the earliest dates of seeding; while in the case of *peas* the returns were about equal for the first two dates, when both yield and weight per measured bushel are taken into account.

Spring Grain—Drilling vs. Broadcasting.

For five years in succession, peas, spring wheat, oats and barley have been sown with the grain drill, and also have been broadcasted with the hand. The experiment was conducted in duplicate in each of these years. It should be clearly understood that the land was in a good state of cultivation when the seeding took place in every instance. Had the land been left in a rough, poorly cultivated state, the result might have been quite different. The plots were 1-100 of an acre in size in every case. The following

table gives the average results of the four kinds of grain for each year during which the experiment has been conducted :

Method of seeding.	Yield of straw per acre.						Yield of grain per acre.					
	1894.	1895.	1896.	1897.	1898.	Average	1894.	1895.	1896.	1897.	1898.	Average
	tons.	tons.	tons.	tons.	tons.	tons.	bush.	bush.	bush.	bush.	bush.	bush.
Broadcasted	1.88	2.03	1.23	1.21	1.07	1.48	45 60	53.23	45.02	25.63	26.72	39.24
Drilled	1.95	1.86	1.40	1.24	1.02	1.49	46.30	51.07	48.13	27.03	25.64	39.63

In a yield of grain per acre, the seeding which was done with a grain drill, produced the best results in 1894, 1896, and 1897 ; and the seeding which was done by hand, produced the highest yields in 1895 and 1898. When the average of the five years results was taken into consideration, it was seen that seeding with the grain drill produced about 2/5 of a bushel per acre more than the seeding which was done by hand. In connection with the results of the foregoing table, the reader should also consider the results of sowing the different classes of grain with the drill and by hand on each of six different dates. These results will be found after the variety test of each class of spring grain.

Spring Grain—Different Preparations of Soil.

Land which grew potatoes, turnips, and carrots in 1897 was cultivated in the autumn of the same year, but was left unplowed. In the spring of 1898 half the land devoted to each crop of the previous year was plowed, and the remaining half was cultivated, but left unplowed. Oats, spring wheat, barley, and peas were each sown upon potato ground, turnip ground, and carrot ground which had been plowed previous to sowing; and also upon land which received a good cultivation but was not plowed. There were in all twenty-four plots ; each crop on the potato and turnip ground being 1/40 of an acre in size, and each plot on the carrot ground 1/80 of an acre in size. The grain was sown on the potato ground on May 4th, on the turnip ground on May 5th, and on the carrot ground on May 6th. The crops were all harvested when they reached the proper stage of maturity, and were carefully taken to the experimental barn, where they were weighed and threshed. The following table gives the results of this experiment for the year 1898 :—

Previous cropping.	Method of cultivation.	Weight per measured bushel.					Yield of grain per acre.				
		Siberian Oats.	Oderbrucker Barley.	Pringle's Champion Spring Wheat.	White Wonder Peas.	Average.	Joanette Oats.	Two-rowed Italian Peas.	Herison Bearded Spring Wheat.	New Zealand Field Peas.	Average.
		lbs.	lbs.	lbs.	lbs.	lbs.	bush.	bush.	bush.	bush.	bush.
Potatoes	Plowed.	35.91	51.75	60.32	60.38	52.09	54.61	44.07	15.50	16.53	**32.68**
	Cultivated.	36.36	51.88	60.44	61.38	52.52	55.86	38.54	17.63	14.94	**31.74**
Turnips	Plowed.	32.09	51.19	60.00	60.13	50.85	78.88	46.83	18.31	32.20	**44.06**
	Cultivated.	33.92	52 25	60.50	59.38	51.51	74.09	50.28	18.82	33.15	**44.09**
Carrots	Plowed.	35.44	52.88	60.00	58.13	51.61	63.98	29.17	21.51	21.63	**34.07**
	Cultivated.	35.61	52.50	59.88	58.50	51.62	57.36	27.45	21.15	21.11	**31.77**

It must be understood that this experiment extends for a period of but one season, and that it will likely be continued for at least four years to come. It will be seen

from an examination of the above figures that the results are very similar for the two methods of working land. In quality of grain there seems to be a slight advantage from the unplowed land, and in the yield of grain per acre a slight advantage from the land which was plowed. It will be understood that the land which was cultivated took less time and labor in preparation than that which was plowed. It is important to know that the sections of the experimental grounds used for the potatoes, turnips, and carrots in 1897 were quite widely separated, although all were in the experimental grounds; it is, therefore, unfair to compare the different sections which were devoted to the root crop in 1897 with one another as grain-producers in the following year, owing to their being somewhat differently located.

Experiments with Potatoes and Field Roots.

In 1898 experiments with potatoes were conducted in the south-western portion of the experimental grounds, on land which had a gentle slope towards the south-west. The greater number of the root experiments were conducted in the same division of the experimental grounds, while others were conducted in different portions. Nearly all the land used for the potatoes and the roots had a grain crop in 1897, after which it was plowed, and in the spring of the present year was thoroughly worked. For the variety experiments, the plots were 1-100 of an acre in size; but for the experiments for different methods of cultivation, the plots varied somewhat according to the individual experiments. Under the heading of "Roots," experiments were conducted with fall turnips, swede turnips, mangels, sugar beets, carrots, parsnips, and kohl-rabi.

Potatoes.—Comparative Test of One Hundred and Eighty-three Varieties.

Varieties of Potatoes.	Results for 1898.			Average for three years.		
	Per cent. of whole crop marketable.	Weight of 30 largest potatoes on each plot.	Yield of potatoes per acre.	Per cent. of whole crop marketable.	Weight of 30 largest potatoes on each plot.	Yield of potatoes per acre
	%	lbs.	bushels.	%	lbs.	bushels.
1 Convoy	86.92	10.50	222.92	87.73	12.75	**226.19**
2 Empire State	88.87	12.00	202.08	90.30	12.83	**224.58**
3 Rural New Yorker No. 2	90.95	11.50	184.17	92.26	14.08	**220.42**
4 Ohio Junior	89.98	15.50	207.92	91.19	12.00	**217.92**
5 Dakota Red	83.74	10.50	169.17	88.78	12.92	**217.22**
6 Early Rose	86.49	14.00	231.25	87.00	13.67	**217.22**
7 Early May Flower	87.02	13.00	218.33	85.61	12.17	**216.94**
8 Dempsey's Seedling	81.53	12.75	196.25	82.01	12.67	**215.14**
9 Ideal	84.63	12.75	214.17	81.01	11.58	**215.14**
10 Silver King	83.16	11.00	200.42	84.90	13.33	**215.14**
11 Early Oxford	80.67	10.25	187.50	85.90	13.42	**215.00**
12 Early Rochester	88.94	12.50	173.33	90.77	15.00	**213.96**
13 Thunderbolt	90.22	12.75	212.92	90.06	14.67	**211.95**
14 Governor Foraker	83.14	9.25	217.50	76.92	9.83	**211.11**
15 Irish Daisy	85.82	8.00	235.00	79.29	9.33	**210.83**
16 Landreth's Farmers' Alliance	79.81	12.75	214.58	81.92	13.25	**210.41**
17 Pearl of Savoy	88.68	11.25	224.58	86.96	12.83	**210.28**
18 Montana Bluff	87.19	14.50	250.42	81.76	11.25	**209.10**
19 Bruce's White Beauty	83.30	13.00	204.58	81.88	12.33	**209.03**
20 Red Australian	82.23	9.50	194.58	84.95	11.92	**209.03**
21 Watson's Seedling	83.19	11.50	240.42	83.04	11.83	**208.89**
22 Munro County Prize	87.88	12.25	192.50	84.97	13.33	**208.89**
23 Halo of Dakota	84.92	12.50	201.67	82.14	11.42	**208.33**
24 Vick's Perfection	84.11	12.50	215.00	82.04	12.67	**208.19**
25 Early Harvest	75.26	9.50	198.75	74.47	10.17	**207.78**
26 Crown Jewel	85.29	11.75	170.00	84.55	12.00	**206.94**
27 Summit	84.63	11.50	208.75	87.85	13.50	**206.80**
28 Sweet St. Vernal	85.88	10.25	176.67	85.24	12.17	**204.86**
29 St. Patrick	86.65	13.00	202.92	83.67	11.83	**204.86**
30 Manitoba Rose	82.57	10.25	191.25	86.95	12.08	**204.17**

POTATOES.—COMPARATIVE TEST.—*Continued.*

Varieties of Potatoes.	Results for 1898.			Average for three years.		
	Per cent. of whole crop marketable.	Weight of 30 largest potatoes on each plot.	Yield of potatoes per acre.	Per cent. of whole crop marketable.	Weight of 30 largest potatoes on each plot.	Yield of potatoes per acre.
	%	lbs.	bushels.	%	lbs.	bushels.
31 Reed's Eighty-Six	83.61	11.50	251.67	77.71	10.25	**203.92**
32 Steele's Earliest of All	80.00	11.75	225.00	72.15	10.25	**203.75**
33 Rose's New Invincible	88.64	12.00	187.08	88.97	13.92	**203.47**
34 Nebula	77.02	10.50	237.58	75.00	10.75	**202.66**
35 American Wonder	87.80	11.50	205.00	86.92	12 75	**202.64**
36 Early Gem	87.78	13.25	245.42	88 15	13.00	**202.64**
37 Halton's Seedling	81.65	12.25	231.67	83.90	12.17	**202.64**
38 Clark's Nonsuch	89.07	15.25	205.83	87 24	12.92	**202.08**
39 Timpe's No 4	87.45	11.50	215.83	84.14	11.17	**201.80**
40 Hotel Favorite	87.80	12.50	208.33	85.26	11.42	**201 53**
41 The Daisy	85.42	13.00	200.00	87.12	13 92	**201,39**
42 P. E. I. Early Rose	83.51	10.75	194.58	83.39	12.00	**201,25**
43 Paris Rose	82.26	10.50	220.83	79.82	11.83	**201,11**
44 Island McDonald	82.97	12.00	232.50	80.72	12.50	**200,56**
45 Molly Star	82.07	13 25	211.67	84.50	12.83	**200,56**
46 Stray Beauty (Wilson's)	77.06	10 00	187.08	79.93	9.33	**200.00**
47 Hoffman	81.53	11.75	223.33	82.84	12.58	**199,44**
48 Burpee's Extra Early	81.04	11.00	184.58	79.36	11.08	**198,61**
49 Rochester Rose	81.08	13.75	246.67	81.74	12.83	**198,20**
50 May's Imperial	87.50	10.00	173.33	85.73	11.83	**198,19**
51 Woodbury White	83.41	10.00	175.83	87.05	13.58	**197,92**
52 White Elephant	91.71	15.00	180.83	88.54	14.75	**197.64**
53 Early Six Weeks	86.36	13.50	241.25	85.06	12.83	**197.64**
54 Early Dominion	89.26	13.50	186.25	89.84	15.25	**197.64**
55 State of Maine	90 95	13.25	179.58	90.66	13.42	**197,50**
56 Rural Blush	82.98	10.25	159.17	84.97	11.58	**197.08**
57 Early Puritan	89.28	15.00	190.42	88.47	14.75	**196.67**
58 Pootaluck	88 62	12.00	205.00	85.49	13.58	**196.67**
59 Advance	82.99	11.50	161.67	85.11	13.42	**196.11**
60 Vaughan	78.39	9.75	212.08	82.47	11.67	**196.11**
61 Burpee's Superior	85.29	10.50	209.58	83.96	11.92	**195.97**
62 Early Maine	82.24	12.00	241.67	84.03	12.67	**195.77**
63 New Queen	87.34	11.75	200.83	86.27	11.67	**195.66**
64 Bill Nye	93.42	11.25	183.75	84.09	11.25	**195.35**
65 Badger State	83.33	11.50	190.00	84.28	12.42	**195.14**
66 Thorburn's Extra Early	81.15	11.25	245.42	83.31	12.00	**195.00**
67 Vick's Champion	91.09	14.25	205 83	88.38	12.92	**194.86**
68 Green Mountain	89.32	11.25	152.08	94.45	13.92	**194.58**
69 Parson's Prolific	88.72	14.75	221.67	88.11	13 50	**194.03**
70 Arizona	84.56	11.50	226.67	83.07	11.33	**193.89**
71 Mount Carbon	90.76	13 50	198.33	88.50	12.92	**193.61**
72 Extra Early Vermont	79.29	12.25	223.33	75.25	10 50	**193.61**
73 Alexander's Prolific	87.73	12.00	203.75	88 08	13.67	**193.47**
74 Polaris	84.50	12.00	225.83	82.89	12.08	**193.47**
75 Brown's Prolific	84.71	11.00	231.67	74.06	9.25	**193.27**
76 Pride of the West	80.77	10.75	216.67	83.41	11.25	**193.06**
77 Rosy Morn	86.87	11.50	206 25	90.19	12.58	**192.92**
78 Tonhocks	91.43	10.50	116.67	89.18	12.58	**192,64**
79 Early Sunrise	80.10	10.50	167.50	84.53	12.25	**192,50**
80 The Dandy	84 14	11.75	223.33	84.42	10.83	**191,81**
81 Scotch Regent	83.23	12.50	193.75	81.08	12.00	**190,83**
82 Mammoth Pearl	90.32	14.00	193.75	88.72	13.67	**190,56**
83 Burnaby Mammoth	86.87	13.50	241.25	81.02	11.25	**190.56**
84 Great Divide	79.49	8.75	181.67	77.93	9.67	**190,28**
85 Wilson's First Choice	88 34	11.50	185.83	86.05	11.83	**189,88**
86 Morning Star	85.65	11.50	174.17	84.96	11.08	**189,86**
87 King of the Roses	86.08	10.25	197.50	82.98	11.33	**189,58**
88 Early Yorker	84.45	13.00	217.08	84.19	12.50	**189,44**
89 Golden Harvest	78.54	10.00	211.67	74.13	9.75	**189,17**
90 Sunlight Star	87.65	12.00	212.50	86.76	12.58	**189,17**
91 Montana Wonder	85.53	11.50	190.00	79.57	12.08	**189.03**
92 Restaurant	91.71	14.50	236.25	85.93	11.42	**189.03**

POTATOES —COMPARATIVE TEST.—*Continued.*

Varieties of Potatoes.	Results for 1898.			Average for three years.		
	Per cent. of whole crop marketable.	Weight of 30 largest potatoes on each plot.	Yield of potatoes per acre.	Per cent. of whole crop marketable.	Weight of 30 largest potatoes on each plot.	Yield of potatoes per acre.
	%	lbs.	bushels.	%	lbs.	bushels.
93 Everett's Seedling	80.04	11.50	206.67	81.29	11.25	**188.75**
94 Garnets	84.25	11.75	203.75	83.09	11 67	**188.61**
95 English Bumpers	89.37	12.25	219.58	82.84	9.50	**188.61**
96 Earliest Known	84.47	11.00	201.25	82.90	10 00	**188.40**
97 Granger	85 33	11.00	187.50	83.34	11.42	**188 19**
98 Keiser	91.02	12.50	176.25	90.18	12.42	**187.92**
99 Early Everett	88 76	13.25	217.08	86.10	13.00	**187.92**
100 Early June Eating	88.98	13.75	204.17	86.07	13.25	**187.22**
101 Early Northern	83.67	10.75	204.17	77 41	10 17	**187.22**
102 The Freeman	83.34	10.00	235 83	73.94	9 67	**186.67**
103 Kosh Konong	89.93	12.50	190.42	88.79	13 83	**185 14**
104 Late Rose	83.47	12.00	196.67	85.69	13 75	**184.31**
105 Delaware	86 99	12 25	172.92	89.32	12.58	**184.17**
106 Howe's Premium	86.42	10.50	190.42	85.96	9.58	**183.92**
107 Hopeful	87.79	12 75	197 92	89.24	13.83	**183.89**
108 Brown's Elephant	86.67	11.25	212.50	79.10	9.58	**183.75**
109 Six Weeks	89.96	12.50	228 33	87 75	11.33	**183.19**
110 Salzer's Prize Taker	83.16	10.00	202.92	79.38	9 92	**181 88**
111 Pride of Ireland	90.46	14.50	209.58	89.66	13.83	**181.39**
112 Great West	86.20	12.00	220.42	87.82	12.42	**180.33**
113 Early Pride	78 87	10.00	236.67	72.92	9.08	**180.00**
114 Burbank's Seedling	82.11	11.00	142.08	82.46	11.50	**179.72**
115 Woodhull	84.76	12 25	194.17	76.49	10.33	**179.72**
116 Eureka	85 66	9.75	197.08	80.00	9.92	**179.30**
117 Russel's Seedling	85.82	13.75	223.33	85.56	11.42	**179.30**
118 Van Orman's Earliest	81.27	11 00	229.17	79.17	10.00	**179.17**
119 Napoleon	80.89	10.25	215.83	72 20	8.83	**179.03**
120 Putnam	80.78	13.25	171.25	82 86	11.83	**178.89**
121 New Satisfaction	81.15	11.00	203.33	79.18	10.42	**177.92**
122 Chicago Market	82.63	11.75	208.75	82.42	11.00	**176.67**
123 General Gordon	83.33	11 25	192 50	86.62	12.17	**176 53**
124 Adirondack	82.19	11.00	182 50	84 62	11.42	**176.53**
125 Chas. Downing	71.89	7.75	154 17	71.31	10.00	**175.97**
126 Snow Queen	85.00	13.50	216.67	79.75	18.83	**175.00**
127 Hartzell's Seedling	89 29	12.25	186 67	88.69	12.17	**174.72**
128 White Lily	83 87	11.50	167.92	82.62	12.17	**174.58**
129 Minister	88.82	10.25	137.92	90.35	12.50	**174.10**
130 Fillbasket	88.11	15.00	213 67	82.53	12.00	**173.52**
131 Columbus	85.84	13.00	194.17	84.62	13.17	**173.47**
132 Early White Prize	83.79	11.50	210.83	80.81	10.00	**171.94**
133 Troy Seedling	75.15	11.50	142 50	68.29	8.92	**170.14**
134 Boley's Northern Spy	91.25	13.25	200.00	92.14	13.25	**170.00**
135 Pride of the Table	81.03	10 75	217.50	80 61	9.00	**169.86**
136 Negro	45.68	6.00	135.00	51.31	7.42	**169 58**
137 North Pole	78.35	10.00	202.08	73.88	9.25	**169.30**
138 The Rosedale	80.77	10.25	216.67	81.78	11.17	**168.61**
139 Flower City	80.28	9.75	177.50	66.36	8.50	**168.54**
140 Snow Drop	84.94	15.25	237.92	82.16	12.17	**168.10**
141 Early Pontiac	80.70	10 75	142 50	79.64	11 33	**168.05**
142 Vanguard	74.89	9.75	194.17	70.47	9.00	**167.05**
143 Rot Proof	63.68	7.75	176.67	61 77	7.67	**166.81**
144 Bell's Stray Beauty	72.58	8.25	155.00	76.79	8.33	**166.67**
145 Ontario	81.60	10.75	192.50	79.58	10.42	**166.39**
146 White Star	84 61	11.50	143.75	85 72	11.42	**165.14**
147 Clay Rose	76.85	10.25	185.42	78.84	9.92	**164.79**
148 N. B. & G. Co's Grand Mogul	88.59	11.25	172.67	89.70	11.75	**164.43**
149 Pride of the Market	82.81	12.25	174.58	82.82	11.17	**163.89**
150 McIntyre	83.66	12.00	188.75	79.88	11.42	**162.78**
151 Governor Rusk	71.29	9.00	171.25	66.73	8.00	**161.11**
152 Early Market	87.70	13.25	179 25	84.53	13.50	**160.12**
153 Snowflake	69.58	9.00	167.08	68.44	8.25	**159.16**
154 The Peoples	89.55	13.00	167.50	87.05	12.00	**159.03**

POTATOES.—COMPARATIVE TEST.—*Concluded.*

Varieties of Potatoes.	Results for 1898.			Average for three years.		
	Per cent. of whole crop marketable.	Weight of 30 largest potatoes on each plot.	Yield of potatoes per acre.	Per cent. of whole crop marketable.	Weight of 30 largest potatoes on each plot.	Yield of potatoes per acre.
	%	lbs.	bushels.	%	lbs.	bushels.
155 Improved Rose	86.71	11.25	216.25	80 91	10.83	**158.99**
156 Early Essex	82.62	11.25	203.75	80.73	11.17	**158.20**
157 Lee's Favorite	76.01	9.25	175 42	73.73	9.50	**156.53**
158 Vick's White Gem	82 04	11 25	220.42	72.97	9.67	**155.83**
159 World's Fair	70.78	10.75	175.42	71.85	9 83	**155.42**
160 Acme	89.98	10.75	174.50	84.32	9.75	**154.21**
161 Victor Rose	83.80	12.00	192.92	85 56	11.50	**153.89**
162 Seneca Beauty	84.03	11.25	190.42	87.86	12.17	**149 31**
163 Early Advancer	74.75	8.75	166.67	74.27	9.08	**147.71**
164 Landreth's Garfield	69.46	8.25	139.17	70.16	9.42	**145.69**
165 Potentate	86.09	12.25	143.75	89.49	13 00	**144.03**
166 Rose Seedling	83.64	10.50	180.83	87.66	11.58	**142.92**
167 Chautauqua	77.90	9.25	182.92	76.62	9.33	**139.17**
168 Silver Dollar	78.73	9.50	150.83	73.47	8.83	**139.17**
169 Browell's Seedling	77.58	9 50	182.08	74.29	9.75	**138.06**
170 Beauty of Beauties	90.13	13.25	194.17	88.57	11.58	**134.03**
171 Harbinger	69.12	9.50	180.83	64 40	9.83	**133.19**
172 Dreer's Standard	76.23	10.50	135.00	79.59	10.17	**130.90**
173 Maggie Murphy	83 82	10.00	172 50	85.79	11.25	**130.00**
174 Rose of Erin	79.37	10.50	145.42	86.58	11.25	**127.43**
175 Lady Finger	25.40	5.75	157.50	31.11	5.33	**125.83**
176 Michigan Blues	85.00	10.75	125.00	87.79	11.00	**125.28**
177 California Red	66.40	8 25	158.75	61.91	7.42	**125.07**
178 Prince Albert	79.42	8.00	172.08	75 87	8.83	**117.64**
179 Manhattan	86.96	10.25	143.75	86 05	8.72	**116.04**
180 Weld's Orange	62.29	4 25	149.17	49 50	4.50	**101.18**
181 Columbia Peach Blow	68.65	7.50	77.08	68.09	4.92	**98.05**
182 Irish Cups	78.66	10.25	173.75	63 60	7.50	**96.32**
183 Eyeless	36.84	4.25	23.75	40.16	6.00	**67.64**

Thirty-nine varieties of potatoes have been grown in the experimental plots for seven years in succession, sixty-four for six years, forty-six for five years, and the rest of the varieties for a less number of years. In order to secure a large number under similar conditions, the average results for only the last three years are included in the report here presented. The seed of the different varieties which we now have under experiment, was obtained from Nova Scotia, Prince Edward Island, Quebec, United States and Ontario. In 1898 the varieties were planted on the 17th, 18th, 19th, 20th, and 21st of May. Each plot consisted of three rows four rods in length, the rows being a little less than twenty-seven inches apart. Fifteen pounds of each variety were used in every instance, and the plots were so divided that there were one hundred and ninety-eight sets of each kind planted. The land was drilled with a double mouldboard plow, and the potatoes were planted four inches below the surface of the land. Flat cultivation was used throughout, and the application of Paris green with water was used three times to destroy the potato beetles. The crop was removed from the ground with a two horse potato digger. The marketable and unmarketable potatoes were divided by means of a "Pease potato sorter." The potatoes mentioned as unmarketable were those which were less than about one and one-half inches in diameter. The potatoes were weighed very soon after being dug.

By an examination of the results of the different varieties of potatoes here presented, it will be seen that no less than eighty-six varieties gave a yield of upwards of 200 bushels per acre in 1898, and that fourteen varieties produced potatoes over ninety per cent. of which were marketable. In the average of three years' experiments, forty-six

varieties gave 200 bushels or over per acre, and three varieties gave less than 100 bushels per acre. The Rural New Yorker No. 2, Ohio Junior, Green Mountain, and Boley's Northern Spy produced potatoes which had upwards of ninety-one per cent. of the total crop marketable, and quite a large number had between ninety and ninety-one per cent. It will also be noticed that only 31.1 per cent. of the Lady Finger variety, 40.16 of the Eyeless, and 49.5 per cent. of the Weld's Orange were marketable.

The Convoy, Empire State, and Rural New Yorker No 2, which occupied the highest place in yield of potatoes per acre among one hundred and eighty-three varieties grown for three years in succession, are all comparatively late potatoes. A special experiment has been conducted which gives additional information regarding eleven varieties of the earliest varieties of potatoes, the results of which will be found under another heading. The Landreth's State of Maine variety, in fact gave the largest yield per acre of all the varieties in the average of the three years; but as this high average was caused by an exceptionally high yield in 1897, it was thought that perhaps some mistake might have occurred in the harvesting of that variety in that year, and it was thought best to draw special attention to this variety in this way, rather than by embodying it in the foregoing table. The Beauty of Hebron made a fairly high record in 1896 and in 1897, but unfortunately was missed from the experiments in 1898; and this omission was not noticed until it was too late to embody it in the experiments of the present year. The Convoy variety, which stands at the head of the list, has given an average of about two and a half bushels per acre more than the Empire State in the average results here presented for the three years. In the average of thirty nine varieties grown for seven years in succession, however, the Empire State came first in average yield of potatoes per acre, and the Convoy came fifth; so that, all things taken into consideration, the Empire State is one of the most substantial varieties of potatoes which we have ever grown at this place, as a cropper for general use. It will be seen that the Early Rose variety still occupies a prominent place, being sixth in yield of potatoes per acre among the one hundred and eighty-three varieties grown for three years in succession.

Potatoes—Comparative Test of Eleven Early Varieties.

As there is usually much interest taken in early potatoes, it was thought advisable to select the eleven varieties which have proved to be the earliest in our experiments of the past few years, and test them under different conditions. An experiment has, therefore, been conducted for three years in succession by planting six rows of each variety in the spring, and digging two rows of each at the end of nine weeks, two rows of each at the end of twelve weeks, and two rows of each at the end of fifteen weeks after the seed was planted, in order to ascertain which variety of potatoes would give the best results in the shortest possible time after planting. The soil in which this experiment was conducted, was quite low-lying in 1898, and was somewhat elevated in 1897 and in 1896. A dressing of twenty tons of manure was applied to the land in the spring before the potatoes were planted. One-half bushel of seed of each variety was planted each year. The following table gives the average results of this experiment for three years:

Varieties of Early Potatoes.	Percentage of potatoes over one inch in diameter. Average three years.			Yield of potatoes per acre. Average three years.		
	9 weeks.	12 weeks.	15 weeks.	9 weeks.	12 weeks.	15 weeks.
				bush.	bush.	bush.
Tonhocks	70.47	89.47	95.20	82.08	164.78	223.70
Early Rose	59.78	88.83	95 15	76.90	143.20	214.50
Stray Beauty	71.76	87.50	92.70	124.06	173 50	200 59
Chas Downing	56.42	83.64	93.77	74.50	143.43	195.95
Steeles' Earliest of All	68.12	88.15	95.32	88.55	148.38	195 53
Early Dominion	80.64	93.77	96.53	94.28	151.68	192.42
Howe's Premium	75.53	90.02	92.61	107.92	155.21	192.40
Burpees' Extra Early	68.89	88.49	95.31	92 21	160.72	183.07
Early Ohio	80.52	93.91	93.80	111 98	170.83	180 83
Snowflake	56.11	85.68	92.83	79.18	142.60	179.17
Early Sunrise	56.93	86.76	96.63	51.06	121.60	158.35

It will be seen by an examination of the figures here presented, that the Stray Beauty, Early Ohio, and Howe's Premium, produced the greatest yield per acre on the first date of digging. Each of these varieties produced upwards of 100 bushels per acre at the end of a period of nine weeks from the time the seed was planted. The Stray Beauty is one of the very earliest varieties in which the tops die, and it will be seen that it is the variety which gave the largest yield per acre at the time of the first digging. The record of the Early Ohio is certainly a good one, as it produced about 112 bushels per acre at the end of nine weeks, over 80 per cent. of which measured more than one inch in diameter. The potatoes of this variety seem to develop very early, as do also those of the Early Dominion. Although the Tonhocks stand at the head of the list in yield of potatoes per acre at the end of fifteen weeks, still as a very early potato they do not make so good a record as some of the other varieties; as at the end of nine weeks the yield was only 82 bushels per acre, and only 70 per cent. of the potatoes were over one inch in diameter. The Early Sunrise produced an average of only 51 bushels per acre at the end of nine weeks, and only about 57 per cent. of this crop were potatoes which measured over one inch across.

Potatoes—Selection of Seed for Three Years in Succession.

In 1894 an experiment was conducted by planting three selections of potatoes, namely, large marketable potatoes, medium-sized marketable potatoes, and small marketable potatoes. In 1895, large, medium, and small whole potatoes were selected from the potatoes produced from the large, medium, and small potatoes planted the previous year. We thus had large-sized potatoes selected from the produce of large potatoes, medium-sized potatoes selected from the produce of medium potatoes, and small-sized potatoes from the produce of small potatoes. Besides this, a selection was also made of very small, unmarketable potatoes from the produce of small potatoes grown in 1895. In 1896, 1897, and 1898 similar selections were made each year from the crop produced in the year previous. The term "small potatoes" in this experiment means those one and one-half inches in diameter, and the term "very small potatoes" means those of an average of about three quarters of an inch in diameter.

Seed Potatoes Selected.	Average amount of seed per acre.	Percentage of wholecrop marketable.				Weight of 30 largest potatoes	Yield of potatoes per acre.			
	'95-6-7-8	1895.	1896.	1897.	1898.	1898.	1895.	1896.	1897.	1898.
	bush.	%	%	%	%	lbs.	bush.	bush.	bush.	bush.
Large whole potatoes	60 60	85.8	79.3	87.7	75.1	7.6	129.7	168.8	283.5	222.5
Medium whole potatoes	38.65	88.0	79.1	83.0	75.5	7.1	112.2	143.8	257 5	196.3
Small whole marketable potatoes	17.71	89 3	79 9	81.0	74.8	6.3	49 7	105.6	215.6	156.3
Very small whole potatoes	10.03	84.4	80.8	80.7	67.0	5.8	14.1	65.0	170.8	98.8

It will be seen that without any exception the largest potatoes produced the largest crop; and as the size of the seed diminished, the resulting crop was less. It will also be seen in the results of 1898, the fourth year after this experiment was started, that the crop produced from the small potatoes had only 67 per cent. of the crop marketable, while those produced from the large potatoes had 75 per cent. of the crop marketable.

POTATOES—PLANTING SETS OF DIFFERENT SIZES WITH ONE EYE IN EACH SET.

Weight of potato sets planted.	Percentage of whole crop marketable.		Average weight of 30 largest potatoes on each plot.		Yield of potatoes per acre.	
	1898.	Average 4 years. 1895-6-7-8.	1898.	Average 4 years. 1895-6-7-8.	1898.	Average 4 years. 1895-6-7-8.
	%	%	lbs.	lbs.	bush.	bush.
Each set containing 1-16 ounce and 1 eye.	64.4	75.7	5.0	6.6	42.5	**44.2**
" " 1-8 " 1 "	81.5	87.3	7.4	8.6	83.1	**83.7**
" " 1-4 " 1 "	89.4	89.1	8.0	9.5	112.5	**107.6**
" " 1-2 " 1 "	86.3	88.0	8.9	9.8	136.9	**125.8**
" " 1 " 1 "	86.0	88.9	8.8	10 0	164 4	**152.5**
" " 2 ounces 1 "	83.3	87.5	8.9	10.1	180.0	**177.4**

In 1895, 1896, 1897, and 1898, an experiment was conducted in which pieces of potatoes one-sixteenth ounce, one-eighth ounce, one-quarter ounce, one-half ounce, one ounce, and also two ounces in size were planted side by side. No piece contained more than one eye. The object of this experiment was to ascertain the influence of the size of the potato seed on the crop produced. The experiment has been conducted in duplicate in each of the four years. The potato sets were planted to a depth of about four inches, and flat cultivation was used throughout the season.

The results of the experiment in planting different-sized pieces of potatoes are very striking and are of much practical value. The average yield per acre for four years indicate very clearly that the yield of potatoes depends quite largely upon the size of the pieces which are planted, the smallest pieces giving the smallest yields, and the largest pieces the largest yields without any exception. The yields per acre for the different pieces in 1898 are very similar to those in the average of four years. The comparative amount of marketable potatoes does not seem to depend so much upon the size of the pieces planted as does the yield of the crop per acre.

POTATOES—PLANTING PIECES OF EQUAL SIZE WITH A VARYING NUMBER OF EYES.

In order to obtain some information in regard to the influence of the number of eyes on pieces of potatoes in affecting the succeeding crop, an experiment has been conducted for four years in succession. Potato sets of one ounce in size were used throughout the experiment, and, in every instance, for number one plot, the seed contained one eye in each piece; for number two plot, two eyes; for number three plot, three eyes; for number four plot, four eyes; and for number five plot, five eyes. The experiment was conducted in duplicate each year. Great pains were taken to have all the pieces of exactly the same weight—in fact, every piece was weighed by itself on an accurate balance; and each plot consisted of one row four rods in length. There were, therefore, 40 rods of potatoes in this experiment each year.

Number of eyes in the seed of potatoes.	Average yield of potatoes from each		Average yield of potatoes per acre, 4 years, 1895-6-7-8.
	Set. Average 4 years, 1895-6-7-8.	Eye. Average 4 years, 1895-6-7-8.	
	ozs	ozs.	bush.
Each potato set containing 1 ounce and 1 eye	7.20	7.20	**136.41**
" " 1 " 2 eyes	7.74	3 87	**145.47**
" " 1 " 3 "	8.06	2.70	**153.13**
" " 1 " 4 "	8.31	1.97	**162.82**
" " 1 " 5 "	8.35	1.68	**164.37**

It will be seen that the number of eyes in each set of potatoes planted has some influence in the yield of the crop; but, at the same time, the difference in yield per acre resulting from the different number of eyes is not nearly so marked as that resulting from pieces of different sizes, having one eye in each piece, as shown in the previous experiment. Seed having one eye in each set produced 136 bushels per acre, while exactly the same amount of seed of the same variety, but the pieces having five eyes in each, produced 164 bushels per acre, or an increase of twenty-eight bushels per acre. It will be understood that some of the eyes of the potatoes were carefully removed with a knife in order to get the exact number to comply with the requirments in this experiment.

Potatoes—Methods of Cultivation.

In 1896, an experiment was conducted for the first time by planting potatoes in rows twenty-six and two-fifths inches apart, with the potato sets one foot apart in the row, and in comparison with planting thirty-three inches apart each way. Another feature in connection with the experiment was that part of the potatoes, which were planted thirty-three inches apart, were cultivated on the flat and part were hilled up. This experiment has now been conducted in duplicate for three years. The different plots used for the experiment were exactly the same in shape and size, each plot being 1/60 of an acre.

Distance between rows.	Distance between plants in the rows.	Kind of cultivation.	Percentage of crop marketable, average 3 years, 1896-7-8.	Yield of whole crop per acre average 3 years, 1896-7-8.
			%	bush.
26⅖ inches	12 inches	Flat	78.12	**189.42**
33 "	33 "	Flat	80.74	**170.63**
33 "	33 "	Hills	84.46	**162.07**

Exactly similar quantities of seed were used in the different plots in this experiment; and it will be seen from the figures here presented, that by planting the potatoes in rows twenty-six inches apart, and having the potato sets twelve inches apart in the row, 189 bushels per acre were realized. In comparison with this the potatoes which were planted thirty-three inches apart, and were hilled up, gave twenty-seven bushels per acre less. There appeared to be, however, a larger percentage of marketable potatoes from the land which was hilled than from that which was left on the flat. This experiment will likely be repeated for several years.

Potatoes—Treatment for the Potato Beetle.

For two years in succession an experiment has been made to ascertain the relative difference in actual experience from treating potatoes differently in order to kill the potato beetle, and also to determine the actual results in the crops produced from the potatoes thus treated. The experiment was conducted in duplicate each year. In every instance some were left untreated, and the potato beetles allowed to eat at pleasure. Another plot in each experiment was treated with a compound which is sold upon the market under the name of "potato bug finish," and the other two plots were treated with Paris green, mixed either with plaster or with water. The application was made four times in 1897 and three times in 1898. The tops of the vines where no treatment was used were, of course, nearly all destroyed, and those upon which Paris green was used with water were the freest from the ravages of the beetles.

POTATOES—TREATMENT FOR THE POTATO BEETLE.

Treatment used for the potato beetle.	Percentage of crop marketable			Weight of 30 largest potatoes.	Yield of whole crop per acre.		
	1897.	1898.	Average 2 years.	Average 2 years 1897-8.	1897.	1898.	Average 2 years.
	%	%	%	lbs.	bush.	bush.	bush.
Paris green with water.....	78.70	60.19	69.45	7.00	190.33	86.25	**138.29**
Paris green with plaster ...	79.06	52.35	65.71	6.57	158.45	77.29	**117.87**
Potato bug finish	74.57	49.86	62.22	6.76	156.86	77.08	**116.97**
Not treated	60.58	35.01	47.80	4.57	70.33	51.05	**60.69**

The early varieties of potatoes were used in 1898, and the yields were very low in every case. It will be seen that there is a marked difference in the average yield per acre of potatoes from the different plots in each of the two years, evidently resulting from the ways of treating the vines in order to destroy the potato beetles. The potatoes which were not treated at all gave a yield of less than seventy-one bushels per acre; while those from which the beetles were destroyed by means of Paris green and water, gave an average yield of about 138 bushels per acre. In average percentage of crop marketable, it will also be noticed that the untreated potatoes had only about forty-eight per cent, while those treated with Paris green and water had nearly seventy per cent of the potatoes which were over one and one-half inches in diameter.

POTATOES—PLANTING SEED ON THE SAME DAY AS CUT AND FOUR DAYS AFTER CUTTING.

For four years in succession, an experiment has been conducted by cutting potatoes and allowing them to remain four days before planting in comparison with those cut and planted immediately.

Time of cutting and planting potatoes.	Percentage of whole crop marketable, average 4 years 1895-6-7-8.	Yield of whole crop per acre, average 4 years 1895-6-7-8.
	%	bushels.
Potatoes planted four days after they were cut	75.12	**154.48**
Potatoes planted same day as they were cut.....	76.41	**165.76**

Although it is the practice of quite a number of people to cut the potatoes and leave them several days before planting, still we have found in the results of the various experiments conducted at this place, that the potatoes which were planted the same day that they were cut gave the best results throughout. In the average of four years' experiments, it will be seen that the potatoes which were cut and planted the same day gave over eleven bushels per acre more than those which were allowed to remain four days after being cut before they were planted. It will also be seen that about one and one-third per cent more marketable potatoes were obtained from seed which was planted the same day as it was cut.

POTATOES—EXPERIMENTS FOR FIVE YEARS.

Several experiments with potatoes have been conducted for five years or over but the results are not presented here. For information regarding these experiments the reader is referred to the reports of former years.

Mangels—Comparative Test of Sixty-Seven Varieties.

In 1898, sixty-seven varieties of the long, intermediate, and globe mangels were grown in our experimental plots. The land on which the mangel seed was sown in the past year was manured in the spring of 1898 with farmyard manure, at the rate of twenty tons per acre. The soil was plowed in the autumn of 1897, and was thoroughly worked on the surface in the spring of the present year. The seeding of the mangels took place on the 11th, 12th and 13th of May, and the germination was very good throughout. The seed was sown on the level, and the land was kept comparatively level throughout the season. There were three rows of each variety, each row being four rods in length, and three and one-third links were allowed between the rows, thus making each plot 1/100 of an acre in size. When the young plants were about three inches in height they were thinned to a distance of ten inches apart in the drills. The young plants were very carefully counted, in order to have the number exact. At the time of harvesting the mangels the roots were again carefully counted, and the total number of roots divided into the total weight in order to find the exact average weight per root.

Varieties of Mangels.	Results for 1898.			Average results for number of years grown.		
	Yield of tops per acre.	Average weight per root.	Yield of roots per acre.	Yield of tops per acre.	Average weight per root.	Yield of roots per acre.
Grown for Eight Years:	tons.	lbs.	tons.	tons.	lbs.	tons.
1 Evans' Improved Mammoth Saw-log	2.85	1.068	15.05	4.08	2.136	**23.91**
2 Simmers' Improved Mammoth Long Red	2.95	1.220	15.13	4.03	2.108	**23.86**
3 Steele's Long Red Selected	3.50	1.624	19.65	3.84	2.118	**23.67**
4 Carter's Champion Yellow Intermediate	1.80	1.440	18.00	2.86	2.098	**23.17**
5 Norbitan Giant	3.15	1.730	19.55	3 89	2.097	**22.97**
6 Carter's Mammoth Long Red	3.55	1.971	23.85	4 03	2.006	**22.30**
7 Elvetham Long Red	3.35	1 583	19.00	4.19	1.897	**22.15**
8 Yellow Obendorf	2.98	1.787	21.98	3.00	1.926	**22.07**
9 Eiffel Tower	3.35	1.672	19.15	3.58	1.992	**21.95**
10 Yellow Oval-shaped Giant	2.50	1.867	22 40	2.24	1.915	**21.65**
11 May's Mammoth Long Red	3.55	1.816	22.70	4.01	1.899	**21.65**
12 New Monarch	3.53	2.071	24.65	3.40	1.859	**21.38**
13 Oblong Giant Yellow	3.05	1.987	23.75	2.56	1.925	**21.32**
14 Giant Holstein	5.75	2.139	26.95	4.17	1.892	**21.23**
15 Colossal Long Red	3.45	1.659	20.08	3.40	1.869	**20.63**
16 Chirk Castle	3.45	1.679	21.33	3.23	1.797	**20.54**
17 Red Globe	5.85	2.229	26.30	3.12	1.742	**19.29**
18 Mammoth Red Intermediate	1.90	2.137	14.85	2.79	1.875	**19.27**
19 Mammoth Golden Giant	2.58	1.939	23.68	2.66	1.719	**19.17**
20 Carter's Warden Orange	1.65	1.573	18.25	2.36	1.565	**17.65**
21 Yellow Globe	2.10	2.004	24.25	2.28	1.794	**17.64**
22 Golden Tankard	2.95	2,029	24.55	2.01	1.531	**17.25**
23 Clark's Devon Orange Globe	2.85	1.772	18.25	2 20	1.564	**16.64**
24 Long Yellow	3.60	2.154	25.85	2.70	1.787	**16.51**
25 Fisher Hobb's Orange Globe	3.05	1.638	19 25	2.21	1.480	**16.00**
26 Webb's Kenver Yellow Globe	2.60	1.558	18.70	2.09	1.412	**15.74**
27 Oblong Giant Red	1.70	1.818	10.00	1.64	1.877	**11.85**
Grown for Seven Years:						
28 Sutton's Mammoth Long Red	4.75	2.256	26.40	3.83	1.849	**20.51**
29 Canadian Giant	4.10	1.760	21.30	3 28	1.606	**17.82**
30 Gate Post	4.35	1.742	20.73	3.34	1.582	**17.35**
31 Berkshire Prize Yellow Globe	3.00	2.122	26.10	1 80	1.561	**17.34**
32 Beck's Champion Globe	1.70	1.889	22.10	1.84	1.506	**17.00**
33 Sutton's Yellow Intermediate	2.45	1 905	25.15	1.69	1.464	**16.74**
34 Sutton's Golden Tankard	2.53	1.670	19.38	1.98	1.415	**15.48**
Grown for Six Years:						
35 English Prize	4.85	2.306	27.90	3.87	1.938	**21.93**
36 Yellow Leviathan	3.60	2.266	26.85	2.89	1.920	**21.43**
37 Giant Yellow Intermediate	3.85	2.141	27.40	2.78	1.855	**21.03**
38 Jarman's Giant Intermediate	3.15	2.762	34.25	1.71	1.874	**20.92**

Varieties of Mangels.	Results for 1898.			Average results for number of years grown.		
	Yield of tops per acre.	Average weight per root.	Yieldr of oots per acre.	Yield of tops per acre.	Average weight per acre.	Yield of roots per acre.
	tons.	lbs.	tons.	tons.	lbs.	tons.
39 Ward's Oval	2.75	1.994	24.93	2.30	1.736	20.15
40 Jarman's Selected Golden Tankard	3.95	2.766	34.30	2.18	1.975	20.13
41 New Eschendorf	3.15	1.935	24.00	2.27	1.766	20.06
42 Jarman's Giant Long Red	4.80	2.313	27.75	3.54	1.784	20.06
43 Sutton's Yellow Globe	3.00	2.118	25.00	2.00	1.908	19.68
44 Yellow Ovoid	.48	4.000	22.09	2.12	2.028	18.52
45 Jarman's Model Yellow Globe	2.05	1.825	22.63	1.69	1.602	17.25
Grown for Five Years:						
46 Thorp's Own Yard Long	4.50	2.419	28.55	4.10	2.063	23.65
47 Dignity	3.95	2.403	27.75	3.87	2.035	23.09
48 Thorp's Own Champion Yellow Intermediate	2.40	2.105	25.95	2.49	1.920	22.09
49 Jumbo	4.15	2.367	25.45	3.41	1.977	21.67
50 Carter's Warden Prize Yellow Globe	1.75	1.595	18.50	1.79	1.737	19.63
Grown for Four Years:						
51 Long White	3.60	2.220	26.20	3.52	2.076	14.92
52 Erfurt Model (yellow intermediate)	3.85	2.124	25.70	2.48	1.795	21.52
Grown for Three Years:						
53 Cornish Giant Yellow Globe	2.60	2.532	31.65	1.96	2.142	26.90
54 Sutton's Crimson Tankard	2.75	2.202	26.20	2.30	2.009	23.73
55 Surprize	2.60	3.576	15.20	3.18	2.757	23.07
56 Red Tankard	1.80	1.933	11.60	1.68	1.602	15.15
Grown for Two Years:						
57 New Model	3.63	3.781	29.30	4.19	3.311	32.40
58 Jersey Queen	3.95	2.264	27.85	4.70	2.583	31.70
59 Buckbee's New Mastodon	4.65	2.555	30.40	4.63	2.587	31.38
60 Riverhall Giant Yellow Globe	2.40	2.132	25.80	2.88	2.494	30.60
61 Golden King	2.05	2.081	25.80	2.02	2.293	29.18
62 Taber's Yellow Gate Post	1.90	1.925	23.10	2.69	2.272	28.50
Grown for One Year:						
63 Giant Yellow Half Long	3.90	2.397	28.65	3.90	2.397	28.65
64 Carter's Elephant Yellow Globe	2.50	2.188	26.25	2.50	2.188	26.25
65 Carter's Windsor Prize Taker (yellow globe)	2.15	2.142	25.70	2.15	2.142	25.70
66 Daniel's Improved Gate Post (intermediate)	2.75	1.975	24.10	2.75	1.975	24.10
67 Carter's Gold Finder	2.00	1.380	16.90	2.00	1.380	16.90

The average yield of mangels per acre in 1898 was 23.3 tons, and the average yield of tops per acre 3.1 tons. It will be seen that the average yield of roots for the past year is nearly equal to the highest yield in the average of eight years. An average of 23.3 tons is about equal to 773 bushels per acre. The land upon which the mangels were grown was fairly uniform throughout; but that section of it upon which the varieties of mangels first named on the list were placed seemed to be somewhat more influenced by the dry weather than the most of the other plots. Even with the greatest of care it is usually unsafe to draw many conclusions from one year's results. When the experiments, however, are conducted over a series of years, the results may be accepted as furnishing information of real value. Among twenty-seven varieties of mangels which have been grown for eight years in succession, it will be seen that the Evans' Improved Mammoth Saw-log stands at the head of the list, with an average of 23.9 tons per acre. This variety is closely followed by Simmers' Improved Mammoth Long Red with 23.86 tons per acre, which is again closely followed by Steele's Long Red Selected, with 23.67 tons per acre. The fourth place is occupied by the Carter's Champion Yellow Intermediate, producing an average of 23.17 tons of mangels per acre. This variety has certainly given excellent results, as it is intermediate in length, and has surpassed in yield per acre a large number of the long varieties. Several varieties were imported from England in the spring of 1896, and some of them were sown in our experimental grounds this season for the first time. Among the five new varieties grown this year the Giant Yellow Half Long came first, with 28.5 tons per acre; and the Carter's Gold Finder the lowest, with about 17 tons per acre.

Sugar Beets—Comparative Test of Fourteen Varieties.

The subject of sugar-beet growing in Ontario has claimed more or less attention within the last few years, partly from the standpoint of their quality for producing sugar and partly from that of their value for feeding purposes. Eight varieties of sugar beets have been grown in our experimental plots for seven years in succession, and six varieties have been grown for a less number of years. The object in this experiment is to ascertain the comparative yields and the general characteristics of the different varieties, to furnish information as to the kinds which will be most serviceable for growing on the farm for feeding the live stock. The soil on which this experiment was conducted in 1898 was quite similar to that described in the experiments with varieties of mangels. Three rows, each four rods long, were given to each variety. When the plants were from two to three inches in height they were thinned to an average of eight inches apart. The following table gives the results:

Varieties of Sugar Beets.	Color of roots.	Results for 1898.			Average results for number of years grown.		
		Yield of tops per acre.	Average weight per root.	Yield of roots per acre.	Yield of tops per acre.	Average weight per root.	Yield of roots per acre.
		tons.	lbs.	tons.	tons.	lbs.	tons.
Grown for seven years:							
1 Lane's Improved	White	4.83	1.35	19.85	3.38	1.45	**19.18**
2 Red Top	Reddish	4.25	1.17	17.05	3.93	1.48	**18.63**
3 White Silesian	White	4 00	1.07	15.30	4.91	1.48	**18.46**
4 Champion	Reddish	2.85	1.18	17.05	3.39	1.43	**18.20**
5 White French	White	4.50	.98	13.70	4.41	1.33	**16.31**
6 Klein Wanzelben	"	4.98	1.12	15.85	4.97	1.26	**15.54**
7 Red Skinned	Reddish	3.23	1.08	15.48	3.46	1.19	**14.91**
8 Improved Imperial	White	4.28	.97	14.53	4.00	1.53	**13.31**
Grown for five years:							
9 New Danish Improved	Reddish	2.75	1.18	17.35	2.82	1.48	**20.10**
10 Jersey	"	4.35	1.20	16.85	3.45	1.40	**18.86**
11 French Yellow	Yellow	2.95	.93	13.25	3.56	1.26	**17.21**
Grown for three years:							
12 Green Top White	White	2.20	1.29	18.80	5.23	1.49	**20.56**
Grown for two years:							
13 Vilmorin's Improved	White	3.80	.86	12.35	5.60	1.18	**16.98**
Grown for one year:							
14 Carter's Nursery	White	6.25	1.28	18.30	6.25	1.28	**18.30**

The White Silesian, which stood first on the list in yield of roots per acre up to two or three years ago, now occupies third place, it being surpassed by Lane's Improved and the Red Top. The Lane's Improved has given an average of about three-fourtha of a ton per acre more than the White Silesian. The New Danish Improved has certainly given very good satisfaction, as the average yield of roots per acre for five years is a little over twenty tons, showing this variety to be one of the best producers among the different varieties of sugar beets. The tops of these varieties are small, but the roots are large and grow well under the ground. The Danish Improved variety was sent out over Ontario with four other varieties for co operative experiments in the spring of 1898. When the reports were received and the results summarized, it was found that the two long red varieties of mangels gave the highest yields, and the globe and intermediate varieties the lowest yields, the Danish Improved variety of sugar beets coming between these two groups in yield of roots per acre. The largest yield in the experimental plots in 1898 was produced by Lane's Improved, and the smallest by Vilmorin's Improved. It will be noticed that in yield of tops per acre there was a variation from 2.2 tons to 6.2 tons, Carter's Nursery, a new variety imported from England, producing the greatest yield of tops per acre.

Carrots—Comparative Test of Fifty one Varieties.

Varieties of Carrots.	Results for 1898.			Average results for number of years grown on plots.		
	Yield of tops per acre.	Average weight per root.	Yield of roots per acre.	Yield of tops per acre.	Average weight per root.	Yield of roots per acre.
Grown for seven years:	tons.	ounces.	tons.	tons.	ounces.	tons.
1 Pearce's Improved Half Long (white)	4.55	15.19	28.00	6.74	15.65	29.10
2 Mastodon (white intermediate)	4.93	16.50	31.40	6.23	15.18	28.44
3 Steele's Improved Short (white)	4.18	13.30	25.60	6.87	15.26	28.41
4 White Green Top Orthe (intermediate)	5.25	14.92	28.20	6.25	14.55	26.84
5 Large White Vosges	3.85	13.18	24.35	5.53	13.93	26.10
6 Simmer's Short White Vosges	3.65	13.96	25.30	5.51	13.95	25.70
7 Large White Belgian	5.00	15.11	28.80	5.81	13.51	23.89
8 Sutton's Yellow Intermediate	3.70	14.12	25.15	5.56	13.18	23.89
9 Danver's Orange	3.38	11.55	22.20	3.96	11.00	21.46
10 Guerande	2.63	12.04	24.75	3.40	10.05	21.35
11 Mitchell's Perfection	3.95	12.53	24.55	4.07	11.19	21.05
12 Giant Wiltshire (long white)	4.08	23.25	15.55	6.09	13.17	20.65
13 Carter's Orange Giant (long)	4.85	15.79	23.10	4.50	12.44	19.20
14 Half Long Stump Rooted (red)	2.45	9.51	18.25	3.11	9.49	19.01
15 James' Scarlet Intermediate	2.75	9.03	16.65	3.44	8.54	17.00
16 Sutton's Improved Intermediate (red)	2.28	8.45	17.83	3.05	8.36	16.08
17 French Intermediate	2.20	7.34	15.95	3.61	7.89	16.16
18 Yellow Belgian	4.15	8.91	17.40	4.45	8.89	15.70
19 Long Red Surrey	1.50	6.78	14.10	3.49	7.80	14.74
20 Long Orange	1.45	6.07	13.75	5.03	7.65	11.69
21 Improved Long Red Altringham	2.10	6.11	12.50	3.66	7.29	13.09
Grown for six years:						
22 Rubicon Half Long (red)	3.15	12.57	24.50	3.60	10.79	20.13
23 Chantenay (short red)	3.65	12.03	24.30	3.38	10.99	19.68
24 Nichols' Improved Large Orange	3.95	10.00	20.50	4.09	9.90	18.84
25 Half Long Scarlet	4.65	10.09	19.50	3.65	8.70	17.38
26 Nantes' Half Long Stump Rooted (red)	1.85	6.45	14.83	2.66	8.65	16.66
27 Long Red St. Vallery	2.60	13.35	12.10	3.22	10.26	16.08
28 Jarman's Selected Green Top (long red)	3.25	14.74	15.25	3.17	13.15	12.62
29 New Long Red Coreless	1.25	4.97	9.10	1.78	5.87	10.92
Grown for five years:						
30 Mammoth Intermediate Smooth (white)	4.45	16.38	30.10	5.47	17.18	31.12
31 Iverson's Champion White (intermediate)	5.15	16.03	30.50	6.18	15.99	27.05
32 Improved White Belgian (long)	3.50	14.26	22.50	4.79	13.20	22.19
33 Yellow Intermediate	2.85	12.56	18.05	5.76	13.85	20.57
34 Victoria (long red)	4.60	12.30	23.45	4.33	10.78	19.51
35 Midsummer (short red)	2.30	10.99	21.15	2.60	10.15	18.32
36 Yellow Giant	4.30	10.29	17.33	4.13	10.27	16.68
37 Early Half Long Carentian	1.45	6.82	11.55	1.59	6.04	11.07
Grown for four years:						
38 Thorpe's Own Short White	4.40	15.86	27.75	4.78	13.29	23.39
39 Henderson's Intermediate (red)	2.90	9.11	18.50	3.83	10.01	18.44
Grown for three years:						
40 Carter's Gate Post Orange (long)	3.85	10.79	22.25	5.87	12.77	23.00
41 Cooper's Yellow Intermediate	4.35	11.64	23.10	5.47	15.65	21.78
42 Intermediate Red	2.75	9.41	17.35	4.37	10.83	20.00
43 California Mammoth Orange	2.30	9.75	14.63	3.93	10.06	17.11
Grown for two years:						
44 Long Yellow Stump Rooted	3.85	12.79	25.10	5.28	14.41	26.40
45 Buckbee's Majestic	3.90	16.42	29.50	5.35	14.13	25.33
46 Lobberich's Agricultural	3.60	12.82	24.35	4.10	13.43	24.68
47 Peer of All	2.75	15.00	13.50	4.18	14.24	19.15
Grown for one year:						
48 Sutton's Matchless (white)	4.10	14.35	27.45	4.10	14.35	27.45
49 Carter's Hundred Ton	3.80	13.69	26.35	3.80	13.69	26.35
50 Daniels' Giant Yellow (intermediate)	3.55	12.63	24.55	3.55	12.63	24.55
51 Carter's Giant Wiltshire (white)	3.60	12.52	23.20	3.60	12.52	23.20

On May 6th and 7th, 1898, different varieties of carrots were sown on plots 1/100 of an acre in size in the experimental grounds. Three rows of each variety were sown, the rows being four rods in length and three and one-third links apart (26 2/5 inches.)

The land used for this experiment was similar to that used in the experiment with mangels, having received a dressing of twenty tons of farmyard manure per acre in the spring of 1898. The seed was sown on the flat, and the land was kept comparatively level throughout the season. The plants were thinned to an average distance of four inches apart when from two to three inches in height. They were again counted a little later in the season, and finally at the time of harvesting, so that the varieties had a very good comparative test.

The carrots grown in 1898 gave an average yield of about 21¼ tons per acre, or a little over 700 bushels. It will be seen, however, by an examination of the foregoing table, that three varieties, namely, Mastodon, Iverson's Champion White and Mammoth Intermediate Smooth, each gave a yield of a little over 30 tons, or about 1,000 bushels per acre. In the average results of twenty-one varieties grown for seven years in succession, it will be seen that the Pearce's Improved Half Long keeps the highest place in the production of roots, the average being a little over 29 tons. This variety is closely followed by the Mastodon and Steele's Improved Short White, each giving 28 2/5 tons per acre. These three varieties are all intermediate in length, and are very excellent varieties to grow for feeding stock. It will be seen that the Large White Vosges has given three tons per acre less than Pearce's Improved Half Long White, and that the Large White Belgian has given over five tons per acre less than the variety first named on the list. The large White Belgian, being a long slender carrot, is very hard to remove from the ground, unless a common plough, a subsoil plough, or some other implement is run along the row to loosen the roots before pulling. The Guerande variety, which stands tenth on the list in yield per acre, is a very short, thick, yellow variety of carrot. We have sent this variety out in connection with the co-operative experiments along with other varieties for several years, and although the yield is considerably less than that of some of the others, still in many cases it is quite highly spoken of, as it is a compact root and is easily handled. Three new varieties of carrots were grown in 1898 for the first time. The seed of these was imported from England, and it will be seen that Sutton's Matchless gave the largest yield per acre, and Carter's Giant Wiltshire the smallest, there being a difference of a little over four tons per acre between these two varieties.

Parsnips—Comparative Test of Thirteen Varieties.

In the spring of 1898 thirteen varieties of parsnips were planted in the experimental department, on plots 1/100 of an acre in size. The seeding took place on the 13th of May. Between that date and the 23rd of May rain fell on five different dates, there being about one and a half inches of rain fall in that period. The germination of the parsnip seed was somewhat irregular, and as a consequence the results of the experiment are not given for this year. In the average of three years' experiments with four varieties previous to 1898, the Improved Half Long came first in yield per acre, with an average of about twelve and a half tons of roots. Among seven varieties grown in 1897 for the first time, the Bloomsdale took first place in yield of parsnips, the produce being 15 tons of roots per acre. This variety stands in quite a marked contrast with the Arlington Long Smooth, which gave less than ten tons per acre.

Kohl-Rabi—Comparative Test of Six Varieties.

Six varieties of Kohl-Rabi have been grown in the experimental department for two years in succession. This crop is sometimes grown for food for stock in some of the older countries. The root of the Kohl-Rabi is somewhat like that of cabbage, while the leaves resemble the tops of Swede turnips. The valuable part of the plant, however, grows about three inches above the level of the ground, in the form of a bulb. Kohl-Rabi makes a very nice vegetable for domestic use, and is prepared for culinary purposes in much the same way as Swede turnips. The seed of Kohl Rabi resembles very closely that of Swede and fall turnips, and the crop is grown in much the same manner as that

of the other classes of roots. The plots used for this experiment in 1898 were exactly 1/100 of an acre in size. The seeding took place on the 13th of May.

Varieties of Kohl-Rabi.	Yield of tops per acre.		Average weight per root.		Yield of roots per acre.	
	1898.	Average 1897-98.	1898.	Average 1897-98.	1898.	Average 1897-98.
	tons.	tons.	lbs.	lbs.	tons.	tons.
1 Large White	4.10	4.25	1.97	2.21	15.00	**25.70**
2 Early White Vienna	2.55	3.98	2.04	2.04	23.95	**25.45**
3 Purple Vienna	6.80	4.70	1.91	1.90	21.60	**23.73**
4 Earliest Erfurt	1.80	2.13	1.63	1.75	19.18	**23.17**
5 Green	6.10	4.68	1.85	1.92	19.80	**22.58**
6 Earliest Green Vienna	3.50	2.78	1.85	1.83	20.55	**21.83**

From the foregoing table, it will be seen that the Large White variety of Kohl-Rabi gave the largest average yield per acre for two years, although the results from this variety in 1898 were not nearly so good as those of the previous year. It will be seen that the Early White Vienna gave the largest yield of roots per acre in the results for the past season. In the average results for the two years there is a difference of about four tons per acre ; and in the results for 1898 the difference in yield was nearly nine tons per acre.

Fall Turnips—Comparative Test of Forty-Six Varieties.

Forty-six varieties of fall turnips were sown in the experimental grounds on the 24th of June, 1898. The plots were 1/100 of an acre in size, three rows, four rods long, being sown with each variety. The seed was sown on the flat, and the land was kept comparatively level throughout the growing season. When the plants were about two inches high, they were thinned to a distance of about ten inches apart in the drills.

Fall turnips are frequently spoken of as soft turnips, or white and yellow fleshed turnips. They usually yield well per acre, but are very poor keepers, and are only suitable for fall feeding. The last two years have proven unfavorably for the production of good turnips of the fall varieties. A large quantity of the roots were badly decayed in 1897, and a smaller quantity in 1898. As the land used for these turnips in each of the pass seasons was very uniform throughout, and as all were subject to the same conditions, one of the most interesting and valuable results from the experiments for the last two years is the record of the power of the different varieties to resist the rot. The roots were accurately counted when the plants were partly developed, and before any rot had started. Those which had not rotted at the time of harvesting were again counted, and the percentage of decayed roots was calculated from these notes. This method of calculation gives the percentage of sound roots with a fair degree of accuracy, and furnishes information regarding the way in which the different varieties resisted or succombed to the injurious effects of the disease. The information thus gained is given in the left hand column of figures in the foregoing table. It will be observed that in the average of the two years results, the Cow Horn, Yellowstone, Early American, Purple Top White Egg, Jersey Navet, and Jersey Lily varieties possessed the largest percentage of sound roots in the order named ; and that the Yellow Globe, Extra Early Milan, Rennie's Selected White Globe, and Sutton's Perfected Green Top Hybrid had the smallest percentage of sound roots ; in fact, over two-thirds of the roots of the last named varieties were rotten before the crop was harvested in October. In the average yield of roots per acre, previous to 1896, the Jersey Navet stood highest among thirteen varieties grown for six years in succession. This variety, it will be observed, is not only a good yielder, but also has produced roots within the last two years which have been very good in quality.

Varieties of fall turnips.	Percentage of roots not rotten when crop was harvested.		Average weight per root.	
	1898.	Average for two years.	1898.	For number of years grown.
Grown for eight years:	%	%	lbs.	lbs.
1 Jersey Navet	98	85.0	1.29	**2.24**
2 Greystone Improved	86	70.0	1.32	**2.23**
3 Purple Top Mammoth	74	75.5	1.11	**2.20**
4 Early American Purple Top	94	93.0	1.18	**2.09**
5 Early Purple Top Munich	58	47.5	1.38	**2.02**
6 Pomeranian White Globe	78	45.0	1.04	**1.97**
7 Red Globe Norfolk	91	55.0	1.00	**1.94**
8 Whitestone	94	66.0	1.14	**1.94**
9 Red Top Strap Leaf	93	82.0	1.40	**1.93**
10 Orange Jelly	91	55.5	1.01	**1.61**
11 Yellow Aberdeen Purple Top	81	49.0	.89	**1.43**
12 Yellow Aberdeen Green Top	79	51.0	.85	**1.36**
Grown for seven years				
13 Imperial Green Globe	73	65.0	.96	**1.52**
14 Purple Top Hybrid	88	64.5	1.03	**1.37**
Grown for six years:				
15 Cow Horn	93	95.5	1.43	**2.04**
16 Jersey Lily	96	84.5	1.21	**2.03**
17 Yellow Stone	95	93.5	1.34	**1.96**
18 Green Barrel	76	69.5	.97	**1.82**
19 Sutton's Improved Green Globe	66	63.5	.99	**1.76**
20 Early White Model	79	72.0	.90	**1.75**
21 White Flat Dutch Strap Leaf	41	43.5	1.09	**1.73**
22 White Six-Weeks	68	68.0	1.02	**1.71**
23 Jarman's Selected Green Globe	47	50.0	.95	**1.70**
24 Amber Globe	78	70.5	.62	**1.61**
25 Extra Early Milan	30	27.5	1.08	**1.61**
26 Yellow Montgomery	69	77.5	.79	**1.55**
27 Jarman's Improved Green Top Yellow Scotch	52	59.5	.63	**1.49**
28 Dale's Hybrid	42	49.0	.89	**1.39**
29 Fosterton Hybrid	45	48.5	.64	**1.18**
30 Carter's Champion Green Top Scotch	54	47.0	.60	**1.09**
Grown for five years:				
31 Milk Globe	73	73.5	1.03	**2.39**
32 White Egg	87	85.5	.91	**2.24**
33 Early La Crosse	96	56.0	1.16	**1.86**
34 White Lily	84	67.0	.83	**1.85**
35 All Gold	45	38.0	.54	**1.48**
36 Orange Sweet	64	43.5	.63	**1.38**
Grown for four years:				
37 Red Top White Globe	42	61.5	.73	**2.36**
38 Rennie's Selected White Globe	35	28.0	.76	**1.69**
39 Yellow Globe	35	26.0	.67	**1.65**
Grown for three years:				
40 Long Tankard	57	45.5	.89	**1.43**
41 Sutton's Favorite Purple Top Yellow Hybrid	39	37.0	.67	**1.22**
42 Yellow Finland	65	47.0	.66	**1.18**
43 Sutton's Perfection Green Top Hybrid	22	32.5	.40	**1.10**
Grown for two years:				
44 Large White Norfolk	65	61.5	.85	**1.12**
45 Sutton's Purple Top Scotch	58	40.0	.63	**.83**
Grown for one year:				
46 Hunter's Purple Top Globe	82	82.0	.70	**.70**

Mangles, Carrots, Sugar Beets, Swede Turnips, and Fall Turnips Sown at Different Depths.

An experiment has been made by planting seed exactly one inch, two inches, three inches, and four inches deep of Swede turnips for four years in succession; and of fall turnips, mangles, carrots, and sugar beets for two years in succession. The soil on which this experiment was conducted in 1898 might be termed an average clay loam.

The land was level at the time of seeding, and flat cultivation was practised throughout. The seed was placed in the soil with great care, and the yields per acre were determined from the actual yields of the plots.

Depth of planting.	Yield of roots per acre.					Average yield per acre.
	Mangels. Average 2 years.	Carrots. Average 2 years.	Sugar beets. Average 2 years.	Swede turnips. Average 4 years.	Fall turnips. Average 2 years.	
	tons.	tons.	tons.	tons.	tons.	tons.
1 inch deep	34.91	21.57	31.41	15.68	22.68	25.25
2 inches deep	34.52	9.70	26.50	13.02	19.96	20.74
3 inches deep	22.13	4.09	16.07	30.28	9.78	11.07
4 inches deep	11.78	3.19	8.01	1.05	1.05	5.02

It will be observed by an examination of the figures here presented, that the seed which was planted 1 inch in depth gave the best results in average yield of roots per acre in every instance. The difference, however, in the results from planting mangel seed 1 inch and 2 inches deep are not very marked, there being only two-fifths of a ton per acre in favor of the one inch planting. From sowing carrot seed one and two inches deep, however, the returns are very different, as upwards of twice the yield per acre was obtained from planting the seed 1 inch deep as compared with that which was placed 2 inches below the surface of the ground. It will be seen that the mangel and the sugar beet seed will stand deeper planting than either carrots, swede turnips, or fall turnips. In the case of mangels, nearly 12 tons per acre were realized from the seed which was placed 4 inches below the surface of the soil; while, in the case of both swede and fall turnips, only about one ton per acre was grown from seed planted 4 inches deep. In 1898, the seed of the mangels, sugar beets, carrots, and turnips was also planted one half and one and one-half inches deep; and eighty per cent of the results show better returns from planting one inch deep, as against one-half and one and one-half inches deep, in the experiments of the past year. This experiment will likely be continued by planting the seed at six different depths in 1899.

Height of plants when thinned.	Yield of roots per acre.				Average yield of roots per acre.
	Mangels. Average 2 years. 1897-98.	Carrots. Average 2 years. 1897-98.	Swede turnips Average 2 years. 1896-98.	Fall turnips. Average 2 years. 1896-98.	
	tons.	tons.	tons.	tons.	tons.
Plants thinned when 1½ to 2 inches high	21.31	20.44	13.90	25.20	20.21
" " 8 to 10 "	17.83	20.44	11.19	16.89	16.59

Mangels, Carrots, Swede Turnips, and Fall Turnips, Thinned at Different Stages of Their Growth.

An experiment was conducted in 1896 for the first time in thinning Swede turnips and fall turnips when the plants were about two inches in height, as compared with thinning them when they reached an average of eight to ten inches in height. In 1897, however, this experiment was conducted with mangels and carrots; and in 1898 it was conducted with all four classes of roots. It may appear on first thought, that from eight to ten inches is an extreme height to allow the roots to grow before being thinned, but if

the reader will pause for a moment and think over the matter, he may recall numerous instances, which have come under his observation, in which the young root plants would approximate that height before the thinning was completed. This experiment was conducted on land of an average quality. The experiment was conducted in duplicate with each class of roots each year. The plants were carefully thinned in the rows when at the stages of growth indicated in the table to follow, and an equal number were allowed to remain in each plot. The foregoing table gives the results for each class of roots, and also the average returns for the different classes of roots taken together :

The figures which represent the results of this experiment show that in the case of mangels, Swede turnips and fall turnips, there was a decided advantage from thinning the plants when quite young. In the case of carrots, however, the results from the two thinnings are exactly equal. It may, however, be mentioned that the detailed results in this case were a little irregular; as the plants, which were thinned when young, gave the best results in three out of the four tests made with carrots. From thinning the plants at different stages the results are less marked in the case of carrots than in the case of any of the other crops included in the experiment. The average results from the four classes of roots show that the plants which were thinned when two or three inches in height, produced nearly four tons of roots per acre more than those which were allowed to reach a height of from eight to ten inches before being thinned.

Mangels, Carrots, Swede Turnips and Fall Turnips Grown on the Flat and on Ridges.

For three years in succession an experiment has been conducted by growing mangels, Swede turnips and fall turnips; and for two years in succession by growing carrots, on land which was level and also on land which was ridged with a double mould board plow at the time of seeding. The experiment was conducted in duplicate during each of these years. The ridges were made to a height of about four inches. The rows were exactly the same distance apart for the flat and for the ridged cultivation. The yield per acre of the duplicate plots were averaged for each year; and the results for 1896, 1897 and 1898 were averaged in the case of each class.

Method of cultivation.	Yield of roots per acre.				Average yield per acre for all kinds of roots.
	Mangels. Average 3 years. 1896-98.	Carrots. Average 2 years. 1897-98.	Swede turnips. Average 3 years. 1896 98.	Fall turnips. Average 3 years. 1896-98.	
	tons.	tons.	tons.	tons.	tons.
Flat cultivation	21.08	20.31	12 33	17.39	**17.78**
Ridged cultivation	21.91	19.35	10.73	17.10	**17.27**

In the average of three years' experiments, it will be seen that the land which was kept flat, produced a little over one-half ton of roots per acre more than that which was ridged at the time of seeding. The best results were obtained by growing carrots, Swede turnips and fall turnips on the flat, and from growing mangels on ridges; the greatest difference between the two methods appearing in the case of the Swede turnips as there was 1 3-5 tons per acre in favor of the flat cultivation.

Mangels, Carrots, Sugar Beets, Swede Turnips, and Fall Turnips Grown from Different Selections of Seed.

An experiment has been conducted by sowing different selections of seed for four years in succession with mangels and carrots, three years in succession with sugar beets

and fall turnips. In each of these years, the large plump seed, medium-sized seed, and small-sized seed was taken from good average seed purchased from leading seedsmen. In selecting the seed, great care was taken to use nothing but what was apparently sound in every respect.

Selections.	Yield of roots per acre.					Average yield per acre for all classes of roots.
	Mangels. Average 4 years.	Carrots. Average 4 years.	Sugar beets. Average 2 years.	Swede turnips. Average 3 years.	Fall turnips. Average 2 years.	
	tons.	tons.	tons.	tons.	tons.	tons.
Large plump seed	36.20	28.71	20.76	14.93	23.82	**24.88**
Medium-sized seed	32.74	26.20	20.20	13.12	19.70	**21.39**
Small-sized seed	24.07	19.15	20.17	5.31	10.90	**5.91**

The results presented in the foregoing table are certainly very interesting and very suggestive. There are but few growers of roots who ever think of sifting the seed or trying in any way to improve the seed purchased for sowing upon their land. As none but apparently perfectly sound seed was used for this experiment, the results indicate that much better returns could be obtained in ordinary farm practice by carefully separating the large from the small seed and using only the former. In the average results of all the classes of roots, for the number of years during which the experiment has been conducted, it will be seen that large plump seed gave about $2\frac{1}{2}$ tons per acre more than the medium-sized seed and about nine tons per acre more than the small-sized seed. The greatest difference resulting from the selection of seed is shown by Swede turnips; and the least difference by the sugar beets. It is only fair to state, however, that the sugar beet seed was more uniform than that of the other classes of roots; and consequently the difference between the different sizes of seed selected was not very marked. We believe that a great mistake is frequently made by root growers trying to purchase seed at a low price without much regard to size or quality.

Mangels, Fall Turnips, and Swede Turnips—Application of Fertilizers.

Fertilizers.	Quantity of fertilizers per acre. 1898.	Cost of fertilizer per acre. 1898.	Yield of roots per acre. Mangels. Average 2 years. 1897-98.	Fall turnips. Average 2 years. 1896-97.	Swede turnips. Average 2 years. 1896-97.	Average yield per acre, three classes of roots for 2 years.
	lbs.	$	tons.	tons.	tons.	tons.
Nitrate of soda	160	3.84	30.40	21.55	15.76	**22.57**
Mixture	213.3	3.79	27.96	20.78	16.39	**21.71**
Muriate of potash	160	3.84	29.70	19.78	14.19	**21.22**
Superphosphate	320	3.68	26.82	19.20	15.33	**20.45**
No fertilizer	.....	.....	27.12	17.78	13.53	**19.48**

There are so many brands of fertilizers on the market containing varying proportions of nitrogen, phosphoric acid and potash that it would be an endless task to experiment with all the different kinds. These complete fertilizers frequently change in composition more or less from one season to another. It will, therefore, be seen that satisfactory work cannot be done by trying to test all the kinds of the so-called complete commercial fertilizers which are offered for sale at the present time. We believe however, that some good work is being done by testing distinct fertilizers which are fairly constant

from year to year, and the constituents of which form the basis of all other commercial fertilizers. Experiments have been made with a considerable number of crops by using a nitrogenous (Nitrate of Soda), a potassic fertilizer (Muriate of Potash), a phosphoric fertilizer (Superphosphate), and a fertilizer containing nitrogen, potash and phosphoric acid (mixed or complete fertilizer). For two years these fertilizers have been used with mangels, fall turnips and Swede turnips. The Muriate of Potash and Superphosphate were applied at the time of seeding, and the Nitrate of Soda when the plants were about two inches in height. One row of roots was left unfertilized between each two plots. The plants were thinned to ten inches apart in the drills, when about three inches high.

The figures here presented give the amount of each fertilizer used per acre, the market price for the quantity of fertilizer used, the yield of crop per acre from each class of roots, and the average yield per acre for all the roots for two years.

It will be seen that the nitrate of soda increased the yield of mangels 3.28 tons per acre, or 117 bushels at a cost of 3.28 cents a bushel; that the nitrate of soda increased the yield of fall turnips 3.77 tons per acre, or 134.6 bushels at a cost of 2.86 cents per bushel; and that the mixed fertilizer increased the yield of swede turnips 2.86 tons per acre, or 102 bushels at a cost of 3.72 cents per bushel. In working out these figures, it will be understood that the full cost of the fertilizers was charged to the first crop. An extra increase might also be secured the following year by the influence of the fertilizers on the second crop. If we examine the average yield per acre for all the roots for the two years, we will find that the nitrate of soda caused an increase of 3.9 tons of roots per acre, or 110.4 bushels at a cost of about 3½ cents per bushel.

It might here be mentioned that fertilizers similar to these have been sent out over Ontario for co-operative experiments in each of the past seven years. These fertilizers were used with the oat crop for five years in succession, and have now been tested with corn and mangels for two years. The results of these experiments are very interesting, as they are being conducted on the different kinds of soil and in various parts of the Province. In the average of nineteen successfully conducted experiments throughout Ontario within the last two years, it is found that the yield of mangels from the use of the different fertilizers and from the unfertilized land is as follows: Nitrate of soda 23.06 tons; mixed fertilizers 21.92 tons; superphosphate 21 tons; muriate of potash 20.9 tons; and the unfertilized land 17.3 tons. This shows that the nitrate of soda had the greatest influence, and increased the crop between five and six tons per acre.

Green Fodder Crops.

Within the past seven years a large number of experiments have been conducted with corn, millet, rape, sunflowers, grasses, clovers, etc. These experiments have included tests with varieties, methods of seeding, methods of cultivation, application of fertilizers, mixtures of grain for green fodder, etc. One hundred and seventy varieties of corn were planted in the spring of 1898; but owing to damage done by crows pulling out part of some of the varieties, the results of the experiments are not reported here.

Millet—Comparative Test of Nineteen Varieties.

Although seven of the varieties of millet have been grown for seven years in succession, it is considered advisable to give only four years' results; as a number of the leading varieties have been grown for that length of time, and this would place a greater number of varieties under similar conditions, and thus give a better basis for the comparison of results. The land used for the millet in 1898 produced a crop of beans the previous year. The plots were exactly 1-100 of an acre in size. The seed was sown brood-cast; and the germination of the different varieties was quite satisfactory.

Varieties of millet.	Earliness or lateness of crops.	Average height of crop for number of years grown.	Average yield of green crop per acre for number of years grown.	Yield of hay crop per acre. Average for number of years grown.
		inches.	tons.	tons.
Grown for four years:				
1. Japanese (Milleacum)	Late	39.50	13.07	**5.98**
2. Japanese (Italicum)	Medium	29.63	12.83	**5.84**
3. Holy Terror Gold Mine	Very late	32.75	13.34	**5.77**
4. Japanese (Crusgalli)	Medium	36.00	12.17	**5.60**
5. East India Pearl	Very late	32.00	13.66	**5.42**
6. Golden Wonder	Late	35.25	12.89	**5.40**
7. German or Golden	"	34.75	12.79	**5.10**
8. Salzer's Dakota	"	36.88	10.80	**4.38**
9. Magic	"	34.13	10.38	**4.38**
10. Hungarian Grass	Early	33.00	9.03	**4.08**
11. California	"	31.50	7.30	**3.46**
12. White French	"	53.38	7.51	**3.28**
13. Common	"	34.19	7.46	**3.22**
14. Red French	"	29.13	6.56	**1.91**
Grown for two years:				
15. Siberian	Early	34.00	11.48	**4.60**
16. Hog	"	36.00	8.25	**3.40**
17. Early Harvest	"	33.00	9.40	**3.25**
Grown for one year:				
18. California Beauty	Early	34.00	8.65	**3.95**
19. Chinese	"	35.00	6.10	**2.95**

The average yield of green crop per acre of nineteen varieties of millet in 1898 was 9.13 tons. This yield is considerably less than that of former years. The season of 1898 appeared to be quite unfavorable for the growth of millet, especially in the case of some varieties. The three varieties of millet which were brought out from Japan a few years ago and gave large yields in the past, standing highest in the list of yield of crop per acre previous to 1898, gave much lower yields in the past year. In the foregoing table, it will be seen that the average height of the crop and the average yield per acre of the green millet, and also of the millet after being made into hay, are given for the number of years that each variety has been grown. It will be seen that the two varieties of Japanese millet which stand at the head of the list in yield of hay, produced an average of nearly six tons per acre per annum; and that seven varieties produced an average of upwards of five tons per acre. The East India Pearl variety, which stands fifth on the list, is very late, seldom heading out in the experiments conducted at this place. The leaves are broad and resemble those of corn, but start very near the ground. The crop is, therefore, not very tall and is mostly composed of leaves. The Salzer's Dakota variety gave most excellent results six and seven years ago, but the seed of that name which is now secured gives very much poorer results. The Hungarian Grass, which is probably the best known variety mentioned in the foregoing table, occupies tenth place in yield of hay per acre and also tenth place in yield of green crop per acre, among fourteen varieties grown for four years in succession.

In 1898, the nineteen varieties of millet were grown in duplicate; one set of the varieties was cut and weighed as a green crop and as hay, and the other set was allowed to mature. The varieties were then cut and when dry were hauled to the barn and threshed, in order to ascertain the relative amount of seed produced from the different varieties. Owing to the very wet season at the time of harvesting, however, the results of the experiment were not so satisfactory as they would have been, had the season been more favorable. The largest yields of seed per acre were produced by the Hungarian Grass, California, Siberian, and Early Harvest varieties of millet, each producing upwards of 30 bushels, while the Common, Japanese (Milleacum), Hog, and Japanese (Italicum) each produced between twenty and thirty bushels of seed per acre. The White French variety produced less than five bushels of seed per acre; and the East India Pearl was the only variety which produced no seed on account of its lateness. The average yield of seed per acre in 1898 for the eighteen varieties was 21.3 bushels.

Mixtures of Grain for Green Fodder.

For six years we have sown oats, peas, barley, and spring wheat separately and in various combinations, to find out which would be the most suitable for producing a large amount of valuable food to be used either as green fodder or as hay. The experiment has been carried on in duplicate for five years. In each of the years, the grains were sown separately and in various combinations, with two or three kinds of grain in each combination; and also in the mixture of all four kinds together. This has required fifteen plots in each set, or thirty plots in the duplicate experiments; so that one hundred and eighty plots have been devoted to this experiment in the past six years. The plots in all instances were 1/100 of an acre in size. In 1898, the seed for this experiment was sown on April 28th on land which had produced a crop of potatoes the year, having been manured at the rate of twenty tons per acre in the spring of that year. The following table gives the results of the grain grown singly and in the various combinations in 1898, and the average of the six years during which this experiment has been in progress:

Crops.	Average height of mixtures, 1898.	Percentage of crop lodged, 1898.	Yield of hay per acre, 1898.		Yield per acre of green crop grown separately.		Yield per acre of green crop grown in mixtures.	
			Grown separately.	Grown in mixtures.	1898.	Average 5 years, 1893, 4, 5, 6, 8.	1898.	Average 6 years, 1892, 3, 4, 5, 6, 8.
	ins.	%	tons.	tons.	tons.	tons.	tons.	tons.
1 Peas and oats	40.5	8.0	2.58	2.84	7.68	7.41	7.80	7.93
2 Barley and peas	40.5	52.5	2.20	2.35	6.89	6.60	7.08	7.20
3 Barley, peas and oats	39.5	6.5	2.43	2.73	7.09	6.72	7.10	7.07
4 Barley and oats	39.5	0.0	2.51	2.65	6.72	6.17	6.88	6.78
5 Peas, wheat and oats	41.5	4.0	2.32	2.64	6.54	6.24	7.23	6.53
6 Barley, peas, wheat and oats	38.5	5.0	2.27	2.74	6.39	6.02	7.05	6.56
7 Wheat and oats	40.0	0.0	2.35	2.50	5.89	5.44	6.35	6.09
8 Barley, wheat and oats	39.0	0.0	2.27	2.68	5.90	5.41	6.43	6.09
9 Peas and wheat	41.5	85.0	2.03	2.13	6.07	5.88	6.28	6.03
10 Barley, peas and wheat	39.5	37.5	2.07	2.22	6.02	5.93	6.03	5.88
11 Wheat and barley	36.5	0.0	1.97	1.83	5.10	4.63	4.53	5.04

The reader should understand that the main objects of the foregoing experiment were to ascertain (1) whether there is any advantage from growing grains in mixtures as compared with growing the same grains separately for green fodder; and, (2) which of the various combinations that can be made from the four principal classes of spring grains, will give the most satisfactory results. In order to find out the proper proportions of seed to use of any combination of two, three, or four kinds of grain for the best results, other experiments are necessary. Work has already been done along this line in the use of nine different proportions of seed of peas and oats, as will be seen from the results of the experiment next referred to. In the experiment now under consideration, the amounts of seed used were as follows: When grown singly, the same quantity of seed was used per acre as in the variety tests for No. 1 set, and one-half as much again for No. 2 set; and when the grains were grown in mixtures, two-thirds the quantity used in the variety tests was sown of each grain in No. 1 set; and, when two kinds of grain were grown together one-half as much seed was used as when grown singly; when three kinds were grown together one-third the quantity of seed, and when four kinds were grown together one-quarter the quantity of seed in No. 2 set.

In averaging the results of these two sets in each of six years, we believe some good results have been obtained in furnishing information on the lines indicated in the objects of this experiment.

The results represented by the figures in the foregoing table are worth a careful study, as they represent a large amount of carefully conducted experimental work extended over a period which embraces different conditions of weather and soil. The question of growing grain in mixtures for green fodder and for hay is an important one, especially in the dairy districts of the Province. It is very unwise for farmers to depend entirely upon their pasture land during the summer months. If the food supplied by the pasture fields, can be supplemented by green fodder, or by ensilage. the flow of milk can be maintained in such a way that the financial results are almost sure to be much more satisfactory. Grain grown in mixtures furnishes an excellent green fodder, or, if not required to be used in that way, it will furnish a large amount of hay of good quality. From an examination of the foregoing table, it will be seen that in average yield of green crop per acre, the grain grown in mixtures gave more than the same grains grown separately, in fully ninety per cent of the experiments. It will also be observed that of all the mixtures used, peas and oats gave the largest yield of green crop per acre. This mixture also produced the greatest yield of both green crop and hay per acre in 1898. Oats, peas, barley, and wheat, when grown in various mixtures, each appeared to exert an influence upon the resulting crop in the order named ; oats producing the greatest influence, and wheat the least. It is very important in selecting varieties of grain to grow in mixtures for the production of either green fodder, hay, or grain, that varieties be selected which require about the same length of time to reach the proper stage for harvesting when all are sown on the same date. The varieties used in the experiment in 1898 were Kinna Kulla barley, Prussian Blue peas, Wild Goose spring wheat, and Siberian oats ; and these varieties have been found to answer well for this purpose.

PEAS AND OATS SOWN IN DIFFERENT QUANTITIES FOR GREEN FODDER AND FOR HAY.

Mixtures.	Height of crop, average 3 years.	Percentage of crop lodged, average 3 years.	Yield of green crop per acre.		Yield of hay per acre.	
			1898.	Average 7 years.	1898.	Average 3 years.
	inches.	%	tons.	tons.	tons.	tons.
Oats 2 bushels, peas 1 bushel	41.33	2.00	12.08	9.31	4.19	3.26
" 2 " " 2 "	41.83	9.17	12.48	9.08	4.16	3.25
" 2 " " 3 "	41.00	21.50	12.38	9.38	3.96	3.19
" 1½ " " 2 "	41.33	13.17	11.05	9.13	3.61	3.17
" 1½ " " 3 "	41.17	35.00	11.75	9.09	3.80	3.12
" 1½ " " 1 "	41.33	3.83	11.50	8.77	3.91	3.00
" 1 " " 3 "	40.33	40.00	11.30	9.03	3.61	3.00
" 1 " " 2 "	40.33	20.50	11.00	8.64	3.51	2.95
" 1 " " 1 "	40.17	6.66	10.78	8.49	3.49	2.80

For seven years in succession an experiment has been conducted in the experimental grounds by sowing nine different proportions of peas and oats, in order to determine which mixture and which quantity of seed would give the best results in the production of fodder. This experiment was conducted in duplicate during each of these years ; thus requiring eighteen plots each year, or a total of one hundred and twenty-six plots in the seven years. The seed was sown broadcast on plots 1/100 of an acre in size. In 1898, the seeding of one set took place on April 16th and of the duplicate on April 29th.

The mixture of two bushels of oats and one bushel of peas, making in all three bushels per acre, has given the largest yield of hay per acre in the average of three

years' experiments. This mixture, however, is followed very closely by a combination of two bushels of oats, and two bushels of peas per acre. In the average yield of green crop for seven years in succession, however, it will be seen that two bushels of oats, and three bushels of peas per acre made the highest record, although the amount of increase produced for the mixture of two bushels of oats, and one bushel of peas is very small in comparison with the extra cost of the two bushels of peas required for the seed. It is also worthy of note that the third mixture on the list had, on an average, over twenty-one per cent. of lodged crop; while in the case of the first mixture, only two per cent. of the crop was lodged at the time of harvest. The mixture of two bushels of oats and one bushel of peas produced a crop which stood up best at the time of harvest of all the different mixtures used. The reader, when examining the results of the experiments here presented, will have but little difficulty in coming to the conclusion that two bushels of oats and one bushel of peas per acre form a mixture which has given very excellent results in the comparative test of seven years.

Peas and Oats—Different Varieties Grown in Mixture for Green Fodder.

In 1897 and in 1898 different varieties of peas and oats were sown in mixtures for the production of green fodder. A very careful selection was made with the object of securing a crop that would come early in the season; and another that would come somewhat later, and another that would come still later. This experiment was conducted in duplicate on plots which were 1/40 of an acre in size in 1897; and in triplicate on plots 1/100 of an acre in size in 1898. The seeding of the different mixtures all took place at the same time in each year, and the crops were harvested when in about the right stage of maturity for using as a green fodder, the peas being nearly full size and the oats in the milk condition.

Mixtures.	Number of days from seeding time until ready for green fodder.		Yield of hay per acre.		Yield of green fodder per acre.	
	1898.	Average 2 years.	1898.	Average 2 years.	1898.	Average 2 years.
			tons.	tons.	tons.	tons.
Chancellor peas, 1 bus. per acre..... } Daubeney oats, 2 bus. per acre..... }	69	72.5	2.68	3.23	6.01	8.31
Prussian blue peas, 1 bus. per acre... } Siberian oats, 2 bus. per acre .... .. }	76	80.5	2.89	3.55	7.27	9.72
Oakshott field peas, 1 bus. per acre... } Golden Giant oats, 2 bus. per acre ... }	84	89	2.30	3.32	5.71	8.39

By examining the average results for two years under the heading of "Number of days from seeding time until ready for green fodder," it will be seen that there is a period of over two weeks from the time the earliest mixture is ready to feed, until the latest has reached a corresponding condition. So, by using suitable mixtures of this nature, a farmer can take his seed and implements into the field and sow at once all that he will require for the season, instead of sowing at several successive dates. In yield of green crop per acre, the Prussian Blue peas and the Siberian oats gave the highest returns in the average two years' experiments. Taking all experiments into consideration, we found that a mixture of two bushels of Siberian oats and one bushel of Prussian Blue peas per acre made an admirable seeding for the production of either green or dry fodder.

Fodder Crops.

For four years in succession six varieties of fodder crops have been carefully tested in the experimental grounds. This experiment is an interesting one, as several of the crops regarding which much has been said of late, are included in the comparative test. The plots were 1/100 of an acre in size in every instance. The crops were harvested when in about the right condition for feeding purposes, and were weighed immediately on being cut; therefore the results given below represent the yields of green crop per acre. In the results of previous years rape was also included in this experiment, and it was grown with these crops in 1898; but the rape this year is reported along with other crops with which there is a closer resemblance in character of growth.

Varieties.	Average height of crop.		Average yield per acre.	
	1898.	Average 4 years.	1898.	Average 4 years.
	inches.	inches.	tons.	tons.
Egyptian peas	24.0	18.8	11.30	9.59
Grass peas	32.0	42.7	8.95	8.88
Yellow Soya Beans	23.0	25.5	8.07	8.52
Crimson Clover	5 0	13.0	1.50	6.80
Prussian Blue Peas	43.0	51.9	6.35	6 73
Horse Beans	24.0	28.3	4.40	4.28

The Egyptian peas have given the largest average yield of green crop per acre in four years; and it will be seen that they have also given decidedly the largest yield per acre of green crop in 1898. The grass peas come second in yield per acre for 1898, and also for the average of four years. The green food produced by the grass peas is much relished by live stock. Three leguminous crops, namely, grass peas, crimson clover, and tares, or vetches, were sent out over Ontario for two years in succession in connection with our co-operative experiments. The grass peas gave the largest yield of green crop per acre during each of the two years, and was the most highly prized by the experimenters as a food for live stock. The Yellow Soya bean, which has proven to be one of the best of the soja beans which have been grown at this place, occupies third place in production of green crop per acre. It will be observed that the crimson clover gave an exceedingly low yield last season. This crop is quite irregular, some seasons doing well and others doing very poorly. Although a great deal has been said regarding the growth of the crimson clover, we find that in nearly all instances it is unprofitable to grow in Ontario, whether sown in the spring or fall.

Sunflowers—Comparative Test of Three Varieties.

Varieties of Sunflowers.	Results for 1898.			Average results for number of years grown.		
	Height of crop.	Total yield per acre.	Yield of heads per acre.	Height of crop.	Total yield per acre.	Yield of heads per acre.
Grown for four years:	inches.	tons.	tons.	inches.	tons.	tons.
Black Giant	78	12.95	4.35	73.00	12.11	4.87
Mammoth Russian	71	10.85	4.45	68·88	9.75	4.31
Grown for two years:						
White Beauty	62	7.85	3.40	64.75	9.23	3.85

Seven varieties of sunflowers were tested in the experiments conducted previous to 1897. Some of these varieties, however, did not give satisfactory results. Nearly all of them were dropped from our list, and that year the experiment was with but three varieties, namely, Black Giant, Mammoth Russian, and White Beauty—the two former

having been grown in 1897 for the third time, and the latter for the first time. The experiment was repeated in 1898 with these three varieties. The experiment was conducted in duplicate, there being six plots in all and each plot being 1-100 of an acre in size.

In the average results from growing the Black Giant and the Mammoth Russian varieties of sunflowers for four years in succession, it will be seen that the Black Giant has done best in every particular. In yield of heads per acre the Black Giant has given about one-half ton more than that produced by the Mammoth Russian. The White Beauty grows a shorter crop and is a more spreading form of plant than either of the other varieties. Farmers who wish to grow sunflowers to secure the heads for cutting with corn and placing in the silo, can glean some useful information from the foregoing table.

Pumpkins and Squashes—Comparative Test of Nine Varieties.

Eight varieties of pumpkins and squashes have been grown under experiment for two years in succession. In each of these years, there have been two hills of each variety. One hill was well manured, and the other was left without any special manuring. In the well-manured hill only one plant was allowed to grow, while in the unmanured hill three plants were allowed to grow. The vines were not cut back, nor were the plants fed in any way except by the manuring they received.

Varieties of Pumpkins and Squashes.	Yield of pumpkins and squashes from one vine of each variety on land highly manured.		
	1895.	1898.	Average 2 years.
	lbs	lbs.	lbs.
Rennie's Yellow Mammoth Squash	552.0	476.5	524.25
King of the Mammoth Pumpkin	618.0	114.0	366.00
Thorp's Mammoth Pumpkin	387.5	277.0	332.25
Mammoth Bright Red Etampes Pumpkin	282.0	375.0	328.50
Mammoth Tours Pumpkin	358.0	174.0	266.00
Rennie's Green Mammoth Squash	253.0	148.0	200.50
Buckbie's New Sandwich Island Pumpkin	200.0	97.5	148.75
Large Cheese Pumpkin	122.5	6.5	64.50
Connecticut Field Pumpkin	82.5	....	....
Gray Boulogne Pumpkin	....	242.5	....
Hundredweight Pumpkin	....	188.5	....
True Potiron Pumpkin	....	186.0	....

The seed of the different varieties which were planted on the manured land gave very poor results indeed in 1898; and in 1895, the yield from the unmanured hills was less than half what it was from the well manured hills. The figures in the foregoing table simply represent the yield of pumpkins and squashes produced from one plant of each variety in each year, when grown on well manured land. Nearly all of these varieties are noted for producing very large specimens; and the object has been to grow them, to ascertain which varieties would likely be the best producers of food for live stock. It will be seen that the King of the Mammoth pumpkin gave the largest yield in 1895, but the returns from it in 1898 were very much less. When the results from the two years' tests are taken into account Rennie's Yellow Mammoth squash occupies first place in yield per acre, this variety having produced good results during each year of the experiment.

Rape—Comparison of Varieties.

For four years in succession two varieties of rape have been grown side by side in the experimental grounds under similar conditions. The crop each year was harvested when it reached the proper condition, and was weighed immediately on being cut. The following table gives the yield per acre of the two varieties in each of the four years, and also the average results for the whole period.

Rape is grown in considerable quantities in some parts of Ontario for feeding sheep and hogs. The Dwarf Essex variety is the one generally used by the farmers of this Province. A few years ago a Wisconsin seedsman introduced a variety, under the name

Varieties of Rape.	Yield of green rape per acre.				
	1895.	1896.	1897.	1898.	Average 4 years.
	tons.	tons.	tons.	tons.	tons.
Dwarf Essex	15.15	24.18	37.20	27.40	**25.98**
Dwarf Victoria	14.55	18.60	32.40	26.10	**22.91**

of Dwarf Victoria, for which he made a very extravagant claim. The following quotation is taken from the annual seed catalogue for 1898: "It, (Dwarf Essex) is eleven miles behind in yield, in bushy, leafy quality, and in vigor of growth and hardness, to our splendid, yes wonderful, Dwarf Victoria rape." In the tests made by growing these two varieties of rape under similar conditions it will be seen from the foregoing table that the Dwarf Essex has given an average of fully three tons of green crop per acre more than the Dwarf Victoria variety. The Dwarf Essex has certainly given very good satisfaction in comparison with the Dwarf Victoria, and also in the comparison of seven varieties grown in 1894 and 1895.

Varieties of Kale, Cow Cabbage, Rape, Etc.

An interesting experiment has been conducted during the past three years by growing crops which much resemble rape in character of growth and of crop. The plots were 1-100 of an acre in size in every instance. The crops were weighed immediately on being cut each year.

Varieties of Kale, Cow Cabbage, Rape, etc.	Average height.		Yield of green crop per acre.	
	1898.	Average for number of years grown.	1898.	Average for number of years grown.
	inches.	inches.	tons.	tons.
Grown for two years:				
Dwarf Essex Rape	32	38.0	27.4	**32.30**
Cow Cabbage, or Marrow Stem Kale	33	37.5	23.9	**31.59**
Tall Jersey Cabbage	30	37.5	21.2	**24.40**
Thousand Headed Kale	31	33.5	20.8	**24.34**
Large Tall French Brussels Sprouts	23	22.5	13.5	**20.75**
Tall Green Curled Scotch Kale	26	18.5	18.1	**16.32**
Grown for one year:				
Jersey Kale	30	30.0	21.6	**21.6**
Georgia Collards	20.5	20.5	10.1	**10.1**

As the experiment with Cow cabbage, or Marrow Stem kale, and the Tall Jersey Cabbage has been conducted for only two years in succession, the results from the other four varieties obtained in 1896 are left out of consideration in order to give the results of the six varieties under similar conditions. It will be seen that the Dwarf Essex rape occupies first place in yield of green crop per acre, furnishing an average of 32.3 tons. This is followed closely by the Cow cabbage or Marrow Stem kale. The seed of the latter variety was secured from Montreal. The Tall Jersey Cabbage is used extensively on the Island of Jersey; and Prof. H. H. Dean, when visiting the Island of Jersey in 1895, observed that this variety was in general use and was very highly prized. He brought

with him a small quantity of seed; and we have since imported a larger quantity. The growth of this variety for two years has been very good, an average of 24.4 tons per acre being produced. Mr. W. E. Butler, one of the graduates of the College, wrote his thesis on the feeding quality of the different varieties of crops named in the above table. He fed them to dairy cows, examined closely the influence upon the milk produced, and found that, in every instance, there was more or less taint in both the milk and the butter.

Rape—Application of Fertilizers.

In 1891, 1896, 1897, and 1898, an experiment was conducted by applying different commercial fertilizers to a crop of rape, in order to compare the results from land which is fertilized with those from land which was unfertilized. The plots were 1-100 of an acre in size in the experiments of 1891, 1896, and 1897, and were 1.80 of an acre in size in 1898. The fertilizers were applied at the time the rape seed was sown. The mixed fertilizer consisted of nitrate of soda, superphosphate, and muriate of potash, one-third as much of each as was used when they were sown separately. The mixture, therefore, would be a complete fertilizer containing nitrogen, phosphoric acid, and potash. The cost of the different fertilizers used per acre was as follows: Nitrate of soda, $3.84; mixture, $3.79; Superphosphate, $3.68; and Muriate of potash, $3.84.

Fertilizers.	Amount of fertilizer used per acre 1898.	Yield of green rape per acre (tons).				
		1891.	1896.	1897.	1898.	Average 4 years.
	lbs.	tons.	tons.	tons.	tons.	tons.
Nitrate of Soda	160	15.8	14.7	14.0	16.3	**15.2**
Mixture (complete)	313	14.8	10.6	15.6	14.7	**13.9**
Superphosphate	220	12.6	10.4	13.8	13.7	**12.6**
Muriate of Potash	160	12.2	10.4	12.7	14.2	**12.4**
No fertilizer		13.2	10.2	11.3	11.4	**11.5**

In the average of four years' experiments, the application of nitrate of soda increased the yield of rape 3.7 tons per acre. Providing the full advantage of the fertilizer was secured in the first crop, this extra increase in yield of rape was made at a cost of practically one dollar per ton. It is very evident that the nitrate of soda exerted the greatest influence of any fertilizer used in this experiment in increasing the yield per acre.

Rape—Methods of Cultivation.

Method of soil preparation.	Yield of green rape per acre.			
	1895.	1896.	1898.	Average 3 years.
	tons.	tons.	tons.	tons.
Land subsoiled	6.7	18.25	24.99	**16.65**
Land not subsoiled	5.5	17.39	26.19	**16.36**

In 1895 an experiment was conducted by sowing rape on land which had been subsoiled, in order to compare these results with those obtained from sowing rape on land the subsoil of which had not been disturbed. This experiment was repeated in 1896, and again in 1898, and was conducted in duplicate during each of the three years. The subsoiling was done with a subsoil plow, which loosened the soil to a depth of from twelve to fourteen inches. The subsoil was simply loosened and was not brought to the upper surface of the soil. The rape, which was sown in rows, was cultivated throughout the season. The crop produced on the different plots was weighed immediately on being cut in each of the years in which this experiment was conducted.

It will be seen that the land which was subsoiled gave the largest yield per acre in 1895 and 1896; but in 1898 that which was left unsubsoiled gave the best results By taking the average of the results for three years, it will be seen that there was the largest yield by about one-third of a ton per acre on the land which was subsoiled. This, however, would not pay for the labor of subsoiling the land. In all the experiments conducted at this place in which the subsoil plow has been used, it has been found that the advantage from its use has generally been very small.

Rape—Selection of Seed.

In 1895, 1896, and 1897 an experiment was conducted in duplicate by sowing the following selections of rape seed, namely, large plump, medium-sized, and small-sized seed. In the average yield per acre for the three years it was found that large plump seed gave about $2\frac{1}{3}$ tons per acre more than the medium-sized seed, and nearly 5 tons per acre more than the small-sized seed. This experiment was repeated in 1898; but, owing to some irregularity in the experiment, the results cannot be given this year, further than to say that sixty-three per cent. of the large seed, forty-seven per cent. of the medium-sized seed, and forty per cent. of the small seed germinated.

Rape—Depths of Planting.

In 1898 an experiment was conducted by planting rape one-half inch, one inch, one and one-half inches, two inches, three inches, and four inches deep. The experiment was conducted in duplicate. Great care was taken to have the seeds exactly the right depth from the surface of the soil. Level cultivation was used throughout. The seed which was sown one-half inch and one inch in depth produced the greatest percentage of plants. There was not much difference in the germination of the seed when planted not deeper than two inches below the surface. The seed, however, which was planted three inches deep produced only one-half, and that planted four inches deep produced only one-sixth the number of plants compared with those produced from the seed which was planted two inches or less in depth.

Clovers—Comparative Test of Varieties.

A considerable amount of important experimental work is now being carried on with the different varieties of clover, and we hope in the near future to furnish some valuable information about this most important crop. We are carefully testing a number of varieties; and are also sending seed of four of the principal varieties throughout Ontario in connection with the co-operative experimental work, to get information about the comparative value of the different clovers when grown on the various soils of the Province. In the summer of 1898 some important experimental work was started with the object of finding out the amount of clover roots produced by some of the principal varieties in the first six inches of soil, the second six inches, and the third six inches. The yield of roots in each of these layers of soil was obtained with Mammoth Red Clover, Common Red Clover, Alsike Clover, and Lucerne, two months, five months, fourteen months, and seventeen months after seeding. The Chemical department kindly undertook the work of analysing the roots, and has given the results in Part IV. of this report. A sufficient area of each variety was used in the experimnnt, so that the results might be presented in yield per acre. We hope the public will not be in too great a hurry for these results, that we may have sufficient time to secure thoroughly reliable information which will be of truly practical value. It might be mentioned here, that, of the four varieties of crops under investigation, the Lucerne, or Alfalfa, has given decidedly the largest yield, and the Alsike Clover decidedly the smallest yield of roots per acre.

Special attention has been given at this place to the growing of Lucerne, or Alfalfa, and seed has been distributed in connection with the Experimental Union work during each of the past seven years. Mr. Robert Harcourt, B.S.A., has also been carrying on

some important work in determining the proper stage to harvest Lucerne in order to secure the best results. The investigations in connection with the digestibility of the Lucerne is being prepared in bulletin form, and in connection with this information some results of field experiments in the growing of Lucerne will be included, and are consequently not presented in this report.

Grasses—Comparative Test of Twenty Varieties.

On the 15th of May, 1894, a large number of varieties of grasses were carefully sown on uniform plots in our experimental grounds. Several of the varieties were completely killed out during the first winter. Twenty varieties, however, have now passed through four winters. No fertilizer or manure of any kind has been applied to the plots, as the desire has been to ascertain which varieties would prove the hardiest and would give the most satisfactory results when constantly cropped without being specially manured or fertilized.

	Names of varieties of grasses.		Height of crop.		Yield of hay.		Yield of freshly cut grasses.		
	Common names.	Scientific names.	1898.	Average four years.	First cutting, 1898.	Second cutting, 1898.	First cutting, 1898.	Second cutting, 1898.	Average per year for four years.
			ins.	ins.	tons.	tons.	tons.	tons.	tons.
1	Lyme Grass	Elymus Virginicus	33.0	28.8	1.32	.72	4.56	1.84	7.23
2	Fringed Brome Grass	Bromus ciliatus	32.0	30.8	2.88	.70	5.16	1.96	7.14
3	Western Rye Grass	Agropyrum tenerum	36.5	27.4	3.08	.38	5.48	.96	6.80
4	Tall Oat Grass	Arrhenatherum avenaceum	49.0	43.3	2.64	.52	6.04	1.72	5.62
5	Bearded Wheat Grass	Agropyrum caninum	39.5	29.9	2.44	.34	4.20	.80	5.23
6	Orchard Grass	Dactylis glomerata	39.0	32.5	2.[illegible]	.42	5.28	1.24	5 13
7	Timothy	Phleum pratense	35.0	33.3	3.12	.16	6.96	.60	4 98
8	American Lyme Grass	Elymus Americanus	37.0	24.3	2.80	.18	4.64	.40	4.97
9	Awnless Brome Grass	Bromus inermis	14.0	19.3	2.04	.10	4.08	.28	3.68
10	Soft Brome Grass	Bromus Mollis	37.0	32.5	1.52	.22	3.36	.64	3.48
11	Meadow Foxtail	Alopecurus pratensis	33.0	30.0	1.44	.18	3.92	.52	3.48
12	Meadow Fescue	Festuca pratensis	29.5	28.1	1.16	.28	2.96	1.00	3.47
13	Canadian Blue	Poa campressa	19.0	16.5	1.92	.10	3.52	.20	2.58
14	Red Top	Agrostis vulgaris	23.0	20.5	1.24	.04	2.64	.12	2 25
15	Rhode Island Bent	Agrostis canina	22.5	21.9	.96	.12	1.84	.16	2.17
16	Yellow Oat	Avena flavescens	31.5	25.4	1.24	.00	2.56	.32	1.98
17	Perennial Rye	Lolium perenne	22.0	18.8	.56	.34	1.20	.88	1.82
18	Kentucky Blue	Poa pratensis	23.0	21.8	.88	.48	1.88	1.24	1.81
19	Creeping Bent	Agrostis stolonifera	23 0	16.0	.76	.06	1 69	.12	1.60
20	Fine Leaved Sheep's Fescue	Festuca ovina	22.0	17.8	(1.90)		(3.64)		1.55

The three varieties which stand at the head of the list in the average yield of green crop per acre for four years were grown from seed which was received from Manitoba through the kindness of Mr. S. A. Bedford, Superintendant of the Experimental Farm for that province. The seed of the Bearded Wheat grass, and American Lyme grass was obtained from the same source. It will be seen that the Tall Oat grass gave about two-thirds of a ton per acre more than Timothy; and the Timothy gave 1.3/10 tons per acre more than the Awnless Brome grass (Bromus inermis). The Canadian Blue grass gave a yield of about three-fourths of a ton per acre more than the Kentucky Blue grass. The Lyme grass, which stands the highest in yield per acre, is coarse in quality, and, it will be noticed, it gave a smaller yield in 1898 than several of the other varieties. This variety did not look nearly so well in the summer of 1898 as in the previous year.

The Tall Oat grass, Orchard grass, Timothy, and Meadow Fescue have been sent out over Ontario for two years in succession for co-operative tests, and it is hoped that valuable information regarding the relative value of these four varities on the various soils of

Ontario will be secured. These experiments, which were started in the spring of 1897, and continued in 1898, show that, in yield during the present year, the Tall Oat grass gave 3 tons of hay per acre, Timothy 2.7, Meadow Fescue 2.1, and Orchard grass 2.

PERMANENT PASTURE.

Mixture recommended in	Grasses and clover.	Varieties in mixtures.	Amount of seed per acre.	Average height of first cutting.	Yield of freshly cut grass per acre.	
				Average four years.	1898, three cuttings.	Average four years, 1895 6-7-8, ten cuttings.
			lbs.	inches.	tons.	tons.
1885	Grasses	Meadow Fescue	6	32	14.00	15.40
	"	Meadow Foxtail	3			
	"	English Rye	2			
	"	Timothy	3			
	"	Canadian Blue	4			
	"	Orchard	3			
	"	Red Top	2			
	"	Yellow Oat	2			
	Clovers	Lucerne	4			
	"	White	2			
	"	Alsike	2			
	"	Red	1			
	"	Yellow	1			
		Total amount seed used.	35			
1893	Grasses	Orchard	4	33	18.28	19.09
	"	Meadow Fescue	4			
	"	Fall Oat	3			
	"	Timothy	2			
	"	Meadow Foxtail	2			
	Clovers	Lucerne	5			
	"	Alsike	2			
	"	White or Dutch	1			
	"	Yellow or Trefoil	1			
		Total amount seed used.	24			

A large amount of experimental work has been done in testing varieties of grasses and clovers, both singly and in combination, during the past twenty years. The grasses and clovers have been carefully studied, and much information has been gleaned in regard to their value for pasture, and for hay. In 1885 Prof. Wm. Brown, who was then Farm Superintendant at the Ontario Agricultural College, recommended a mixture which he thought well adapted for permanent pasture. Only the most hardy varieties which had been tested up to that time were included in the mixture. In 1893, after eight years additional experimental work, during which time the writer was closely connected with the work of the experimental department, we recommended another mixture containing a smaller number of varieties and requiring a smaller amount of seed per acre. The grasses and clovers recommended in 1893 have proved themselves to be a valuable mixture. They are all hardy varieties and, when grown together, give a large yield. An experiment was started in the spring of 1894 by sowing a plot of the mixture which was recommended in 1885, and another plot of the mixture which was recommended in 1893. The seed was sown with a light seeding of barley; and the germination of the seed of the grasses and clovers were quite satisfactory.

Two cuttings were made from each plot in 1895 ; three, in 1896 ; two, in 1897 ; and three, in 1898. Without a single exception, the mixture which was recommended in 1893 has produced a larger yield per acre than that which was recommended in 1885. We have named all the varieties of grasses and clovers sown in each mixture : and also the quantity of seed per acre, particularly, for two reasons : In the first place, that this experiment might thus be as clear as possible and, secondly, that any person wishing to know the quantity of seed per acre of the different varieties which were recommended as a permanent pasture mixture could find the information in good form. It will be observed that the mixture recommended in 1893 possesses none but very hardy grasses which have been tested at this place more or less for about twenty years. It could, of course, be somewhat modified to suit different localities and different soils.

Miscellaneous Crops.

As experiments have been conducted with a number of crops which do not strictly belong to any of the classifications of the previous part of the report, the results will be briefly referred to under the heading of miscellaneous crops. With some of the crops, however, more experimental work will need to be done before anything very definite can be said about them.

Flax. For two years in succession three varieties of flax have been grown in the experimental department. There was some difference in the appearance of seed of the different varieties, that which was received under the name of Russian being decidedly the largest and the common variety of Ontario being the smallest. In the results of the two years' experiments it is found that the Russian variety has given the best yield of seed per acre, the average being 15.6 bushels. The Manitoba and the common have given about equal yields of seed per acre.

Peanuts. For two years in succession experiments have been conducted with seven varieties of peanuts. None of these fully matured in either of the years. The varieties which gave the best satisfaction in 1897 were the White, Red, Spanish, Root Hog or Die, and Rennie's New Canadian ; and the varieties which gave the best results in 1898 were the Root Hog or Die, Savatilla, Spanish, and Rennie's New Canadian, in the order named. Some of these varieties produced nuts of good outward appearance, but on becoming dry they shrivelled considerably on account of not being fully matured.

Soya, Soja, or Japanese Beans. Five varieties of Japanese beans have been grown for two years in our experimental grounds. Most of these varieties were brought out from Japan by Prof. Brooks of Amherst University, Massachusetts. Some of them are doing well in the State of Massachusetts. They produce grain which is the richest of any produced on the farm. Our experiments, so far, are not of sufficient extent to justify our saying much in regard to the place these beans are likely to occupy in the future agriculture of Ontario. It might be stated, however, that in yield of grain per acre, the Yellow Soya beans, the seed of which we originally obtained from the State of Kansas, stands highest, and that the Early White, Medium Black and Medium Green gave yields in the order named. The seed of the last three were secured from Prof. Brooks. In yield of green crop per acre the largest returns were secured from the Yellow and from the Medium Green varieties of Soya beans.

Horse Beans. Experiments have been conducted more or less for the last eight years with Horse beans, but in the most of the years the crop has proved unsuccessful. During the hot, dry weather of the summer, the leaves dropped from the plants, and the stems turned black and became dry. In some instances there was a second growth from the roots after the fall rains saturated the ground. Among the different varieties tested the Small Horse bean has proved to be one of the best.

Cow Peas. One or more varieties of Cow peas have been sown in our experimental grounds during each of the past seven or eight years. These crops, however, are too late for the climate of Ontario, unless it is, in some instances, for producing a green

crop for ploughing under. They seldom grow to a height of more than ten to twelve inches, and sometimes do not reach even the blossoming stage. The four varieties grown in 1898 were the Warren Extra Early, Black Eye, New Era and Thorp's Cow peas. Of these varieties the Black Eye gave the largest yield of green crop per acre, and the New Era the smallest.

TARES, OR VETCHES. For two years in succession an experiment has been conducted in growing three varieties of Vetches for food purposes. In the average results of the two years' experiments, the Hairy Vetch gave the best results, the yield per acre being considerably more than that of the common variety. Vetches are frequently mixed with oats for producing a green fodder crop; but in the experiments on our experimental grounds, and in the co-operative tests throughout Ontario, we find that peas and oats give better all round satisfaction.

CHICORY. In 1896, 1897 and 1898, Chicory was sown in the experimental plots. It is from the dry roots of the plant that the chicory of commerce it obtained, which is so commonly used as an adulteration in coffee. Nothing was done with the roots excepting that the yield of the fresh roots was determined. In 1898 there was 7.5 tons and in 1896 11.4 tons of green roots per acre. In 1897, however, the crop was a comparative failure.

FLAT PEA. *(Lathyrus Sylvestris.)* Several plots of the flat pea have been sown in the experimental grounds within the past eight years, but on the whole the results have not been very satisfactory, and we believe that this will not be a very important crop in general cultivation. While visiting the Agricultural College in Michigan in 1897, the writer saw about one acre of the flat pea, which was producing a good crop. From our experiments, however, we find that it is not relished by the live stock, and we scarcely know what to do with the crop after it is grown. The seed is very expensive, and the plants require three years to obtain their full size. There is apt to be much trouble from weeds during the first year or two when getting a crop once properly established. With great care, we have succeeded in getting fairly good crops on our small plots; but, on the whole, we consider it a crop of but little value to the farmers of Ontario.

BOKHARA OR SWEET CLOVER. Seed of the Bokhara—Sweet or Wild Clover—has been sown on our plots on several occasions, and the crop therefrom has been large; in fact, on some occasions the yield from this clover has been two and three times greater than that of the Common Red Clover. It is a biennial, the plants dying after the second year's growth. The green fodder and the hay produced by this variety of clover is not very suitable for live stock, for the reason that it has a bitter taste and the stems become very large and woody while the plants are still comparatively young. This clover is sometimes recommended, however, to be grown for ploughing under as a green crop, for which purpose it might prove quite serviceable.

LUPINES. Three varieties of Lupines have been grown in our experimental grounds, but they have proved a failure in every case. The climate of Ontario seems to be unsuited to their growth and development. They have been tested for several years, and have given very unsatisfactory results during each of these years.

SACHALINE, PRICKLEY COMFREY, KIDNEY VETCHES, ETC. Besides the experiments above referred to, some work has been done in testing sachaline, prickley comfrey, kidney vetches, hemp, ground almonds, teosinte, ramie, Australian salt bush, lentils, banana field beans, etc.; but so far none of these crops have given returns which warrant us in concluding that they will be of much value in this Province.

CO-OPERATIVE EXPERIMENTS IN AGRICULTURE.

The co-operative experiments in agriculture are carried on conjointly by the Experimental Department of the Ontario Agricultural College and the Ontario Agricultural and Experimental Union. All necessary material and detailed instructions for conducting the various experiments are furnished to the experimenters from the Agricultural College. Each experimenter joins in the work voluntarily, and chooses from a carefully

prepared list, furnished by the director, the particular experiment in which he is most interested. At the end of the season the results of the tests are reported to the director, who carefully examines them and prepares a summary of the results of the successfully conducted experiments, with conclusions therefrom, for the annual meeting of the Union and for general distribution in printed form. The number of voluntary experimenters in agriculture has increased from 12 in 1886 to 3,028 in 1898.

Concise Statement of Work Completed or Now Being Done.

1. Testing nitrate of soda, muriate of potash, and superphosphate; wood ashes, salt, and land plaster; complete fertilizers, farmyard manure and no-manure with different kinds of farm crops in a study of the fertility of the soil. The principal objects of this work are as follows: (1) To ascertain whether it will pay to use commercial fertilizers in Ontario; (2) To ascertain the comparative value of commercial fertilizers and farmyard manure with different crops and on different soils; and (3) To ascertain which kinds of soluble plant food, if any, are lacking, in order to know how best to improve the fertility of the soil. A more systematic use of clover, greater care in the use of absorbents for saving all the liquid manure, a decrease in the practice of selling valuable wood ashes from the farm at low prices, etc., all naturally result from this line of investigation.

2. Testing different methods of cultivation, as embraced in the three following experiments: (1) Growing potatoes in hills and on the level; (2) Growing corn in drills and in squares; and (3) Growing corn broadcast and in drills, 42 inches apart, from thick and from thin seeding in each case.

3. Testing the following methods of planting potatoes: (1) Planting large whole potatoes, small whole potatoes, cut pototoes with two eyes in each set, cut potatoes with one eye in each set, etc.; and (2) Planting potato sets immediately after and five days after being cut.

4. Testing the following mixed grains as green fodder crops: oats and peas, oats and tares; and oats, peas, and tares.

5. Testing the leading varieties of grain, root, tuber, grass, clover, and fodder crops. These experiments embrace the principal classes of farm crops which are grown in Ontario. Each experiment includes from three to six varieties. Sixty-six of the varieties distributed in 1898 have done exceptionally well among all the varieties grown for several years in succession in the experimental grounds at the College, and the remaining six varieties, which were tested in 1897 for the first time, headed the list in their respective classes.

For the results of the co-operative experiments for 1898 the reader is referred to the annual report of the Ontario Agricultural and Experimental Union.

Conclusions.

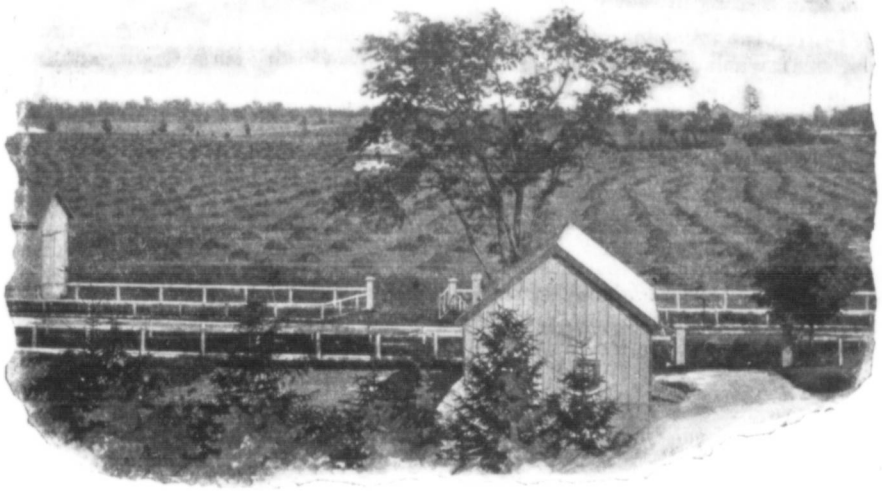
We have aimed to make all our work practical, accurate and reliable, and we hope that the record of the results here presented may be of some service in the advancement of agriculture in Ontario.

I wish to thank you, and also the Minister of Agriculture, for the able support given me in developing the work of the Experimental department.

Respectfully submitted,

C. A. ZAVITZ,
Experimentalist,

Guelph, Dec. 31st, 1898.



FIELD OF HAY O. A. C. FARM, GUELPH.

PART XI.

REPORT OF THE FARM SUPERINTENDENT.

To the President of the Ontario Agriculture College:

SIR,—I have the honor to submit herewith my annual report of the Farm department for the year 1898. It affords me pleasure to state that notwithstanding the frost on July 9th, followed by extreme heat and dry weather, which injured our grain crops very much in quality, we reaped an abundant harvest, all of which was housed in good condition.

Improvements.—Last spring we found that the wooden silo was so much decayed that it would not permit of being used another season; and, as there was no appropriation for that special purpose, we had to use what had been voted for underdraining and fencing. The new silo is a substantial structure built of cement, in two compartments, one 16½x13½ ft. inside measurement, and the other 16½x9½ ft., 36 ft. high. The capacity of the two is about 300 tons. During the winter we fed out of the larger compartment; and in the spring and summer out of the smaller one. The walls are 21 inches thick at the bottom and 14 inches at the top. The cost of the cement was $200, and the other material and the labor, including the roof, was as much more, making a total cost of $400. Small stones were put in the centre of the walls, and the cost was materially lessened thereby. Instead of doors there are openings from top to bottom, which are closed by means of inch boards, 12 inches wide, nailed together with an overlap of 2½ inches, to break the joints and exclude the air. These are tacked on as the ensilage is used and remain ready for re-filling.

Fencing.—We have the posts nearly all set for a new wire fence on the Puslinch town-line, 200 rods. It is the same style of fence as we put up three years ago. When this is complete, all the boundary fences on the farm will be in good condition. We have also done a good deal of grading on the public road adjoining the farm.

Implements.—Last year favorable arrangements were made with implement manufacturers for a number of up-to-date implements adapted to modern methods of cultivation. Our old implements were given in part-payment; and the exchange proved very satisfactory.

Rotation of Crops.—Under the present systematic rotation of crops, and by the cultivation of the soil according to scientific principles, the fertility of the farm is rapidly increasing without the application of any fertilizer but the barnyard manure made on the place.

Although the farm proper has been reduced to 340 acres, we have, nevertheless, secured a very fair profit on the year's operations, as will be seen by the financial statement at the end of this report.

Meadow.—We had 85 acres of meadow which averaged 2 tons per acre, which was cured and housed in good condition. It was composed of common red clover, alsike, and timothy, mixed as followa: red clover 7 lbs., alsike 3 lbs., and timothy 4 lbs.—total 14 lbs. Twelve pounds of this mixture was sown with the grain and the remainder immediately after harvest, wherever there were any spots too thin. There were 40 acres of pasture for the College cattle (including 15 feeding steers) and sheep; and 25 acres for the cows of the Dairy department.

Fall Wheat.—24 acres were grown—13 acres of Dawson'a Golden Chaff, and 11 acres of Early Genesee Giant—all of which succeeded peas the previous year. It was an extraordinarliy heavy crop and greatly admired by visitors during the month of June; but the frost on the night of July 9th injured it somewhat. We commenced cutting on July 14th, when the grain was in the dough state, finishing on the 16th; and in this short time the grain had become quite hard and the straw brittle on account of the excessive heat which followed the frost. The yield was as follows: Dawson's Golden Chaff, straw, 69 dozen sheaves, and grain, 36 bushels per acre; Early Genesee Giant, straw, 72½ dozen sheaves, and grain 38 bushels.

Oats.—64 acres of Siberian oats were grown on the section following corn and roots. Instead of the land being plowed the previous fall it was drilled with a double mould-board plow, 21 inches wide, and thoroughly harrowed and cultivated last spring, before the oats were sown: 1½ bushels per acre were sown with the drill, and our usual mixture of clover and grass seed. We had an excellent crop of oats. According to what we have threshed they will average between 60 and 65 bushels per acre; and had it not been for the July frost, followed by excessive heat, they would have yielded considerably more. They were sown 11th to 15th April and harvested 1st to 5th August.

Barley.—29 acres of Mandscheuri barley were grown after sod, which had been plowed shallow early in the fall and thoroughly harrowed and cultivated with a spring-toothed cultivator, with wide points, to cut off all weeds about 2 inches below the surface. This was ribbed in the early part of November. The barley was sown, 20 acres on the 15th to 16th of April, and 9 acres on the 28th and 29th, at the rate of 1½ bushels per acre; and harvested on the 20th to 23rd July. Both were magnificent crops. Although it is not threshed yet, we can safely place the yield at not less than 50 bushels per acre.

Peas.—22 acres were grown of the Prussian Blue variety, which has been the principal variety on the farm for a number of years. From it we usually get a superabundance of straw; and we never fail to get a fair yield of grain. According to what we have threshed the yield this year will be about 25 bushels per acre, notwithstanding the July frost. They were sown on the 29th and 30th of April, at the rate of 2½ bushels per acre, and harvested 1st to 5th of August.

Corn.—32 acres of the following varieties were grown: 6 acres of Early Butler, 16 acres of Wisconsin Earliest White Dent, 8 acres of Mammoth Cuban, and 2 acres of Kendall's Giant Sweet—the last for green fodder, which was of good quality but not more than 10 tons per acre. The corn was sown with the grain drill, 42 inches apart, at the rate of 14 lbs. per acre, on the 26th to 28th of May. It started nicely; but we had a very heavy shower of rain on June 8th, which formed a crust on the land that had to be broken up as quickly as possible. On the 11th we had another heavy shower, and as soon as the land was dry, the cultivators were started again. By the 1st of July the corn had quite recovered and did well until the frost on the night of the 9th, which blackened most of it, so that there was little hope of a crop; but with persistent cultivating it started anew and grew rapidly until it was again slightly frost-bitten on Sept. 10th. We commenced cutting on the 13th and finished on the 26th Sept. The yield of Early Butler was 12 tons per acre; Wisconsin Earliest White Dent and the Mammoth Cuban, 18 tons per acre. All considered, Wisconsin Earliest White Dent was the best corn.

Preparation of Land for Corn and Cultivation of Corn Crop.—The previous fall clover sod was plowed, 4 inches deep, about the 1st of Sept. Afterwards it was harrowed and cultivated. In October barnyard manure was spread on the surface, at the rate of 15 loads per acre, and the land was then drilled 22 inches wide, with a double mould-board plow. In the spring, before seeding, the drills were levelled down with the harrows and spring-tooth cultivators. A few days after sowing the ground was thoroughly pulverized with Breed's weeder, which was followed a few days later with a two-horse corn cultivator, about 3 inches deep. This implement was kept going until the corn was about 4 ft. high, when we used two home-made harrows with ordinary harrow teeth, set on a slant and projecting 4½ inches below the frame. These were weighted with a block of wood, and were kept going until the corn was in tassel. We found this an excellent

implement to pulverize the surface soil and thereby conserve moisture for the benefit of the corn; and the teeth being set on a slant are not so liable to break the rootlets (feeders) as an ordinary cultivator.

Rape.—Six acres were grown. One acre was sown on May 18th, for early feeding (Pigs and Lambs), and the remainder on June 20th and 21st, in shallow drills, 24 inches apart, and cultivated the same as other root crops. This was fed during the fall to pigs, lambs, young cattle, and feeding steers. All animals do well on this succulent food.

Field Roots —There were 8 acres of mangels grown as follows: 3 acres of Mammoth Long Red and 5 acres of Yellow Intermediate, yielding 770 bushels per acre. Two acres of Red Top sugar beets were grown, of the Nantes variety, which yielded 560 bushels per acre.

Cultivation of Land for Roots.—The previous fall, early in October, clover sod was plowed about 4 inches deep, and thoroughly harrowed: during the winter barnyard manure was spread on the surface at the rate of 15 loads per acre. In the spring it was gang plowed, harrowed, and cultivated with a spring-tooth cultivator, until the manure and rotted sod were thoroughly incorporated. The subsoil was loosened with three horses attached to a cultivator with narrow chisel-pointed teeth for the purpose. The land was then put into shallow drills, 30 inches apart, with a double mould-board plow, with a marker attached, so that the rows were uniform in width. The seed was sown with an ordinary horse turnip drill, at the rate of 4 lbs. per acre. After seeding, the drills were rolled down with an ordinary field roller, and in a few days the surface was pulverized with Breed's weeder, to conserve moisture and destroy weeds. After thinning the plants to 12 inches apart, we used the ordinary horse-hoe with rake attachment. The mangels and sugar beets were sown on the 4th and 5th of May, and pulled on the 20th to 26th October. Six acres of turnips were grown after clover sod, treated the same as for the mangels. They were sown on the 17th and 18th of June, and pulled on the 29th Oct. to 2nd Nov., yielding 3,150 bushels, or 525 bushels per acre.

Potatoes —Seven acres of the following varieties were grown: Burpee's Extra Early, Stray Beauty, Rose of Erin, Empire State, and American Wonder. The July frost injured them very much, so that they grew very little afterwards. The preparation of the land was the same as for the mangels and turnips. The potatoes were planted in drills 30 inches apart, on the 19th to 21st of May, and harvested on the 1st to 6th Oct.—total yield 790 bushels.

Fall Cultivation.—As soon as the peas and 9 acres of barley were harvested the land was gang-plowed shallow, and then harrowed and cultivated twice for fall wheat; before seeding the sub-soil was lossened with a three-horse grubber.

In the previous spring, before the peas were sowed, barnyard manure was gang-plowed in at the rate of 15 loads per acre. In the fall this was thoroughly decomposed and available for the use of the wheat plant. The fall wheat, 31 acres, was sown the last days of August, and, before sowing, we treated it with a strong solution of blue vitriol to prevent smut—20 lbs. of bluestone dissolved in 20 gallons of water for 32 bushels of wheat. We took half-a-barrel of the liquid and used it by putting a bushel of wheat in a coarse sack and immersing it in the solution for 5 minutes; after taking it out we allowed it to drip for 1 minute, then spread it on the floor and dusted it with lime. The treatment proved a preventive of smut, but I think it was rather strong as it slightly injured the germinating power of the wheat.

On the 31st of August we commenced gang-plowing 20 acres of barley stubble that had been grown on 1st year clover sod; we cultivated it thoroughly in the fall, manured it at the rate of 15 loads of farmyard manure per acre, and put it up in drills 22 inches wide, so as to be ready for corn next season. The remainder of this section of the farm, 58 acres, being clover sod, was plowed about 4 inches deep, thoroughly harrowed and cultivated (shallow) by a spring-tooth cultivator with wide points. It will be manured during the winter, and gang-plowed in the spring for corn, mangels, turnips, potatoes, rape and peas. After our corn was harvested, the roots were turned out by plow without the mould-board, after which the land was harrowed and cultivated with wide points, and

then drilled across with the double mould-board plow. After the mangels, turnips and potatoes were harvested the land was drilled across, so as to incorporate the tops with the surface soil. All this section will be sown with grain and seeded in the spring.

Live Stock.

Thoroughbreds.—We have at present 21 pure-bred cows (eight breeds) which are kept for educational purposes and to supply milk to the College. We have the following dairy breeds: Ayrshire, Holstein and Jersey. The beef breeds are: Short-Horn, Hereford, Aberdeen-Angus, Devon and Galloway. These might with advantage be reduced to three breeds. We have six pure-bred bulls, as follows: Short-Horn, Hereford, Aberdeen-Angus, Ayrshire, Holstein, and Jersey.

Steers.—On the 28th of Oct., we bought twenty-four 2-year old, grade steers for feeding during the winter. The average weight was 1,147 lbs. They were all dehorned. Eleven are tied in double stalls and will not be let loose all winter; four others are tied but will be let out on mild days for exercise, and nine are loose in box-stalls—three in each—the latter will not be turned out for exercise. During the month ending Dec. 15th, those loose in the box-stalls made an average gain of 114 lbs. each, while those that are tied gained only 86 lbs. each, both lots receiving the same amount of food.

Milch Cows.—During the summer, while on pasture, the cows that are milking receive 6 lbs. of chopped grain and bran, mixed half and half. The winter feed per day for each cow is 10 lbs. chaff, 4 lbs. hay, 20 lbs. ensilage, and 10 lbs. pulped roots. It is mixed the day previous, so that the whole may be moistened, and is given in two feeds, morning and night, with the addition of 6 lbs. of chopped grain and bran (half and half), at noon; each cow receives also 20 lbs. whole mangels. The cost per day is 10¾ cents. The chaff is estimated at $1.50 per ton; hay, $6; ensilage, $1.50; roots, $2.00; and chopped grain and bran, 75c. per 100 lbs.

The following is the result of feeding 21 steers last winter—fifteen tied in stalls on Nov. 1st, and six fed loose in box-stalls, 14 x 15 ft. each (three in each stall), until April 28th, 1898, nearly six months. The steers were bought at the beginning of October and ran on grass till Nov. 1st, when the experiment began. Both lots were fed the same rations, as follows:

November—		
30 lbs. cut fodder corn	Mxd.	$ .0225
4 " " chaff		.003
16 " pulped roots		.016
3½ " chopped grain and bran		.025
Rape (only) at noon		.02
Cost per steer per day		$ .0865
December—		
30 lbs. ensilage and fodder corn		$ .0225
10 " pulped roots		.0100
10 " cut clover and chaff		.0187
6 " chopped grain and bran		.0388
Rape (only) at noon		.0200
Cost per steer per day		$ .1100
January—		
25 lbs. ensilage		$ .0188
10 " cut clover and chaff		.0187
10 " pulped roots		.0100
7 " chopped grain and bran		.04875
30 " turnips (only) at noon		.0300
Cost per steer per day		$ .12625
February—		
25 lbs. ensilage		$.0188
10 " cut clover and chaff		.0187
10 " pulped roots		.0100
7½ " chopped grain and bran		.0500
30 " turnips alone at noon		.0300
Cost per steer per day		$ .1275
March—		
22 lbs. ensilage		$ .0165
12 " cut clover and chaff		.0225
10 " pulped roots		.0100
8 " chopped grain and bran		.0530
Cost per steer per day		$ .1020
April—		
Same rations as March		$ .1020
Average cost per steer, 6 mos.		$ 19.40½
Total cost food for 21 steers		407.50

The steers were weighed the 1st of each month, before receiving their noon meal or being watered that day. The following is a table of the cost of the rations :

Fodder corn and ensilage, per ton	$1 50
Roots, per ton	2 00
Clover hay, per ton	6 00
Chaff, per ton	1 50
Chopped grain (barley, oats, and peas, a good part screenings, per 100)	75
Bran, per ton	8 50

The chopped grain and bran were mixed, $\frac{2}{3}$ grain and $\frac{1}{3}$ bran.

One of the steers in the box stall was off his feed for a few days at the end of March, which accounts for the small gain for that month, and the very small gain in April was owing to the allowance for shrinkage when sold.

Comparative Increase in Weight During Experiment.

Weight of 15 steers in stalls on November 1st, 1897 : Total weight, 13,333 lbs.; average weight, 1,122 3-15 lbs.

Average gain	for	November	57 7-15	lbs.
"	"	" December	72 9 15	"
"	"	" January	62 10-15	"
"	"	" February	37 9-15	"
"	"	" March	50 1-15	"
"	"	" April	11 1-15	"
Total average gain			297 7-15	"

Weight of 15 steers on April 28th, 1898 : Total 22,705 lbs.; average, 1,513 10-15 lbs. Total gain, 4,372 lbs. ; average gain, 291 7-15 lbs.

Weight of 6 steers, loose in box stalls, on November 1st, 1898 : Total weight, 7,315 lbs. average weight, 1,219$\frac{1}{6}$ lbs.

Average gain	for	November	75 5 6	lbs.
"	"	" December	81 2 6	"
"	"	" January	91 1-6	"
"	"	" February	54 5 6	"
"	"	" March	35 4-6	"
"	"	" April	22	"
Total average gain			360 5 6	"

Weight of 6 steers on April 28th, 1898 : Total, 9,480 lbs. ; average, 1,580 lbs. Total gain, 2,165 lbs. ; average gain, 360 5-6 lbs.

Profit and Loss Account.

21 steers, weighing, when bought, 25,080 lbs., at $4.10 per 100	$1,028 28
21 steers weighing, when sold, 32,185 lbs., at $4.65 per 100	1,496 60
	$ 468 32
Less cost of food	407 50
Net profit	$ 60 82

Those that were tied had water before them all the time, and were not let out for exercise ; those that were loose were watered twice a day.

The steers were all sold to Mr. A P. Scott, of Brampton, and shipped April 28th, 1898.

While we made this test as accurate as possible, still we intend to repeat the experiment.

Pasturing Steers.

Fifteen steers were bought May 2nd, total weight 16,790 lbs., at $4 per 100 lbs.—$671.60. Sold Oct. 27th, to A. P. Scott, Brampton, weighing 20,800 lbs., at $4.90 per 100 lbs.—$1,019.20 ; leaving a balance of $347.60.

In addition to the pasture, they received at the commencement four pounds each per day of chopped grain and bran, mixed two-thirds grain to one third bran, which was increased to eight pounds per day. During October the steers were kept in loose boxes and fed cut corn and clover hay. Total cost of grain and bran, $132. They were dehorned in the spring and pastured during the summer with the cows.

By feeding off two lots in the year, instead of one, a double profit is gained, and young growing animals increase in weight more rapidly and at less cost than older animals.

Sheep.—We have fifty-eight sheep—fifty-one ewes and seven rams—of nine breeds as follows: Lincoln, Cotswold, Leicester, Shropshire, Oxford-down, South-down, Hampshire-down ; Suffolk amd Dorset-horn. They might be reduced to six or seven breeds. This winter the ration is a mixture of clover, silage, pulped turnips and bran for morning and night, and pea straw at noon. The lambs are dropped in March ; shearing is done in April. Before the sheep are turned out to pasture, and after shearing, the ewes and lambs are dipped, to clean them of ticks, etc. The dipping is repeated in October. The following are the average weights per fleece of unwashed wool :

Lincoln	12.43 lbs.	Suffolk	7.29 lbs.
Cotswold	11,17 lbs.	Shropshire	7.00 lbs.
Leicester	9.60 lbs.	South-down	6.86 lbs.
Dorset-horn	7.83 lbs.	Hampshire-down	6.71 lbs.
Oxford-down	7.50 lbs.		

The wool was sold to the Guelph Woolen Mills. The long wool from Lincoln, Cotswolds, and Leicester, sold at 12 cents per lb., and the fine wool from the other breeds at 13 cents per lb.

Swine.—The following five pure breeds are kept for educational purposes : Yorkshire, Berkshire, Tamworth, Chester White, and Poland China. Since the demand is for lean hogs, the last two breeds might be disposed of. Of all the live stock the hog is the most profitable, being more prolific and giving quicker returns than any other. Our breeding pigs are fed pulped roots mixed with chopped grain and bran, morning and evening, and at noon mangels or sugar beets only. A number of grade pigs are kept to consume the College refuse, which is cooked.

Horses.—Four teams and two cart horses are kept for work on the farm. A man is engaged for each team during the summer season. In the winter, when the farm work is not so pressing, the students get an opportunity of driving the teams. During the summer months, when the horses are hard at work the daily ration for each animal is a mixture of cut clover and silage—all they will eat up clean—and 16 lbs. of chopped grain and bran mixed. The grain is composed of oats, barley and peas. During the winter, when they have little work. the ration is pulped carrots, clover and silage mixed, and 6 lbs. of chopped grain and bran. At noon 10 lbs. of carrots with a little of the clover mixture. Our horses keep healthy and ready for their work with this method of feeding.

Practical Instruction.—The first and second year students are required to work on the farm or in the other departments every alternate afternoon, for which they are allowed in proportion to the work performed and credited on their board accounts.

Plowing.—Before the June examination the second year students plowed a ridge each for the purpose of testing their skill; and marks were given according to the work performed. In the beginning of November an opportunity was given to the first and second year students who wished to test their skill in plowing sod. About forty entered into the competition, and each plowed ten furrows.

The successful competitors were as follows:

1. N. G. Cowle, Ontario County.
2. A. Stewart, Middlesex County.
3. R. Wilson, Huron County.
4. M. Switzer, Wentworth County.
5. G. Humphrey, Wentworth County.
6. J. R. Hutchison, Leeds County.
7. S. M. Ling, Wellington County.
8. H. Williams, Dufferin County.
9. J. A. Sangster, Glengarry County.
10. C. Kidd, Simcoe County.

Annual Sale.—The annual sale of surplus young stock was held on the farm, Wednesday, Oct. 19th. A large number of farmers from different parts of the Province were present: and the prices realized were moderate, considering the quality and breeding of the animals.

13 calves, various breeds realized	$724.00
12 lambs, " " "	97.50
65 pigs, " " "	716.50
	$1,538.00

Financial Statement.

I submit herein a statement of the accounts for 1898:

Cash Receipts.

Sales of cattle	$3,435 25	
" pigs	1,315 74	
" sheep	308 30	
" wheat	452 24	
" oats	122 68	
" barley	159 16	
" peas	165 30	
" potatoes	5 40	
" milk	49 46	
" wool	58 17	
" hides and skins	3 70	
" screenings	8 15	
" old fence	43 80	
Service of animals	207 50	
Incidentals, (labor of man and team at Mr. Harrison's house)	75	
		$6,335 60

Food, feed, fodder, and services of men and horses supplied to other departments.

To College.

Milk, 5,815 gals @ 8c	$465 20	
Potatoes, 460 bus. @ 50c	230 00	
Keep of 3 horses, 1 year @ $75.00	225 00	
Teams for hauling ice, 3 teams, 3 days @ $2.50	22 50	
Use of horse for hauling sewage	50 00	
Team hauling trunks to and from station	5 00	
		$997 70

To Experiment Department.

Keep of 4 horses, 1 year @ $75	$300 00	
Hay for experimental feeding dept. 5¼ tons @ $6.00	31 50	
Turnips for experimental feeding dept., 440 bush. @ 7c	30 80	
Team hauling 4 loads of pigs to station	3 00	
		$365 30

Disbursements.

Salary of superintendent	$1,200 00	
Wages	2,930 25	
Live stock	2,196 67	
Maintenance of stock	585 82	
Seeds	130 06	
Binding twine	14 00	
Avertising, printing, postage and stationery	147 43	
Fuel and light	4 32	
Contingencies	106 27	
		$7,314 82
Repairs and alterations	373 28	
Furnishings	274 54	
Implements—$250.46—⅕ charged charged to 1898	50 10	
Implements in 1897, $190.67, ⅕ charged to 1898	38 14	
Two cement silos—$609.29—1/10 charged to 1898	60 92	
	$796 98	
Total expenditures		$8,111 80

To Horticultural Department.		
Keep of 2 horses, 1 year @75	$150 00	$150 00
To Dairy Department.		
Milk, 10,185 lbs. @ 65c per 100..	$ 66 20	
Wood, 63 cords @ $1.25	78 75	
Hay, 36 tons @ $6.00....	216 00	
Turnips, 420 bush. @ 7c.....	29 40	
Mangels, 1,275 bush. @ 7c.....	89 25	
Ensilage, 225 tons @$1.50	337 50	
Pasture, 25 acres @ $4 00	100 00	
Soiling crop, 1½ acre @ $8.00.....	12 00	
Team hauling 2 loads drain tile from Breslau.....	6 00	
Team hauling 1 load of gypsum from Guelph	1 00	
Team hauling 3 loads of shavings from Guelph	2 25	
Teams hauling ice, 3 teams, 2 days @ $2.25.....	15 00	
Service of cows, 18 grade and 8 pure bred.....	34 00	
	$987 35	
Cr.		
By 25,000 lbs skim milk @ 10c 100	25 00	$962 35
Other Items.		
Less—		
Allowance for time spent by Farm Superintendent at outside duties—lecturing to students on soil cultivation and management, attending Farmers' Institute meetings, and waiting on excursionists during the month of June	$400 00	
Keeping various breeds of live stock, male and female, for educational work—8 breeds of cattle, 9 breeds of sheep, and 5 breeds of swine.....	400 00	$800 00
Total Receipts		$9,610 95

Cash receipts	$6,335 60	
Other "	3,275 35	
		$9,610 95
Expenditure		$8,811 80
Net profit.....		$1,499 18

NOTE.—It is gratifying to know from the above statement that the farm is yielding a good profit; that the systematic rotation of crops, with the cultivation of the soil according to scientific principles, is giving large returns; and that our system of feeding, though very economical, keeps the animals healthy and produces satisfactory results.

Respectfully submitted,

WM. RENNIE,
Farm Superintendent.

GUELPH, December 31, 1898.

PART XII.

REPORT OF

MANAGER OF POULTRY DEPARTMENT.

To the President of the Ontario Agricultural College:

SIR,—I beg herewith to submit my annual report for 1898. The work of the past season may be considered successful for the reason that a larger number of birds have been raised than formerly, and the quality has been much superior to that of the stock of previous years; also several successful experiments have been conducted which will be of interest to farmers and poultry breeders.

The regular course of lectures this year has included the following topics: Poultry plants, location, planning, drainage of the soil, buildings, construction, ventilation and furnishing; fowls, their origin, kinds and breeds; principles of breeding, mating, special breeding, including water fowl and turkeys; natural and artificial incubation; care and management; foods and feeding; egg and meat production; fattening, killing, dressing and marketing; diseases, symptoms and treatment; scoring, and comparison judging.

During the session of the Dairy School, lectures were given to the students in the Home Dairy Course on the most important points in the care and management of poultry.

EGG PRESERVATION.

We tried the keeping of eggs with sodium silicate (water glass) with good results. Sodium silicate is a compound containing silicon, sodium and oxygen in the proportion of one, two and three respectively. It can be purchased from druggists in the form of a semi fluid resembling thick sugar syrup, for which it might easily be mistaken.

An experiment was conducted in our department for the purpose of determining the most effective degree of concentration. The result of the experiment is of considerable importance, inasmuch as the cost of the mixture may be greatly reduced without destroying its value.

On the 27th May, we took twelve dozen eggs, all known to be perfectly fresh, and prepared the following solutions:

No. 1. One part water glass in the semi-fluid form to ten parts water.

No. 2. One part water glass " " to fifteen parts water.

No. 3. One part water glass " " to twenty parts water.

The first solution was found to be too strong, as it caused the eggs to float. The second was all right in this respect. The third, though much weaker, gave perfect satisfaction. We divided the eggs into three lots of four dozen each, and put one lot into each solution. We tested them from time to time, and in every case found them perfectly fresh; and, on breaking we notice that the yolk stood up exactly as in new laid eggs, and did not show the slightest tendency towards decay.

We tested one half dozen from each solution on the first of December, and could not detect any difference in the appearance or quality in the eggs out of the different solutions,

all being perfectly fresh after being in the solution six months. We still have three dozen in the pickle to ascertain how long they may be kept without losing their flavor.

In order to use water-glass successfully, the following plan should be adopted. Take one part by measure of water-glass, say one gallon, and twenty parts by measure of water that has been boiled (twenty gallons), and allow the water to cool; then place the water-glass and water in a vessel; stir the ingredients well together; put the eggs into the tub or vat in which they are to be kept, and pour the solution over them until the topmost layer is completely covered. The reason for boiling the water is to kill any putrefactive germs which may be in the water at the time.

If water-glass is purchased by the cwt., it should be procured for $2.50 to $3.00 per cwt. (112 lbs.).

So far as we know this is the best solution yet tried for the preservation of eggs. When taken out of it the eggs have the appearance of fresh laid eggs, and when they are broken the yolk standing up exactly as in new laid eggs, without showing the slightest tendency towards decay. It is first necessary, before boiling eggs that have been kept in this solution, as in lime pickle, to puncture the shell with a needle, otherwise the shell will crack as soon as placed in hot water, owing to the pores of the shell being closed.

Lime Pickle. We made another test this year with twenty-six dozen of eggs put down in a solution composed of lime and salt.

Three years ago we put down for College use one hundred dozen of eggs in a lime and salt pickle, using two pounds and one-half of lime and one pint of salt to four gallons of water. After the eggs had been used during the winter, the matron said they were all good—but some appeared as if they had been partially cooked, so I came to the conclusion that more lime had been used than was necessary, and we tried a solution made of two pounds of lime and one pint of salt to four gallons of water, and another composed of one and three-quarters pounds of lime and the same amount of salt and water. We tested the eggs from time to time out of both solutions, and found them as fresh apparently as fresh-laid eggs. They were put into the pickle in the first week of May, and we tested the last time the first of December, after the eggs had been in the pickle seven months. We broke and tested one dozen out of each solution, and every one was perfectly fresh and did not show the slightest appearance of being injured by the lime. We still have several dozen in pickle, and will keep them there until spring, and will report on the same next year.

How to Proceed. Take three and one-half pounds of stone lime, place the same in a pail and pour sufficient water over it to slacken, then add two pints of salt; have eight gallons of water in tub or barrel; to that add the lime and salt, stir well, and let stand to settle. Then stir thoroughly the second time; and when settled, the clear liquid can be poured over the eggs that have been placed in a tub or firkin, until the topmost layer is covered. Only the clear liquid is used.

Barrels with wooden hoops are generally used. Eggs can be put into the liquid from time to time, until the barrel is filled. Cracked or bad eggs will float and should be removed. When eggs are purchased on the market or from stores, or when there is an uncertainty about their being perfectly fresh, they should be candled.

How to Candle. Take an ordinary biscuit box and make an aperture on the side, a little less than the size of the egg. Then place a lamp on the inside of the box, and place the same in a dark room, or candle at night. Hold the egg in front of the aperture, and if it is fresh it will appear perfectly clear.

Feeding Ducks for Market.

We purchased a few sittings of duck eggs in the spring for the purpose of having ducks for experimental feeding. The Pekin and Rouen varieties were selected. We hatched seventeen—eight Pekins and nine Rouens. One of the Pekins got killed when young. For the first two weeks we fed equal parts by measure, corn meal, wheat bran and middlings, having added enough scalded water to make it crumbly, but not porridgy,

and fed five times a day, but no more at a time than they would eat up clean. For the next four weeks, two parts wheat bran and five parts middlings constituted their ration, and after that the same mixture was used without scalding.

Grit and sharp sand was placed in a vessel containing water, so that they could have access to it at any time. No water, except for drinking purposes, was supplied to them.

We weighed the entire flock when six weeks old, with the following result: The seven Pekins weighed thirty-nine pounds, being an average of five pounds and nine and one-seventh ounces each; and the nine Rouens weighed thirty-six pounds, or an average of four pounds each. When they were ten weeks old, we again weighed the entire flock and found that seven Perkins weighed fifty-nine and one-half pounds, or an average of eight and one-half pounds each, and the nine Rouens sixty-three pounds, or an average of seven pounds each.

Fertility and Production of Eggs.

Ten laying hens were selected and separated from the male. The eggs laid from day to day were placed in an incubator the date of laying having been marked on the shell. The eggs were tested, and the result was as follows:

Of eggs obtained during the first four days after the male was removed, 70 per cent. were fertile; on the fifth day, 61 per cent.; on the sixth day, 60 per cent.; on the seventh day, 49 per cent.; on the eighth day, 12 per cent.; on the ninth day, 2 per cent.; and on the tenth day all were unfertile.

A similar experiment was conducted to determine the time eggs become fertile after introducing the male. In this case, six laying hens that had not been with a male were selected, and a male was placed in the pen with them. The eggs were tested as before with the following result: The eggs layed on the first and second day after introducing the male were all infertile. The percentage of fertile eggs on the different days were as follows:

On the third day	30 per cent.	On the seventh day	70 per cent.
do fourth day	42 do	do eighth day	68 do
do fifth day	50 do	do ninth day	70 do
do sixth day	60 do	do tenth day	74 do

On the first of January we made up two pens, as follows: Pen No. 1, consisted of one male and ten females, five being pullets and five hens; pen No. 2, contained five pullets and five hens, of the same varities as pen No. 1, but without a male. On the first of September, after an experiment of eight months, we found that pen No. 1, which contained the male, had laid 959 eggs; and pen No. 2, 972, both pens having been fed the same quantity of the same kind of food. Their yards and pens were the same in every particular.

The wide flunctuation in the number of eggs produced, according to the season of the year, and the consequent tendency to a wide range in prices, from the time when eggs are plentiful in the spring and early summer to the period of light production in the winter, have led dealers to hold eggs from one season to another, and this business can be made profitable, if the quality of the eggs could be certainly preserved, But the egg is so delicate that even with the latest improved methods of refrigeration, the flavor becomes old from long holding. The risk incurred in storing for long holding is therefore very great, and with the possible exception of preserving in pickle, the losses are likely to be as frequent as the profits.

We think that eggs preserved in water-glass will command a better price than those preserved in other mixtures, from the fact that the quality of the egg is certainly better. Eggs put in lime solution, have more or less the flavor of the lime. They can be detected easily by the smell, and the composition of the shell is somewhat weakened by the lime; while the shell of eggs preserved in water-glass appears be somewhat strengthened.

The experiment in feeding ducks teaches us that by selecting the right varieties of ducks, and feeding them on the right kinds of food, you can get them on the market when six weeks old. We also find that water is not needed, except for drinking purposes, but is a hindrance to the growth and fattening of ducks.

We selected two of the best varieties of ducks for market purposes; and while they have the same standard weight, when fully matured, the experiment plainly shows that the Pekins can be made to take on flesh faster than the Rouens. We find on our markets ducks that are fully matured and six months old not weighing over four or five pounds; and we venture to say that such birds do not pay for the food they consume, let alone the trouble of caring for them. No ducks should be kept longer than ten weeks, as they can be placed on the market at that age and sold at a good profit.

Ducks that are intended for breeding purposes should not be fed on a fattening ration, so as to weaken them by to much forcing. They should be selected when about six or seven weeks old, when their sex can readily be seen and the most perfect specimen selected.

It has been generally conceded that eggs for hatching purposes can not be relied upon for at least ten or twelve days after the hens have been mated for breeding. In our test, we found some eggs fertilized on the the third day after mating, and they proved to be strong germs; but while we found this to be the case we would prefer to wait six or seven days, or more, as a great deal depends on the condition of both male and female at the time of mating; for instance, over-fat hens, or hens that have been laying a length of time, or a male bird out of condition. We also find that the male will not mate with certain individual hens for some time after being placed in the pen. So we say that it is advisable to wait a week or so before collecting eggs to be used or sold for hatching.

Our experiment to test whether the male increases or diminishes the egg production speaks for itself. It can be seen that there was but very little difference in the number of eggs laid by the two pens, both pens containing the same number of hens and the same varieties. I have always been and am still of the opinion that hens will lay as well but no better when separated from the male. Some claim that they will lay much better. I intend selecting two pens next year, say for three months in the spring and early summer, composed of pullets of the same breed and strain.

Cross Breeds.

We kept over from last season three pullets, Langshan and Indian Game crosses, to see if there was any benefit to be derived from this cross so far as egg production is concerned, but they did not prove to be so good layers aa the purebred Langshans; they are no better than the Indian Game. They have a beautiful plumage of a rich lustrous black, and in shape are like the Indian Game. If flesh producers are wanted, I consider this cross a good one, but not profitable if egg production is the chief aim in view.

We also selected four pullets from the Brown Leghorn and Barred Rock cross, and found them great egg producers, laying a fair-sized egg. We found, in comparing this cross with others tried last season, that they made a fine table fowl, maturing early and flesh of the finest quality; so by this cross we have both egg and flesh producers.

We tried also the Buff Cochin and Barred Rock this season with good results, so far as size and shape are concerned. The plumage resemble the Rock, while in shape they resemble both. I have reserved five pullets to test their egg producing qualities.

Respectfully submitted,

L. G. JARVIS,

Manager of Poultry.

Guelph, Dec. 31st, 1898

PART XIII.

REPORT OF THE APIARIST.

To the President of The Ontario Agricultural College :

SIR.—I have the honor of submitting herewith the report of the Apiarian department for 1898. Our reports for 1897 and former years have frequently been referred to in the agricultural press of the United States, Europe and Canada.

Some of the experiments, particularly in wintering, have been carried on from year to year with the object of adding to their value and weight.

PURE AIR, VENTILATION AND ARTIFICIAL HEAT IN THE WINTERING OF BEES.

It is generally recognized that the length of life of a worker bee corresponds to the activity it displays. For instance, during the spring and summer, when daily engaged either in doing the work inside the hive, or gathering honey outside, the life time of the worker bee is only some six or eight weeks. In winter, under the best, that is, a semi-dormant and inactive condition, its life time is from six to eight months. When active, there is of course waste of muscular tissue which must be replaced by the consumption, digestion, and assimilation of the elements which go to constitute muscle ; to produce this, nitrogenous food is required, which is found in the pollen or bee bread, and of course vitality in the bee is required to change it into muscle. The less activity required in the honey bee, the less there is of waste of muscular tissue, and the less has to be replaced. Heat and energy in the bee are produced by the consumption, digestion and assimilation of honey. It is a carbohydrate ; but it has a large percentage of water, and this surplus moisture is thrown off by the bee. We may also take it for granted that the bee, like other animals, when breathing throws off or expels carbonic acid gas ; and hence it is important that the atmosphere so vitiated should pass away and be replaced by fresh air. If the temperature is as low as forty-five degrees, an individual bee cannot generate sufficient heat to keep from perishing.

In an ordinary cluster, however, where the heat of one bee is conserved by the heat of its neighbors, the condition is very different. There a cluster can withstand a freezing temperature, and the cluster expands and contracts according to the temperature—the higher the temperature, the more the cluster expands ; the lower the temperature, the more it contracts, or in other words, the lower the temperature, the less space between the bees which go to form the cluster.

From the difference in the life time of the worker-bee during the active summer and quiet winter, we could judge that the less activity, the longer the bee will live, and as the bees move every time the temperature falls and rises, it is desirable to keep the bees at an even temperature. Careful observation covering the last three years shows that when the bees are put into winter quarters, and the temperature is kept even, forty-two degrees preferred, and there is a constant change of air, the bees settle down and cluster quietly on the combs, thus assuming naturally the condition most favorable for securing the greatest economy in the vitality of the bee, and in heat, and incidentally in stores consisting of pollen and honey. This being the case, it is desirable as far as possible to surround the bees with the conditions best fitted to secure the above results

In my report of 1897, there was given the result of two years' experiments in cellar wintering. In that report was shown the great importance of furnishing the bees in the cellar with a constant supply of pure fresh air from some outside source, and also the

importance of having the air at a certain temperature. It was found that very little attention had been paid to this matter by bee-keepers generally. The tests would indicate that bee-keepers have been too easily satisfied with results in wintering. To bring a colony through alive is one thing; to bring them through not only alive but with the least percentage of deaths, and the least loss of vitality, is quite another matter. A colony may be alive and yet with so much vitality lost that it will yield no profit, when another wintered under proper conditions will yield a handsome return.

With cattle and other stock, some men give every care necessary to bring their cattle through the winter in the best condition for yielding a good return at the pail or the shambles; there is another class which we believe to be diminishing in numbers, who bring their cattle through alive even if towards spring they occasionally require to help them on their legs. Bees and cattle alike may be alive; but in one case, they are in spring in proper condition to yield a profit; in the other, they take a large part of the summer to return to the condition of the previous autumn. With the bees, the colony is building up during the time they should be strong enough to take advantage of the honey flow.

A careful test was made covering three years, and four distinct experiments, taking in all, observations with 782 colonies From early winter until they were placed on their summer stands, the bees showed by signs unmistakeable to a careful and experienced bee keeper, that their action varied very much under different conditions. They suffered from lack of ventilation and from variations of temperature. When the fire was started and the temperature raised suddenly from thirty-eight and thirty-nine degrees to forty-three degrees, and in one case forty-five degrees, the bees made quite a roaring or loud humming sound which ceased shortly after the cellar had regained the regular heat. At the home apiary, a compartment was constructed, (See fig. I.), and in it a stove was

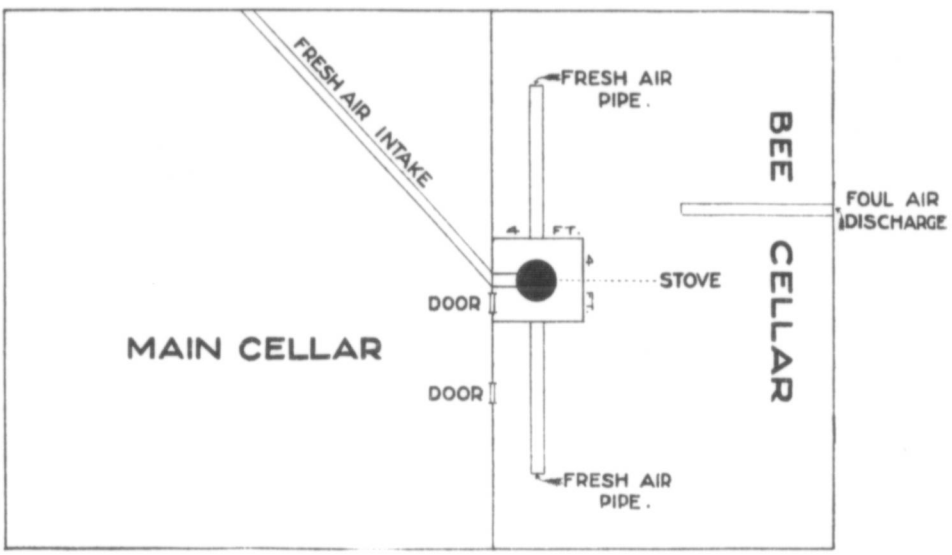


Fig. 1.

placed. In the stove we kept up a continual fire, the object being to heat fresh air brought from outside, through the pipe discharging under the stove. In the fall of 1897 the fresh air intake pipe was enlarged to fourteen inches in diameter to secure the above results; and to prevent the cellar from getting too warm the stovepipe which before had passed through the cellar was passed directly upward through the ceiling of the stove compartment. The plan of the cellar was as seen in Fig. 1.

The stove is in the centre of the compartment; the warm air shafts are 2 ft. 6 in. from the ground. The foul air pipe runs within three inches of the cellar floor, taking the foul air from the cellar bottom, or a damper may be opened to take the air fifteen inches from the ceiling. The air pipe runs to the roof of the house and about the same height as the chimney. The temperature was regulated by means of the stove; fresh air could be supplied more abundantly, and yet at not too low a temperature, by means of the same, and lastly, the heat from the stove supplied a cheap means of moving or changing the atmosphere in the cellar. Comparing non-artificial heat and steady ventilation with the old, and at present ordinary method, we find the following:

With The Old. During cold weather the ventilation is likely to be ample, as the cold air outside presses into the warmer, and the force, leaving out of the question for the moment the effect of the wind, increases in proportion to the difference of temperature between the outside and inside. A common and conspicuous illustration of this is given when we open a door between the kitchen and the outside on a cold winter's day. Then the wind plays an important part in the question; the stronger the wind striking exposed portions of the cellar, the greater the ventilation. But when the outside temperature rises and approaches that of the cellar, the ventilation is imperfect, there being the absence of special outside pressure. And the nearer to spring, when the bees are more easily aroused by unfavorable conditions, the more likely it is that these unfavorable conditions will prevail. Of course, if strong winds prevail they will tend to force fresh air into the cellar, but that cannot be depended upon.

Another very great disadvantage in depending for ventilation upon defective plastering, crevices about the windows, etc., is that such ventilation cannot be controlled and the temperature of the air cannot be regulated. It is likely to be too great when it is cold, and insufficient when warm. A few have ventilation by means of windows and pipes, but here there is the objection that it is irregular, and there is no way of regulating temperature.

The variations of temperature disturb the bees. As before stated, when the temperature rises the cluster expands, when it falls, the cluster contracts. This compels the bees to activity, waste of muscular tissue, and loss of vitality. Again, when the air is not changed, the bees charge the atmosphere with moisture and carbonic acid gas. This causes the bees to become restless and active, and again there is loss of vitality. By their activity the bees change the air, still more intensifying the trouble. Not alone do the bees suffer directly from the foul air, but the moisture in the atmosphere is in part absorbed by the honey in the comb: it becomes thin in the hives and the bees consume it to their injury.

Discomfort to the bee from improper food lessens its vitality in a twofold way; this discomfort arouses activity, and inferior food curtails the digestibility and assimilation of food by the bee. We have made frequent tests of honey in the comb which has been exposed to the temperature of the bee cellar, about forty-three degress, and in a cellar poorly ventilated containing bees, and the honey becomes thin. Uncapped stores still more rapidly deteriorate. We have also found that with colonies not sufficiently strong to cover their combs, the stores in the uncovered combs turn sour and ferment more rapidly. We are also justified in coming to the conclusion that the bees clustering in the stores raise the temperature of the stores: and we know that moisture has a tendency to condense on the cold surfaces. This is also obviated. Prolonged activity without flight appears to be an unnatural condition in the bees; just what effect unfavorable conditions have upon the relative consumption of pollen and honey we have been unable to find out: but tests made in the apiary show that strong colonies, well wintered, where they have plenty of stores in the hives, have lost from time of selling in November 21st, to the time of taking out, March 23rd, as little as four and a quarter pounds. I have frequently noticed what appeared to be dry excrement on the bottom board of the hive; and examination under the microscope showed it to consist of pollen grains. How this dry excrement, or perhaps a more proper term, refuse, is obtained I have not been able as yet to determine; different theories may be advanced. It may be separated by the bee, as she with her proboscis takes up the honey; this, however, is not likely if she does not make the separation when the liquid is in the form of nectar taken

from the flowers. I cannot readily understand how she could do so, when the liquid has been evaporated to the consistency of honey. The other and more probable source of the granules is that they have been voided as dry excrement from the bowels. If so, we have yet to understand how the bee can at one time consume pollen, digest and assimilate it, and at another time pass it undigested through its alimentary canal, or digestive system. This, however, we do know, viz., that activity under continuous confinement is very disastrous to the hives; frequent inspection of colonies in the experimental apiary proves that. There appears to be a provision in nature by means of which activity on the part of the bees, and in consequence wearing out on their part, causes consumption of stores; this, at the same time, results in the more liberal feeding of the Queen, egg production, and brood rearing. As activity begins, it sets in motion certain laws which result in an effort to replace the exhausting vitality by young bees. It has also been noticed that young bees after they emerge from the cells in which they are cradled, require a cleansing flight, discharging considerable excrement. I have examined for several years in connection with the experimental work, colonies when taken out of winter quarters; and I have yet to see a colony not showing symtoms of activity, with dysentery, and having brood. I am perfectly well aware that the great majority of bee-keepers state that the bees will, under healthful conditions, brood while in winter quarters, and that it is natural for them, particularly so towards spring. I was inclined to that theory myself; but the investigations carried on for the last three years show that the bees brood in repositories only after, by thoroughly unfavorable conditions, they have become active. During these three years, without exception, every colony showing signs of good wintering had no brood in the combs; and those in the opposite condition for the same time had brood. The longer the bees are active and rear brood when unable to fly, the more rapidly they lose vitality. Brood rearing in repositories is opposed to good beekeeping.

With the New. In our experiments we have found that with the artificial heat and specific and definite means of ventilation, we have the following advantages:

Pure air at an even temperature, the moisture in the atmosphere constantly carried off, and the air kept drier. As the temperature of air rises, its power to hold moisture in suspension increases, or, in common language, its drying powers increase; and we have by this method yet to find any moisture condense about the hive, bees, or walls of the cellars. Again, no sign of mold has ever been found about the combs; and everything about the hives has had a healthy appearance. The cellaring conditions by these means are, as far as I can see, with one exception perfect. When the outside temperature rises to the 40 or 43 degrees, and is then much the same as the cellar, it cannot be heated when passing through the stove compartment; there is then the tendency to stagnation of air. This should be overcome by means of an air pump drawing out the foul air, and by the same action filling the vacuum formed with fresh air. A good deal of expensive experimenting would require to be done to design and construct, and apply the pump and power for such. It appears to me clock work would be the most easily applied. The trouble with a wind mill would be that, with the least wind there would be the greatest necessity for the working of the pump. The more quiet the bees, the more stores they consume; and the direct gain in this way with fifty colonies of bees will in five years, more than pay for any expense in connection with the necessary changes in the cellar, the cost of the stove, and the coal. We use a self-feeder coal stove; it takes the cold air from the floor, and can be kept low without the danger of going out. During the winter we used 3,340 pounds of chestnut coal; and the stove was used eleven days previous to putting the bees into the cellar, the object being to dry out the cellar thoroughly before placing the bees into winter quarters.

To return to the old system of cellar wintering of bees, without artificial heat, and abandon the system as above described, would mean a heavy loss.

Without a special stove and compartment with ventilating pipes, we have found that the best way to secure regular ventilation is to have a pipe three inches or more in diameter, one end of the pipe connecting with a chimney in which is entered at some point a stovepipe communicating with a fire; the other end of the ventilating pipe reached within three or four inches of the cellar floor. Such a ventilator would draw off much of the foul air as it collects in the cellar.

The following is a table of the weights of 53 colonies of bees wintered in the cellar. The weights were taken November 18th, and again April 3rd following. It, therefore, embraces more than the actual consumption of stores while in winter quarters. The average consumption of stores was twelve pounds per colony during that time.

Fall Weight.	Spring Weight.	Loss.	Fall Weight.	Spring Weight.	Loss.
lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
45	30½	14½	43	29½	13½
47	37½	9½	45	36	9
46	28	18	43	33	10
44	35	9	44	30½	13½
40	26	14	42	32	10
46	33	13	56	31	25
49	36	13	47	30½	12½
48	31	17	46	34	12
44	31	13	40	29	11
40	25	15	42	34	8
40	30	10	42	31	11
41	31	10	45	35	10
53	42	11	45	33	12
47	36	11	46	30	16
42	34	8½	41	30	11
40	26	14	41	25	16
43	31	12	51	36	15
48	36	12	40	31	9
43	30	13	41	30	11
50	44	6	44	36½	7½
42	25	14	43	30	13
47	30	17	46	31	15
46	33	13	43	29	14
42	32½	9½	43	33	10
43	32	11	54	40	14
43	33	10	54	42	12
45	36	9	43	31	11
42	30	12	50	36	14
54	42	12	40	30	10

Outside Wintering.

A four year's test in the outside wintering of a hive of bees having the brood chamber in two parts, the first set of frames, ten in number, measuring 14¾ x 8½ inches, and the upper ten 14¾ x 4½ inches, has been followed by another year's test. As before, the only protection offered was plenty of old woollen clothing in a super above the frames. The

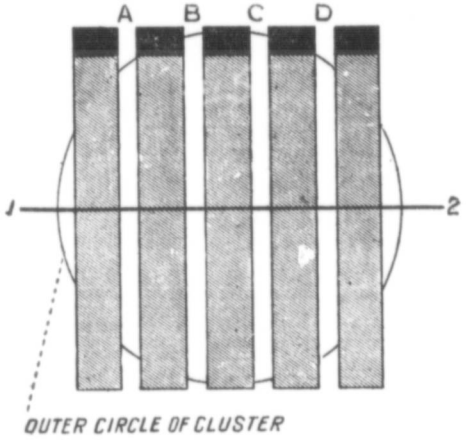


Fig. 2. Non-Divisible Brood Chamber.

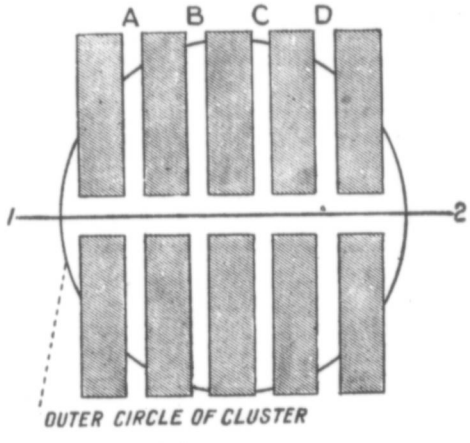


Fig. 3. Divisible Brood Chamber.

bees, as before, came through in splendid condition. This has now been carried on for five years in succession, and without any exception they have come through in first-class shape. Thinking that the success was in part due to the ready means of communication which the odd-sized hive had through the lines 1-2 (see figure 3), we selected six Hedden

hives, which have a divisible brood chamber, and in which the depth of each frame is 5¼ inches. Here, again the bees had a ready means of communication by the opening through which the lines 1-2 run. The colonies were wintered on their summer stands, without any bottom or side packing, and only a little at the top. The result was decidedly unsatisfactory; no colony was in first-class condition in the spring. There were live bees in each hive; but when compared with other colonies, they were very weak. They took all the summer to build up; and if all the colonies in the apiary had been of the same strength, there would have been no honey crop this season. They consumed 10¾ pounds more than those wintered inside. After carefully weighing the results of our experiments in the above direction during the last five years, we came to the following conclusions:

Foreseeing the danger of encouraging outside wintering without plenty of protection, I dislike to make the statement that they can be so wintered at all; yet when the cluster can expand and contract through central passages, as per figure 2; when they have plenty of protection in the form of woollen or some other absorbent; and have plenty of stores, they can, at Brantford, or in as mild a climate as it is at Brantford, be wintered successfully outdoors without side and bottom protection. The passage alone, without ample top protection of woollen or some equally good absorbent, was a failure; the bees consumed more stores, and in the spring they were not worth the room they occupied in the hive.

Outside Wintering with Protection.

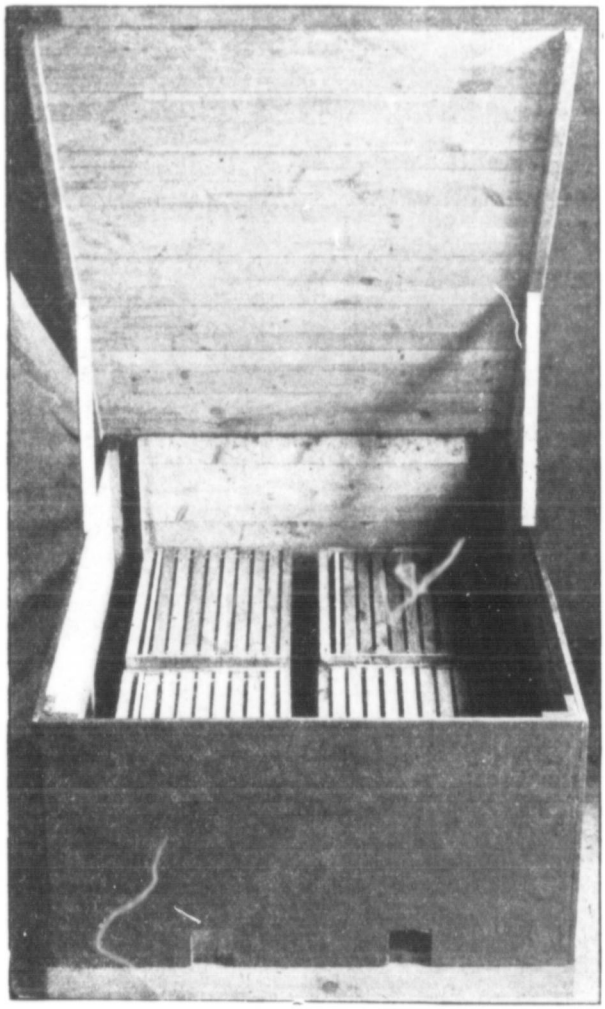
With the object of benefiting those who have not good cellars for wintering bees, and who cannot take advantage of the experiments conducted in cellar wintering, we decided to test what appeared to us to be the best method of outside wintering. The method adopted was as follows:

Outer cases were constructed of ⅞ inch stuff and painted a dark color, to contain four colonies, two to stand side by side and the pairs back to back as in Fig. 4, with room for two inches of packing between the hives and the outer case sides, and one inch between the hive sides and backs. At the bottom, provision was made for half an inch of packing at the front, and a little over an inch at the back, thus giving the hive, when packed, a slightly forward pitch.

The entrances run the full width of the hive, 12½ inches. To prevent the front from completely closing the entrance, the plan indicated in Fig. 5 was adopted.

On the alighting board was placed a bridge six inches long, (Fig. 5,) the width of the alighting board; under the board and at the end underneath was nailed a piece ⅞ inch square, and the length of the board width. When this bridge is placed on the alighting board and the hive packed, it offers underneath a passage for the bees to go in and out on the alighting board, and underneath the packing alone. Another important point, is a piece of pasteboard (A, Fig. 5) six inches wide, an inch and a little more in depth in the centre of the lower edge; a passage one-half inch square is cut in the pasteboard. The pasteboard is put between the front of the hive and the bridge. When packing, the pasteboard is kept just above the entrance to the hive; this leaves the board projecting ⅜ inch below the bridge. I am explaining this minutely because the ⅛ inch projection is a matter of great importance. The bees should be packed by October 1st., and yet it is not advisable at that time to contract the entrance to ½ inch wide; for this reason the cardboard is kept above the entrance. It is allowed to project ⅜ inch below the bottom of the bridge board to allow the bee-keeper, when settled cold weather comes, to pass a long bladed knife or sharp tool, in at the entrance of the outer case, and with this draw the cardboard down to the bottom board, thus leaving the entrance to the hive only ½ inch wide and deep. This was done Saturday, November 27th. The covers were removed from the hives; where quilts were used, they were loosened, and a block put under the rear corner (See Fig. 5, C), leaving an opening for the air to pass upward from the hive. In about half the number of colonies, honey boards ⅜ inch thick were used instead of quilts; they were loosened and a ⅜ inch block put under

one corner. This too allows the air to pass upward through the hive. Dry leaves are now packed loosely about the hives, and ten to twelve inches on top, the last five or six inches of top packing being put in on Nov 27th. In four cases planed shavings were used. While these answered well, I would give the preference to the leaves. At the same time, a board ten inches wide was placed in a slanting position against the outer case, protecting the entrance in the wintering case.



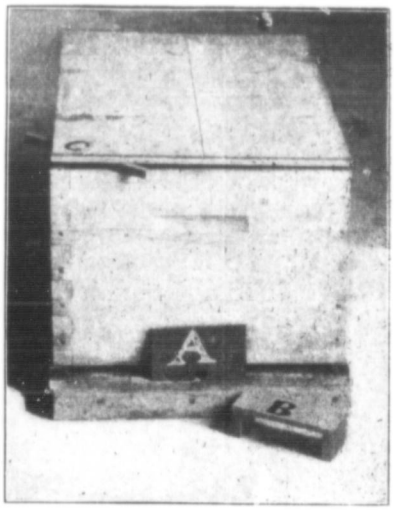


Fig. 5. Hive, showing—A, card with entrance—B, bridge which goes in front of card and on alighting board—C, block under honey board leaving space for upward ventilation.

Fig. 4. Outer case containing four hives.

The object in having the small entrance is to prevent rapid changes of air in the hive, and in the same way prevent loss of heat generated by the bees. It also keeps the air at the bottom of the hive warm enough to enable the bees to go down and keep the entrance clean. The board leaning against the outer case was placed there to prevent snow from falling against the entrance—also to keep the bees quiet by excluding light, and, to a certain extent, wind.

The opening between the honey board or quilt and the hive allows the air to pass gradually up and through the loose leaves taking all moisture with it. With the small entrance I consider this exceedingly important. The forest leaves are packed somewhat

loosely, but not so tightly as they could be packed, to give the sun a better chance to penetrate in the spring. The light material for outer cases was used for economy, and also to allow the sun to penetrate more readily. The dark color with which the cases were painted was used with the same object in view.

RESULTS. During the entire winter not an entrance was clogged by dead bees. The bees appeared to be able to leave the cluster and come down to clear away dead bees, as they could not with the larger entrances, which would make the air at the bottom of the hive too cold. Again, no moisture was found about the interior of any of the hives.

With the exception of five colonies out of sixty-five, wintered nine miles from here in which four were disturbed by thieves, combs of honey being removed, and another being queenless, every colonly came through in first-class shape. What astonished me greatly was, that when the bees wintered in the cellar were put upon their summer stands, March 21st, forty of the colonies wintered outside were examined and no brood found in the combs. They had evidently wintered so perfectly in their summer stands that there had been but very little activity and loss of vitality. I must confess that this was a revelation to me. The outer cases were removed just before the supers had to be placed on the hives. The bees were then in splendid condition for the honey flow, and I consider, as far as I am justified in speaking from the result of one year's experiece, that this method of wintering was eminently satisfactory.

The question may be asked : Could not the entrance be enlarged or the top ventilation be done away with? In reply to this I would say, the details as above described, require to be connected to secure a definite result. To leave out any portion is to abandon the system. Many have already asked if sawdust or chaff will not answer equally well. Sawdust packs too closely ; chaff attracts mice, and is more likely to mould.

A SWARM CATCHER.

There has been a long-felt demand for some device by means of which the bee-keeper could secure swarms without climbing trees, or following them into all kinds of awkward places, to say nothing about an occasional chase over neighbors' farms, and sometimes their total loss. The device shown in Fig. 6 is a swarm catcher. It is made of light material, a hopper-shaped frame, the width of the entrance of the hive, with $\frac{1}{4}$ inch

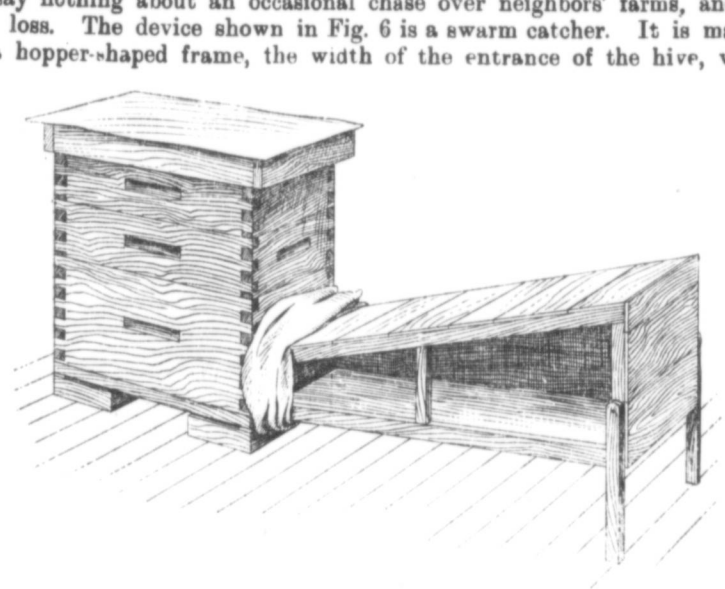


Fig. 6. A Swarm Catcher.

boards at the bottom, top, and end. The sides are enclosed with ordinary wire cloth, the same as used in window screens The mouth of the swarm catcher next the hive has a strip of cotton taked to the lower edge of the hopper, twelve inches wide, and

projecting two feet at either end of the swarm catcher. This cotton serves the purpose of closing any further opening between the entrance of the mouth of the hive and the swarm catcher. At the wide end of the hopper and at the lower end of it are legs, attached by a screw, so that by swinging them backward or forward they can be shortened or lengthened and adjusted to uneven ground. In an apiary of a little over 100 colonies, we had eight of these swarm catchers standing at convenient distances.

How Applied. As soon as the swarm begins issuing, the swarm catcher is adjusted to the entrance and the bees pour into it, attempting to get out through the wire screens. In about five minutes, or ten at the outside, the swarm is in the swarm catcher, when the entrance of the catcher can be cleared up with the attached piece of cotton. We have found that the most convenient way to do this is to fold the cotton over it, and then tie a string about the mouth. I mention this because it is absolutely necessary to leave no opening through which the bees can pass from the catcher. In one catcher we made an opening $\frac{3}{8}$ inch round and through this one bee at a time passed until the entire swarm was in the air.

Method of Handling the Self Hiver. At first we dumped the new swarm at the entrance of the new hive at once, but this did not answer. The bees had the impulse to fly and, instead of entering the new hive, they took wing just as they would do if they were leaving the hive in the first place. If our experiment had stopped with this, we would have pronounced the self-hiver a failure. Another plan, however, suggested itself, and this was a complete success. The self hiver, mouth down, was set on end, the bees were kept in it until they clustered as they do in nature, and after this, when dumped at the entrance of the hive, they readily entered it.

Carniolan Bees.

In last year's experiment with Carniolan Bees, we found, briefly, that bee hives on starters swarmed excessively, and built their comb very irregularly; but those hived on full sheets of foundation did not show any greater tendency to swarm than other varieties. The bees were gentle, and built up well in the spring.

During the season of 1898, the Carniolan Bees were the first to swarm, and with one exception the last. Even on full sheets of foundation, they showed a greater disposition to swarm. With that exception, they showed all the characteristics given above.

In addition, they took longer to cluster when swarming, and showed a marked tendency to swarm out. I remember particularly that one Sunday we had twice hived the same Carniolan swarm. The last time about 4 o'clock p. m., I said we would let it go. It was bad enough to be troubled on a week day, but Sunday it was beyond endurance. However, at 6.30 p. m., the swarm was still clustered in the tree it selected the first time, and we hived it.

A good trait we found was, that the Carniolans gave us the whitest and prettiest capped comb honey.

Conclusions. With the exception of a tardiness in clustering, which is of no great importance, and a tendency to much swarming, which is a serious defect, and particularly so for those of limited experience, they are the best bees we ever had. We would still advise caution in their introduction.

Comb Foundation.

Last year some tests were made in connection with the production of comb honey. The sections were filled to a greater or less extent with foundation running from a starter to a full sheet. Last season the advantage was greatly in favor of a full sheet. This year the experiment was repeated, and a few sections were added without any foundation at all. The flow this year, although prolonged, was slower. We actually succeeded in filling in the super sections which contained full sheets of foundation, when the sections without foundation had not a particle of comb or honey in them; and the parti-

ally filled sections did not have so good an appearance, nor were they so well filled as the first mentioned. Had separators, which are indispensable in securing the best results, not been used, it is likely that the bees would have filled the sections more evenly.

Different weights of foundation, running from six square feet to fifteen square feet per pound, sections with natural comb from last season, and the deep cell foundation were also tested in the same super.

The deep cell is a new foundation. We purchased ten pounds of this at $1 25 per lb., duty twenty per cent. to be added, bringing it to $1.50 per lb. The deep cell foundation has a very thin base and side wall ; the latter, unlike ordinary comb foundation, has a side wall one-quarter inch deep.

Results.—The bees worked on the natural drawn comb first, and the deep cell foundation next ; there were the least number of pop holes in it. Probably owing to the deep side wall the bees capped the sections with the natural comb first, and the deep side wall next. The honey had no marked fishbone or heavy base. The heaviest brood came first in order of acceptability to the bees, and so on in weight, the lightest being the last accepted by the bees. The same as in pop holes—the lightest had the greatest number. When it came to figuring cost, the lightest section was the least costly.

The heaviest foundation had the most fishbone. In fact, that built on the six and eight feet foundation sold to the public would be likely to injure the comb honey market. The section foundation, twelve square feet to the pound, aside from the cell, was, all round, the most satisfactory.

Regardless of price the deep cell foundation was the most satisfactory. At the same time, although the order was placed the previous fall, it did not arrive until near the close of the honey season, and we could not give it the thorough test we should have liked. I am inclined to think that aside from the way in which the bees filled the deep cell foundation, it tends to draw the bees into the supers. When given the bees, they entered first the sections with the deep cell foundation ; and this foundation may prove valuable as well in drawing bees into the supers. If this should be the case, it would prove, at a reasonable price, very advantageous.

Foul Brood (Bacillus Alvei.)

During the season of 1898 no foul brood has appeared in the combs built on foundation made from beeswax injected with the germs of foul brood. Mr. F. C. Harrison, B.S.A., College Bactereologist, has made a very extensive study of the question, and his investigations have shown conclusively that some of the theories of bee-keepers are not correct.

Moving Bees for Fall Pasture.

During the years 1895, 1896, and 1987, we moved bees after the clover and linden flow to fall pasture, buckwheat being the particular blossom in view. Last year we had 155 colonies within range of buckwheat. For the past three years it has paid us to move the bees. This year we had 173 colonies within range of buckwheat. They were at three different apiaries, and in two of the apiaries the results were satisfactory. The bees built up well, and had plenty of young bees for winter ; they also put in ample winter stores for themselves, and gave a surplus in comb and extracted honey which more than paid for the labor expended. The third apiary did nothing at all ; the bees when placed there did nothing at all, and although buckwheat was in full bloom, they were continuously on the verge of starvation. Four years of experience and observation, combined with previous experience, have put us in a much better position to judge as to the expediency of moving bees to any location for a honey flow, and while that experience applies to a greater or less extent to the flow from all blossoms, it is particularly applicable to buckwheat which is very susceptible to drouth. Buckwheat is mostly grown on sandy soil ; the lighter the soil, the more readily it dries out, and then the honey flow fails. When

the weather is dry, and this condition has been prolonged, pasture and crops generally feel the effects, and under such circumstances it is not advisable to move bees to the vicinity with the expectations of a return in honey.

The bees had better be held in readiness to move, and should copious showers come, with buckwheat still in blossom, and the time when frost may be expected still remote, they can be moved. The two apiaries referred to above gave good results, simply because there had been plenty of rain in the vicinity ; the third apiary, only nine miles distant, gave no return, because little or no rain had recently fallen in that locality.

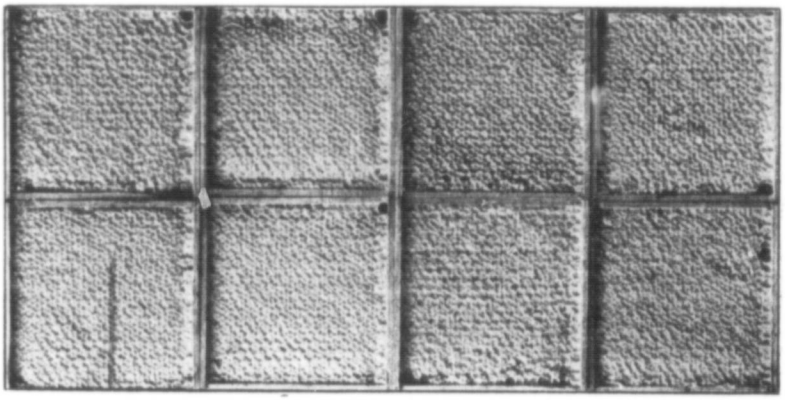
Experience in Moving Bees.

Bees in July and early August that are able to use two and three comb honey supers with twenty four and twenty-eight sections each, must be strong. With one apiary of 100 colonies we took a very radical departure in preparation. Eighty colonies were prepared with a wire screen on top, and at the entrance a portico (See Fig. 7.) of the same width and height as the brood chambers in front of the eight frame dove-tailed hive, and two and a half inches deep. A frame was constructed of the above proportions, and the front covered with wire cloth. This really forms a pocket into which the bees can crowd, when, through the excitement of moving on the wagon, they feel too crowded to remain in the hive. Twenty strong colonies were prepared the same as the eighty, with porticos at the entrance, but no ventilation at the top. Instead of a screen on top, a board giving no ventilation was nailed on the hive. We thought this number would be ample for the test, and we were a little afraid that the experiment might result in the destruction of the colonies so tested.

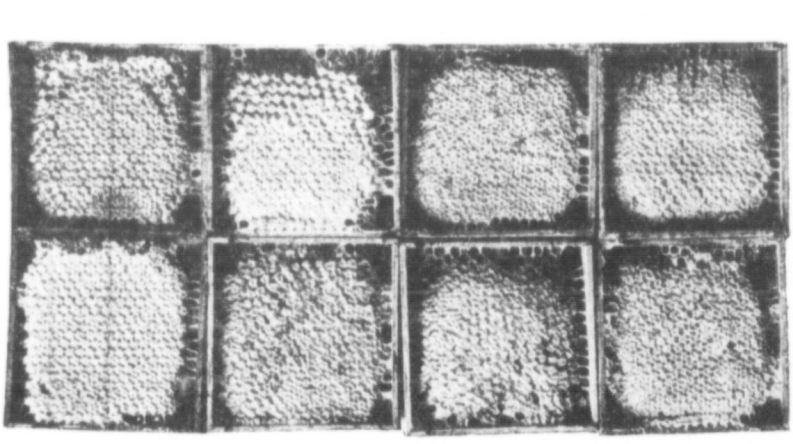
Fig. 7. Portico for moving bees.

The porticos were attached as soon as the bees ceased flying in the evening. They were loaded on three wagons engaged for the purpose. Owing to a baulky horse, a tire coming off the wagon, and other unforeseen difficulties, the bees did not reach their destination until 6 p.m. the following day. They were exposed to a bright and hot July sun during the day, yet, in spite of this, the bees came through in perfect condition. Those with the porticos only were in as good condition as those with the wire screen on top. The test was certainly severe, and we feel safe in saying that no one need hesitate in future to prepare bees for moving in this way.

Precautions.—We were careful to hammer very lightly in driving nails just before moving the bees. Two pieces of wood, of a wedge shape, formed a projection on each side of the portico, and when they were inserted into the hive entrance, the portico was kept in place by only two small wire nails. These we intend to do away with in future, and use a clamp on each side. When the hive is tapped the bees fill themselves with honey, and with the honey sack full they are more likely to be injured in moving. We find that bees suffer considerably unless the porticos are removed immediately after the hives have been moved and placed in their new stand.



Specimen of eight sections of comb honey taken at the Experimental Apiary and desirable for market.



Specimen of eight sections of comb honey which cannot be shipped to distant markets owing to their liability to break out.

Closing Remarks.

In closing, permit me to say that too many bee-keepers are at present adopting methods in wintering which will never allow them to produce a pound of honey for the least outlay. Strong colonies early in the spring, other things being equal, will give the bee-keeper a much larger honey crop, and the larger honey crop will, of course, decrease the cost of production, and enable the bee-keeper to secure a better net profit on his operations.

Respectfully submitted,

R. F. HOLTERMANN,
Apiarist.

Guelph, December 31st, 1898.

PART XIV.

REPORT OF THE PHYSICIAN.

To the President of the Ontario Agricultural College:

SIR:—Complying with your request in a recent communication received from you I now submit to you my report for the current year.

I have first to state that I have, as heretofore, carefully observed the by-laws of the College respecting the physician's duties.

The health of the College has been better this year than in any previous year during which I have been connected with the Institution. But although such has been the case there have been quite a large number of minor respiratory and digestive disorders, and a few minor accidents.

I deeply regret, however, to have to report a death in the College in the month of February last: A very estimable young man was taken ill with appendicitis. He was removed to the General Hospital in this city, where he underwent an operation for the disease, but failed to recover.

The present term opened with a large attendance, and so far there has been very little sickness. One case occurred, however, in which I was obliged to advise the patient to return home, where I hope he may improve in health.

The sanitary condition of the College is excellent.

Respectfully yours,

WM. O. STEWART,
College Physician.

Guelph, Ont., Dec. 31, 1898.

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