TWENTY-SECOND ANNUAL REPORT

OF THE

ONTARIO AGRICULTURAL COLLEGE

AND

EXPERIMENTAL FARM.

EIGHTEENTH ANNUAL REPORT

OF THE

AGRICULTURAL AND EXPERIMENTAL UNION

1896.

(PUBLISHED BY THE ONTARIO DEPARTMENT OF AGRICULTURE.)

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AND EXPERIMENTAL FARM.

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GUELPH, January 2nd, 1897.

To the Honorable JOHN DRYDEN,
Minister of Agriculture:

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

In this report, the work of the year 1896 has been briefly reviewed under the following heads:

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

JAMES MILLS,
President.

THE ONTARIO AGRICULTURAL COLLEGE

AND

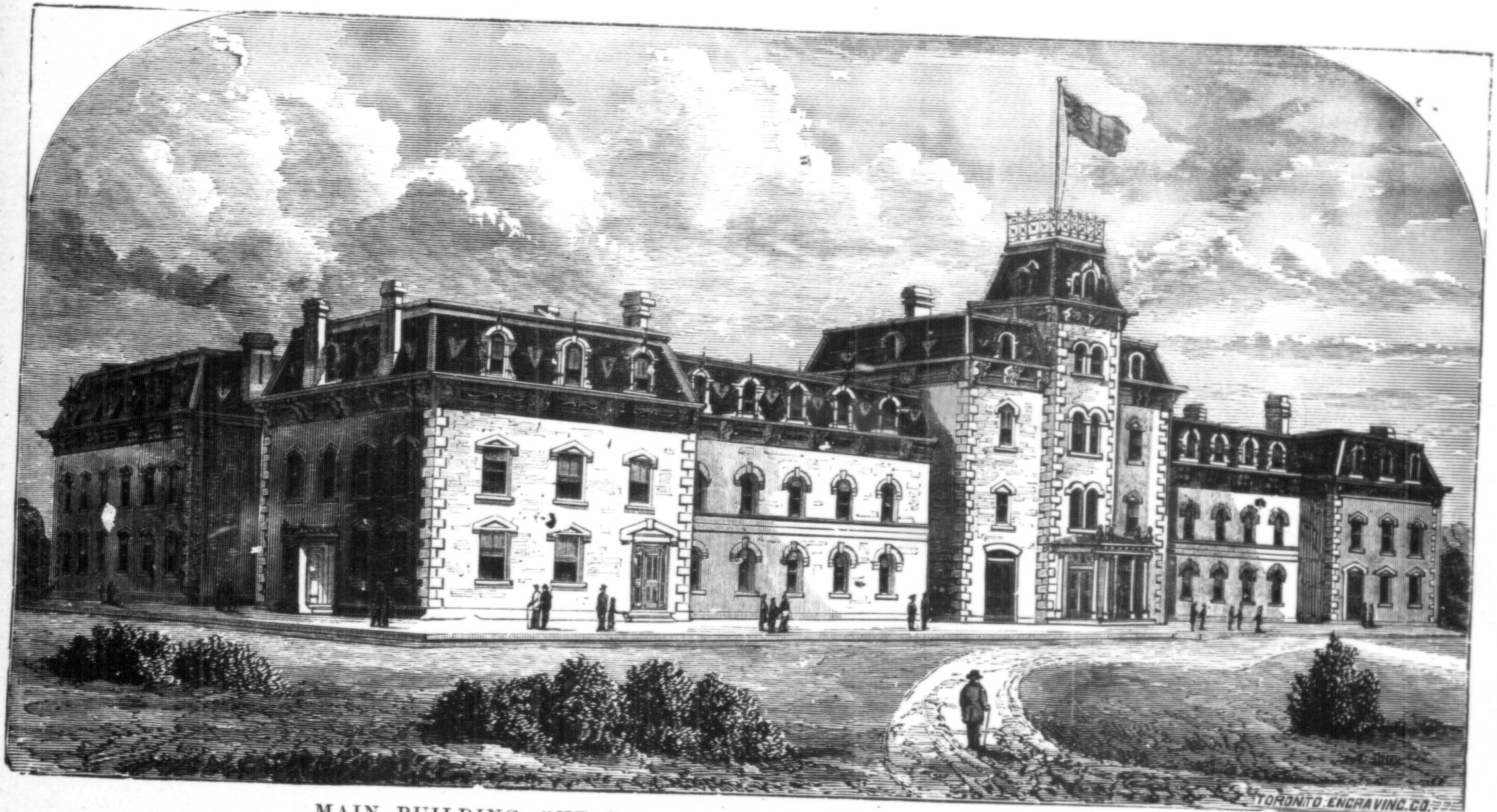
EXPERIMENTAL FARM, GUELPH, ONT.

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

JAMES MILLS, M.A., LL.D.	President.
J. H. PANTON, M.A., F.G.S.	Professor of Biology and Geology.
A. E. SHUTTLEWORTH, B.A.Sc.	Professor of Chemistry.
J. H. REED, V.S.	Professor of Veterinary Science.
H. H. DEAN, B.S.A.	Professor of Dairy Husbandry.
WM. RENNIE,	Farm Superintendent.
C. A. ZAVITZ, B.S.A.	Experimentalist.
G. E. DAY, B.S.A.	Agriculturist.
H. L. HUTT, B.S.A.	Horticulturist.
F. C. HARRISON, B.S.A.	Bacteriologist.
J. B. REYNOLDS, B.A.	Lecturer in English and Physics.
J. F. CLARK, B.S.A.	Resident Master.
R. HARCOURT, B.S.A.	Assistant Chemist.
L. G. JARVIS	Manager and Lecturer in Poultry Department.
R. F. HOLTERMANN	Lecturer on Apiculture.
CAPTAIN WALTER CLARKE	Instructor in Drill and Gymnastics.
W. O. STEWART, M.D.	Physician.
G. A. PUTNAM	Stenographer.
A. McCALLUM	Bursar.

ADVISORY BOARD.

JOHN I. HOBSON, *Chairman*	Mosborough, County of Wellington.
JOHN McMILLAN, M.P.	Seaforth, County of Huron.
EDWARD JEFFS	Bond Head, County of Simcoe.
J. S. SMITH	Maple Lodge, County of Middlesex.
G. B. BOYCE	Norham, County of Northumberland.
D. A. DOWLING	Appleton, County of Carleton.
WM. DONALDSON	South Zorra, County of Oxford.
C. C. JAMES, *Secretary*	Deputy Minister of Agriculture, Toronto.



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PART I.

REPORT OF THE PRESIDENT.

Although all heads of departments have been urged to condense and abbreviate the accounts of their work as much as possible, nevertheless our report increases in size from year to year. Hence my comments on the year's operations must be very brief.

At the outset, I may say that the year 1896 has been one of the most satisfactory in the history of the College. We have had peace, harmony, and progress all along the line. As the College grows in the confidence of the people, the members of the staff seem to work with constantly increasing zeal and energy.

Students in Attendance.

The attendance of students has been very satisfactory. The number on the roll for the year has been 168 in the general course and 69 in the dairy course, or a total of 237. During the past term, every bed in the College has been occupied, eight students have been boarding out, and some who wished to board in did not come because we were unable to accommodate them. The great majority of our students in recent years have been farmers' sons. Of those now in attendance, over 90 per cent. belong to that class.

County Students.

Each county in the Province is allowed to send one student free of tuition, and the nomination is made by the county council. Of those on the roll in 1896, fifty-three were so nominated, and as a consequence were exempted from the payment of tuition fees. The counties represented were the following:

Addington, Brant, Bruce, Dufferin, Dundas, Durham, Elgin, Frontenac, Glengarry, Grey, Haldimand, Halton, Hastings, Huron, Kent, Lambton, Lanark Leeds, Lennox, Lincoln, Middlesex, Muskoka, Norfolk, Northumberland, Ontario, Oxford, Parry Sound, Peel, Perth, Prescott, Prince Edward, Renfrew, Russell, Simcoe, Victoria, Waterloo, Welland, and Wellington.

Analysis of College Roll.

1. *General Course.*

(1) From Ontario.

Counties, etc.	Students.	Counties, etc.	Students.
Algoma	2	Middlesex	6
Addington	1	Muskoka	1
Brant	5	Norfolk	1
Bruce	3	Northumberland	2
Dufferin	1	Ontario	3
Dundas	5	Oxford	3
Durham	4	Parry Sound	4
Elgin	2	Peel	1
Essex	1	Perth	4
Frontenac	5	Prescott	4
Glengarry	3	Prince Edward	3
Grey	4	Renfrew	1
Haldimand	1	Russell	4
Halton	3	Simcoe	4
Hastings	2	Victoria	5
Huron	5	Waterloo	2
Kent	2	Welland	1
Lambton	6	Wellington	8
Lanark	2	Wentworth	4
Leeds	2	York	2
Lennox	2	Toronto	12
Lincoln	4		
			140

(2) From Other Provinces of the Dominion.

Provinces.	Students.	Provinces.	Students.
Manitoba	2	Quebec	4
Nova Scotia	3		
			9

(3) From Other Countries.

Countries.	Students.	Countries.	Students.
Australia	2	India	1
Bermuda	3	Ireland	1
England	11	United States	1
France	1		
			19

Total in General Course—168.

2. *Dairy Course.*

Counties, etc.	Students.	Counties, etc.	Students.
Brant	2	Middlesex	4
Bruce	4	Norfolk	1
Carleton	2	Oxford	6
Durham	2	Peterboro	1
Dundas	2	Peel	2
Essex	1	Perth	5
Elgin	3	Renfrew	1
Frontenac	1	Stormont	1
Glengarry	1	Wellington	5
Grey	4	Wentworth	1
Grenville	2	York	4
Hastings	1	England	1
Halton	1	New South Wales	1
Huron	2	New Brunswick	4
Lambton	1	Ohio	1
Lanark	2		
			69

Total of Dairy Students—69.

Age of Students in General Course.

1	14 years of age.	9	23 years of age.
1	15 "	5	24 "
15	16 "	4	25 "
21	17 "	3	26 "
22	18 "	3	27 "
26	19 "	1	28 "
22	20 "	2	29 "
23	21 "	1	30 "
8	22 "	1	31 "

Average age of Students in General Course—20 years.

Average age of Students in Dairy Course—25 years.

Religious Denominations.

1. *Students in General Course.*

Methodists	58	Congregationalists	2
Presbyterians	54	Brethren	1
Episcopalians	38	Roman Catholic	1
Baptists	9	Unitarian	1
Friends	4		
			168

2. *Students in Dairy Course.*

Methodists	27	Roman Catholics	3
Presbyterians	20	Congregationalists	2
Episcopalians	10		
Baptists	7		
			69

New Buildings.

Our chemical laboratory was burned on the 28th of last February. A thorough investigation was held at the time, but the cause of the fire was not discovered. A much better building has been erected on the old foundation. The old building was only one storey high; the new one is two storeys and is much better built.

In the planning and furnishing of the new building, we were assisted, not only by Mr. Heakes, architect of the Department of Public Works, but in a large measure by Dr. Pike, of the University, of Toronto, whose new laboratory in Queen's Park is one of the best in America.

I think I may say that we have a first-class chemical building, furnished with the most modern appliances and affording ample accommodation for our work—a class-room, preparation room, glass and chemical rooms, balance room, etc., and three laboratories—one for first and second year students in general inorganic, organic and agricultural chemistry; another for quantitative analysis by third year students; and a third for station work, that is, for analytic work in connection with the dairy and experimental departments. The building is heated by steam and lighted by electricity.

Hitherto our engineer has lived in the city, about a mile and a half from the College, but our system of heating, lighting, pumping, etc., has become so complex and extensive that we need him on hand or close by at all times. Hence we have just finished for him, at a cost of $1,388, a nice brick house at the north entrance to the College grounds, thirty-two rods from the engine-room.

Water Supply.

For sixteen years (1880 to 1896), we used the city water, which was conducted in a six-inch pipe from the city mains to the College grounds, a distance of about a mile and a quarter. The city supply was very satisfactory and we hoped to continue using it indefinitely; but the city council of 1895 informed us of their intention to increase the rate from $650 to $1,000 a year; and, after some negotiation, they gave us formal notice that our supply would be cut off on the 1st July, 1896, unless we agreed to pay the higher rate.

Had the city been at the expense of laying of the pipe from the mains to the College, we should, perhaps, have felt warranted in recommending the payment of $1,000 a year; but in view of the fact that the pipes from the city were laid by the College, we thought the charge unreasonably high, and decided so see what we could do towards providing water on our own premises. We employed Mr. John Savage, of Petrolea, to bore for water a short distance from the kitchen door of the College. He put down a six-inch hole to a depth of 1,000 feet, but failed to get a flowing well. From first to last, the water stood at about 40 feet from the surface.

Fearing that the one well might not be sufficient, we put down a second one 86 feet from the first, to a depth of 475 feet. The water stood at the same height in this well as in the first. The two wells are connected by an underground passage which extends from the most distant well into the engine-room; and a shaft laid along the passage and driven by a Wheelock engine, works the pumps in the two wells separately or conjointly. A Northey Underwriter fire pump, of 500-gallon per minute capacity, has been set in the engine-room, but cannot be used till we get a storage tank or pond and the necessary pipe connections.

The water in both wells is pure and good, but that in the deeper one has a slightly metallic taste.

Electric Light.

For lighting purposes we have used gas supplied by the Guelph Light and Power Co. for the last sixteen years. The old chemical laboratory was lighted with gas and the supply was quite satisfactory, but having to use some sort of power to run a ventilating fan in the new one, we decided to put in a small dynamo and motor, sufficient not only to furnish the requisite power but to light the building. Hence the first instalment of electric lighting.

OUTSIDE WORK.

I shall not occupy space with a detailed account of many alterations and additions made in College and laboratory buildings during the year, and I shall simply refer to the fact that, in January last, we sent our carpenter and engineer to fit up the Western Dairy School at Strathroy. Six weeks of their time was spent in setting machinery, putting in pipes, putting up shafting, and making the many stationary appliances required in a dairy building. And, late in the fall, our carpenter was sent again, the object of his visit being to fence the grounds around the school and put up a shed to protect the horses of patrons while their milk is being run through the separators in the butter department.

ENGLISH AND PHYSICS.

With the extreme specialization of these times, people are inclined to think that one cannot do even two things well, and no doubt there is some ground for the popular belief, but the work in some of our High Schools and in many other schools proves that there are men who, within certain limits, can do first-class work in two or more departments, as in the ancient classics and modern languages, in science and moderns, and even in classics and mathematics; and I think we are fortunate in having in our College some men of that type.

Mr. J. B. Reynolds, our teacher in physics and English, would, no doubt, much rather devote his whole time to one or other of these branches; but the unanimous verdict of our students is that he is an excellent teacher, one of the very best, in both subjects. So thoroughly have I been satisfied on this point myself, that, within the last two years, I have transferred all our advanced English to Mr. Reynolds, and I am more than satisfied with his work in physics. It is a long way in advance of what we were able to do under this head at any time in the past.

This statement will no doubt be gratifying to all friends of the College, and I am pleased to be able to report that we have recently taken a current from our College dynamo into the physical class-room and have placed therein a motor and other electrical apparatus for practical instruction in this important branch of science.

BIOLOGY.

Our work in biology has increased very much since the adoption of special courses for the degree of B.S.A. The laboratory practice in botany and zoology is fourfold what it was before this extension of our work.

At the same time the duties of Prof. Panton, our biologist, have become much more numerous and exacting. His lectures in the forenoon remain about the same as they were, but he has to prepare materials for laboratory demonstrations from day to day and take charge of students at practical work in the afternoons. This, of course, he could manage very well, were it not for the large and constantly increasing amount of outside work which he has to do—work for the Province similar to that done by Dr. Fletcher at Ottawa for the Dominion—in naming weeds and insects which come by almost every mail at certain seasons of the year, and in answering questions from farmers about troublesome plants and regarding remedies for insect and fungous pests.

A glance at Prof. Panton's report in Part III. of this volume will show what I mean by outside work, and I may say in a word that Prof. Panton's duties under this head now occupy so much of his time that I have elsewhere asked for the appointment of a fellow at a salary of $350 a year in the Department of Biology.

Chemistry.

Owing to the burning of our chemical laboratory so early in the year, it was, of course, impossible for Prof. Shuttleworth to make so satisfactory a showing as in 1895. Nevertheless good work was done in the Department of Chemistry. The usual amount of theoretical instruction was given in the bacteriological class-room, and the analytic work was done in temporary quarters hastily fitted up in the basement of the experimental building.

Certain investigations begun some time since to determine the value of wood ashes as a fertilizer and the effects of rich and poor rations on the percentage of fat in milk, were brought to a close within the year. The results will no doubt be interesting to farmers, and I need only refer to Prof. Shuttleworth's report in Part IV. of this volume for a full and clear statement of the facts and practical conclusions in each case.

Veterinary Science.

We have nothing special in the Veterinary Department to report this year. We have not suffered much from disease or accidents. Our stock has been healthy and our losses less than usual. See Dr. Reed's report in Part V. of this volume.

I cannot, however, pass on without saying that, in my judgment, the course of practical instruction given to our students by Dr. Reed will be a great benefit to them in after life.

Dairy Deparmment.

The work of our dairy school last year was quite satisfactory. A considerable proportion of those in attendance remained to the end of the session and passed the examinations for certificates.

The cheese and butter sections of our Experimental Dairy were busy as usual for nine months of the year with a great variety of experimental work. Prof. Dean's report in Part VI. of this volume contains a full statement of the results. It is not necessary to repeat his deductions, but it may not be amiss to call attention to the fact that last year's work confirms in nearly every instance the conclusions drawn from previous experiments. This goes to show that our men are doing careful and reliable work.

Experimental Feeding.

Our experimental feeding department is now in shape for experiments in the feeding of cattle, sheep, and swine. The sheep and cattle sections are rather small; but they will serve the purpose, and the piggery built in 1895 is well adapted to the work.

Our agriculturist, Mr. G. E. Day, who has charge of the department, commenced last spring with six breeds of pigs—Yorkshires, Tamworths, Berkshires, Poland Chinas, Duroc Jerseys, and Chester Whites—as near the same age as he could get them. His object was to obtain exact and reliable information as to the merits and demerits of these breeds, especially for the export trade, and at the same time to determine the relative values of sour and sweet whey, compared with each other and with water, in feeding swine; also the value of clover pasture alone and as a supplementary food for hogs.

At the end of the season, the hogs were killed by the Wm. Davies Co. (Ltd.), Toronto, and reported on by J. W. Flavelle, managing director of the company. For detailed information, see Mr. Day's report in Part VII. of this volume.

Another lot of pigs was put into the experimental piggery in the fall of 1896, and nine steers were purchased in November for a series of tests in cattle feeding. The results will be reported in 1897.

Horticulture.

Under the supervision of Mr. H. L. Hutt, our horticultural department is making steady progress. During the past year, routine operations in the growing of vegetables, fruit, and flowers were performed as usual, and a considerable amount of special work was done in testing varieties of strawberries. The list of varieties was large, the tests were carefully made, and the results are valuable. A glance at Mr. Hutt's report will show how extensive and important these tests were.

I need scarcely refer to the fruit experiment stations of Ontario, because our secretary, Mr. L. Woolverton, has prepared a separate account of the work done at these stations, and Mr. Hutt speaks at some length in his report of the visit of inspection which he made in the latter part of August and the beginning of September. See Mr. Hutt's and Mr. Woolverton's report.

Bacteriology.

Our students are beginning to realize that there is a vast and very important field for study and research in bacteriology. The invisible forms of creation seem to be far more numerous and troublesome than the visible.

The time of Mr. F. C. Harrison, our bacteriologist, has been fully occupied during the past year with lectures to students, laboratory instruction, and special investigations. Every hour has been taken up, and we are beginning to think that we could find profitable employment for half a dozen men in this department.

The special investigations referred to dealt with the bacterial contamination of milk and "foul brood" in bees. Much work was done and some valuable conclusions reached; but long-continued investigations under both heads is still required. See Mr. Harrison's report in Part IX. of this volume.

One point more under this head. As a result of recent quarantine negotiations at Washington, cattle entering the United States from Canada have to pass the tuberculin test. Hence the need of an immediate supply of tuberculin for the Dominion. This supply is, I believe, to be provided at Montreal for the Province of Quebec and in our laboratory at Guelph for Ontario. Hence my request for a fellow in bacteriology to assist in the manufacture and distribution of what may be required throughout the Province.

Field Experiments.

I may say in a word that we look with some pride on our fifty acres of plots devoted to field experiments; and I think that, without boasting, we may claim credit for doing from year to year on this fifty acres a large amount of work which is of great practical value to the farmers of Ontario. We are not giving to the country the results of hasty and ill-considered tests, but of well-thought-out and long-continued experiments.

Our station has undoubtedly been instrumental in discovering and distributing throughout Ontario some of the best varieties of wheat, oats, barley, and corn now grown in the Province. Mr. C. A. Zavitz, our Experimentalist, is a very zealous and enthusiastic worker on these lines; and I commend his report in Part X of this volume. This report contains a large amount of valuable information as to variety tests, selection of seed, dates of seeding, methods of cultivation, co-operative experiments, and other matters of interest to farmers.

The Farm Proper.

I have no hesitation in saying that Mr. Rennie's management of our farm is very satisfactory. In lecturing on agriculture and kindred subjects, we have not to point our students to Germany, the United States, or elsewhere, but to our own practice. "See how Mr. Rennie does it," is our usual advice to students who wish to learn the secret of successful farm management. Our farm is in good condition and is improving from year to year. "How, then," says someone, "is it that the public accounts and your own financial statement represent the College farm as losing money every year?" My answer is that so much of the Farm Superintendent's time is taken up with the public, he has to keep so much expensive and unprofitable stock for the educational work of the College, and so much of the time of his men and teams and of the produce of the farm are required and used by the College, the Dairy Department, the Poultry Department, and (in a less degree) by the Experimental and Horticultural Departments, that no man whom this country has ever produced or received from any other country can manage our farm so as to make a good financial showing. Mr. Rennie, like many others, was sure he could do it—till he tried.

I could easily figure it out to show that the farm is paying (as I believe it is) by making due allowance for all contributions made and services rendered to the College and other departments of the institution; but such estimates are always open to question. Hence I prefer generally to state the facts as they are, under the peculiar circumstances surrounding the management of a College farm.

Poultry Department.

Our Poultry department has got nicely under weigh, and has been doing more or less experimental work; but it is thought unwise to publish results until further tests have been made. We have already learned that hens need larger runs than we have given them. Hence I have asked for posts and wire to enclose an additional piece of the field in which the houses are situated. See Mr. Jarvis's report in Part XII. of this volume.

Apiculture.

Courses of lectures on apiculture were given to our first and second year students in the Spring Term by our Apiculturist, Mr. R. F. Holtermann, of Brantford. The lectures were illustrated by a few colonies of bees kept on the College grounds, and some appliances, comb, etc., furnished by Mr. Holterman as required.

Certain experiments in apiculture were also made by Mr. Holtermann in his apiary at Brantford. The results seem conclusive on some points and will, no doubt, be of interest to bee-keepers throughout the Province. See Mr. Holterman's report in Part XIII. of this volume.

Drill and Gymnastics.

We do not devote much time to drill and gymnastics. Our aim is to straighten, strengthen, and develop weak and defective figures, and to improve the address and manners of all our students. During the past year, the work under this head has, as usual, been done in a very satisfactory manner by our drill instructor, Captain Walter Clarke.

Travelling Dairy.

Our travelling dairy, in charge of F. J. Sleightholm, B.S.A., with H. Smith as butter maker, was at work from the 13th of May to the 26th of October. The territory covered was East and West Lambton, East and West Huron, North and South Bruce, East and West Manitoulin, St. Joseph's Island, Centre and East Algoma, East and West Parry Sound, Muskoka and North Muskoka. Generally speaking, the attendance at the meetings was good and much interest was manifested both in the lectures and in the practical demonstrations, especially throughout the northern districts.

This dairy might go on indefinitely; but the whole of the Province having been visited once and many portions of it twice, it has been decided to discontinue this part of our work, for the present at least.

Eastern and Western Dairy Schools.

These schools have given me some care and anxiety during the past year; but I am glad to be able to report that they are doing good work. The attendance at the Eastern School in Kingston has been quite satisfactory; that in the Western School at Strathroy has not been so large, owing, no doubt, to the facts that the school has not been so long in operation and the western counties (on which this school is dependent) take much less interest in dairying than the eastern portions of the Province.

Class-Room Work.

The class-room work in the different departments has gone on as usual. Eleven candidates wrote for the B. S. A. degree in the University of Toronto. Ten received dsplomas and one was starred in Chemistry. 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 proper 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 Prof. Alexander, University of Toronto, Wm. Tytler, B.A., Guelph, and J. M. McEvoy, B.A., LL.B., London, Ont.

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:

Atkinson, James	Egmondville, Huron Co., Ont.
Bishop, W. R	Beachville, Oxford, Ont.
Clark, J. F	Bay View, P. E. I.
Knight, J. W	Elginburg, Frontenac, Ont.
Maconachie, G. B	Gurdaspur, Punjab, India.
Paterson, T. F.	Lucknow, Bruce Co., Ont.
Smith, G. A.	Morrisburg, Dundas Co., Ont.
Smith, P. B	Hamilton, Bermuda.
Thompson, W. J.	Barrie, Simcoe, Ont.
*Wilson, A. C	Greenway, Huron Co., Ont.
Wilson, N. F	Rockland, Russell Co., Ont.

*Starred in Chemistry of the General Course.

Recipients of Associate Diplomas.

Twenty-two having completed our regular course of two years, were examined for associate diplomas, and all were successful. The diplomas were presented by the Hon.

James Young at our closing exercises on the 30th June. The names and addresses of the recipients are as follows :

Bell, T. C.	Cataract, Peel, Ont.
Black, G. W.	Winchester, Dundas, Ont.
Butler, W. E.	Dereham Centre, Oxford, Ont.
Charlton, E. S.	St. George, Brant, Ont.
Cousins, R. J.	Enterprise, Addington, Ont.
Cunningham, Jno.	Ardtrea, Simcoe, Ont.
Devitt, I. I.	Floradale, Waterloo, Ont.
Gadd, T. T.	Varney, Gray, Ont.
Gamble, Wm.	Cumberland, Russell, Ont.
Guy, J. T.	Columbus, Ont.
Higginson, G. O.	Hawkesbury, Prescott, Ont.
Hodgetts, P. W.	St. Catharines, Lincoln, Ont.
Hutton, H.	Toledo, Leeds, Ont.
Kennedy, A.	Limehouse, Halton, Ont.
Leavitt, A. S.	Vankleek Hill, Prescott.
Loghrin, S. M.	Stratford, Perth, Ont.
MacDonald, J. C.	Lucknow, Huron, Ont.
Oastler, J. R.	Fetherston, Parry Sound District, Ont.
Parker, F. A.	Bowmanville, Durham, Ont.
Rogers, C. H.	Grafton, Northumberland, Ont.
Stoddart, R. L.	Bedford, England.
Wilson, A. F.	McGarry, Lanark, Ont.

First-Class Men.

The work in 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 1896, arranged alphabetically :

First Year.

1. Craig, R. D., Guelph, Ont., in three departments: Natural Science, Veterinary Science, and Mathematics.
2. Heartz, W. B. G., Spring Hill, Nova Scotia, in two departments: Agriculture and Veterinary Science.
3. McCalla, G. B., St. Catharines, Ont., in four departments: Agriculture, Natural Science, Veterinary Science, and English.
4. Ross, H. R., Gilead, Ont., in two departments: Agriculture and English.
5. Wiancko, T. A., Sparrow Lake, Muskoka, Ont., in one department: Agriculture.

Second Year.

1. Hodgetts, P. W., St. Catharines, Ont., in three departments: Natural Science, English, and Mathematics.
2. Higginson, G. O., Hawkesbury, Ont., in two departments: Agriculture and Natural Science.
3. Oastler, J. R., Featherston, Parry Sound, Ont., in one department: English.
4. MacDonald, J. C., Lucknow, Ont., in one department: English.

Medallists.

Medals are given to the three students who rank highest in general proficiency in the theory and practice of the second year. The following were the successful competitors in 1896:

Gold Medallist. George Owen Higginson, Hawkesbury, Prescott, Ont.

First Silver Medallist. Percy W. Hodgetts, St. Catharines, Ont.

Second Silver Medallist. James R. Oastler, Featherston, Parry Sound, Ont.

THE GEORGE A. COX SCHOLARSHIPS.

First Year.

1. *Agriculture, Live Stock, Dairying, Poultry, and Apiculture.* T. A. Wiancko, Sparrow Lake, Muskoka, Ont.
2. *Natural Science.* G. B. McCalla, St. Catharines, Lincoln, Ont., first in four departments.
3. *Veterinary Science.* W. B. G. Heartz, Truro, Nova Scotia.
4. *English.* H. R. Ross, Gilead, Hastings, Ont.
5. *Mathematics.* R. D. Craig, O. A. C., Guelph, Ont.

Second Year.

1. *Agriculture, etc.* G. O. Higginson, Hawkesbury, Lincoln, Ont.
2. *Natural Science.* P. W. Hodgetts, St. Catharines, Lincoln, Ont.
3. *Veterinary Science.* Not awarded.
4. *English.* Not awarded.
5. *Mathematics.* I. I. Devitt, Floradale, Waterloo, Ont.

PRIZE MEN.

First Year.

Agriculture, Live Stock, Dairying, Poultry, and Apiculture. 1st, G. B. McCalla; 2nd, H. R. Ross.

Natural Science. 1st, G. B. McCalla; 2nd, R. D. Craig.

Veterinary Science. 1st, G. B. McCalla; 2nd, R. D. Craig.

English Literature, Grammar, and Composition. 1st, G. B. McCalla; 2nd, H. R. Ross.

Mathematics, Book-keeping, and Drawing. 1st, R. D. Craig; 2nd, G. B. McCalla.

General Proficiency. 1st, G. B. McCalla; 2nd, R. D. Craig; 3rd, H. R. Ross; 4th, W. B. G. Heartz; 5th, T. A. Wiancko; 6th, Wm. J. Elliott, Seaforth, Huron, Ont.

Second Year.

Agriculture, Live Stock, Dairying, Poultry, and Apiculture. 1st, G. O. Higginson; 2nd, J. R. Oastler.

Natural Science. 1st, P. W. Hodgetts; 2nd, G. O. Higginson.

Veterinary Science. 1st, W. Gamble, Cumberland, Russell, Ont.; 2nd, J. T. Guy, Columbus, Ontario Co., Ont.

English Literature and Political Economy. 1st, P. W. Hodgetts; 2nd, J. R. Oastler.

Mathematics and Physics. 1st, P. W. Hodgetts; 2nd, G. O. Higginson.

General Proficiency. 1st, G. O. Higginson; 2nd, P. W. Hodgetts; 3rd, J. R. Oastler; 4th, J. T. Guy; 5th, Wm. Gamble.

Valedictory Prize.

A prize of $10 in books is offered annually to the second year students for a valedictory address. The subject last year was "Practical Economics," and the prize was awarded to J. C. MacDonald, Lucknow, Bruce County, Ont.

Closing Exercises.

Our closing exercises for the year took place on the 30th June. The weather was fine and the attendance of visitors large. The Hon. James Young presented the diplomas and delivered a short address. Rev. Dr. Caven, Principal of Knox College, and President Louden, of the University of Toronto, also favored us with their presence, and delivered addresses suitable to the occasion.

Visitors.

We had a very large number of visitors in the month of June—not less than 15,000. Some drove in from the surrounding country, but most of them came by rail.

Conclusion.

I think I may say in conclusion that our College is now in a position to do good work. Our equipment is so much better than it was a few years ago that we are inclined to speak of it as good; and our staff, though not quite large enough, is composed of earnest, hard-working men who are working zealously for the success of the Institution and the benefit of the students in attendance.

Dec. 31st, 1896.

JAMES MILLS,
President.

FINANCIAL STATEMENT FOR 1896.

I. College Expenditure.

(a) *College Maintenance.*

1. *Salaries and Wages*	$19,298 64
2. *Food*—	
Meat, fish, and fowl	3,603 00
Bread, biscuits, etc.	616 73
Groceries, butter, and fruit	3,822 58
3. *Household Expenses*—	
Laundry, soap, and cleaning	141 66
Women servants' wages	1,877 41
4. *Business Department*—	
Advertising, printing, postage, and stationery	1,345 80
5. *Miscellaneous*—	
Maintenance of chemical laboratory	267 24
" botanical laboratory	148 51
" bacteriological laboratory	107 56
" physical laboratory	111 93
Library and reading-room—books, papers, and periodicals	443 10
Medals	90 50
Unenumerated	847 59
	$32,762 94

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

Furniture and furnishings	955 03	
Repairs and alterations	1,000 27	
Fuel	3,044 17	
Light	727 46	
Water	612 50	
Sewage disposal	143 00	
		6,482 43
		$39,245 37

College Revenue.

Fees	1,519 55	
Balances for board, after deducting allowances for work in outside departments	5,121 61	
Chemicals	17 00	
Gas	45 00	
Supplemental examinations	20 00	
Sale of linseed oil to other departments of institution	46 99	
Sale of sundries	29 48	
Contingencies	43 65	
		6,843 28
		$32,402 09

Unexpended balance for the year, $1,385.11. (See Estimates for 1896, pp. 37 and 43.)

II. Farm Expenditure.

(a) *Farm Proper.*

1. *Permanent improvements—*		
Fencing, underdraining, etc		$243 53
2. *Farm maintenance—*		
Salary of superintendent	$1,200 00	
Wages—herdsmen, teamsters, engineer, etc	2,980 50	
Live stock	1,299 85	
Maintenance of stock	674 99	
Seed	226 71	
Binding twine	28 17	
Repairs and alterations (including blacksmithing)	754 61	
Furniture and furnishings	333 60	
Tools and implements	223 04	
Advertising, printing, postage, and stationery	193 37	
Fuel and light	9 18	
Contingencies	76 20	
		8,000 22
		$8,243 75

Cash Revenue of Farm Proper.

Sales of cattle	$953 60	
" pigs	769 79	
" sheep	195 85	
" wheat	460 60	
" barley	244 31	
" oats	478 78	
" peas	99 25	
" potatoes	82 10	
" milk	72 92	
" wool	58 97	
" horses	80 00	
" hides and skins	6 60	
" old fence and wood	29 20	
" service of animals	172 50	
		3,704 47
Net expenditure of farm proper		$4,539 28

Unexpended balance for the year, $385.72. (See Estimates for 1896, p. 38.)

(*b*) *Experimental Plots and Feeding.*

1. *Permanent improvements*—		
Alterations in buildings, furnishings, etc	266 47	
2. *Maintenance*—		
Experimentalist	1,500 00	
Foreman	399 96	
Feeder	195 00	
Teamsters	555 00	
Laborers	1,873 83	
Seed	263 37	
Manure and special fertilizers	149 46	
Stock for feeding	630 02	
Furniture, furnishings, and repairs	419 40	
Printing, postage, and stationery	128 81	
Implements	193 10	
Feed and fodder	293 35	
Contingencies	117 14	
	$6,984 91	
Revenue from sale of pigs	355 05	
		$6,629 86

Unexpended balance for year, $133.14. (Estimates, p. 38.)

III. Dairy Department.

(*a*) *Experimental Dairy.*

Salary of foreman—instructor, butter-maker, and experimenter	$649 92	
Experimental cheese-maker (nine and a half months)	500 00	
Man to assist in experimental work, attend boilers, etc. (nine and a half months)	285 00	
Assistant in chemical laboratory, employed in analyzing milk, etc	200 00	
Cattlemen, milkers, etc	650 00	
Temporary assistance	22 58	
Milk for experimental cheese-making	1,581 76	
Purchase of cows and pigs	546 42	
Feed and fodder	558 42	
Furniture, furnishings, and repairs	673 87	
Advertising, printing, postage, and stationery	87 41	
Fuel and light	434 73	
Contingencies	104 26	
	$6,294 37	

Revenue of Experimental Dairy.

Sales of butter	1,120 62		
" cheese	1,126 88		
" milk	65 84		
" cream, skim milk, and butter-milk	16 70		
" cattle	242 00		
" pigs	571 95		
" oil to poultry department	2 69		
		3,146 68	$3,147 69

Unexpended balance for the year, $987.31. (Estimates, p. 39.)

(*b*) *Dairy School.*

Wages of instructors	$1,171 99
Engineer	84 10
Helper	75 00
Cleaning	8 51
Milk for school	2,459 95
Dairy appliances, pasteurizing apparatus, etc	558 68
Expenses of butter and cheese judges	19 00
	$4,377 23

Revenue of Dairy School.

Sales of butter	$1,206 45		
" cheese	801 19		
" skim-milk	38 89		
Registration fees	170 00		
		$2,215 53	$2,161 70

Unexpended balance for the year, $1,061.30. (See Estimates for 1896, p. 39.)

(c) Travelling Dairy.

Expenses of Travelling Dairy	$1,970 12

Unexpended balance for the year, $529.88. (See Estimates, p. 39.)

IV. Poultry Department.

Salary of manager		$700 00	
Purchase of stock		90 45	
Feed, etc		146 83	
Furnishings—coops, etc		149 14	
Fuel and Light		61 47	
		$1,147 89	
Sales of poultry	$115 70		
" Eggs	84 90		
		200 60	$947 29

Unexpended balance for the year $52.71. (Estimates p. 39.)

V.—Horticultural Department—Garden, Greenhouses, Lawn, Arboretum, Orchard, Forest-Tree Clumps, etc.

1. *Permanent Improvements*—fencing, tree and shrub labels, etc	208 65	
2. *Maintenance*—		
Foreman	649 92	
Florist	528 00	
Assistant in greenhouses	385 00	
Teamster and laborers	1,757 82	
Manure	67 50	
Trees, shrubs, plants, seed, etc	345 70	
Furniture, furnishings, tools, implements, and repairs	333 34	
Fuel and light	784 61	
Contingencies	65 85	
	5,126 39	
Less sale of vegetables and trees	15 80	
		$5,110 39

Over-expenditure for year, $142.39. (Estimates, p. 39.)

V. Mechanical Department.

Salary of foreman	700 00	
Salary of carpenter	700 00	
Tools, etc	37 31	
Fuel and light	17 32	
		$1,454 63

Unexpended balance for year, $20.37. (Estimates, p. 40.)

Summary.

Total net expenditure of all departments in 1896.

I.	College and Government Buildings	32,413 89
11.	Farm—	
	1. Farm Proper	4,539 28
	2. Experimental Plots and Feeding	6,629 86
	3. Dairy Department—Experimental dairy, dairy school, and travelling dairy	7,279 51
	4. Poultry Department—Wages, stock, etc	947 29
III.	Horticultural Department—Garden, greenhouses, orchards, lawn, arboretum, etc	5,110 39
IV.	Mechanical Department—Construction of buildings, repairs, ecc	1,454 63
		$58,374 85

The unexpended balances on the year's operations in all departments was $4,413.15.

The sum of $3,273.18 was paid by the College to students for work in the outside departments in 1896. This was done by crediting on board bills the sums allowed to students from week to week by the foremen under whom they worked.

Notes on Statement.

Without going into a formal statement of accounts between different departments, I may say that *the Farm Proper is entitled to credit* from several of the other departments—

1. From the College, for feed and bedding of College horses; the filling of the College ice house; a large quantity of milk (varying from thirty to seventy quarts a day), and potatoes, turnips, etc., for College use.

2. From the Dairy Department, for ensilage and mangels, and the year's supply of pasture, hay, and straw for thirty cows, ten to twelve calves, and a number of swine.

3. From the Poultry Department, for straw, chaff, mangels, etc.

4 From the Experimental Department, for the feed and bedding of four horses throughout the year.

5. From the Horticultural Department, for feed and bedding of two horses throughout the year.

It is also right to add in this connection, that the farm proper keeps a number of male animals—bulls, rams, and boars—solely for educational purposes. Twenty-three or more of these animals are fed and cared for from year to year at large expense, when three would serve all the requirements of the farm superintendent for breeding. This is a large item of expense which the farm superintendent has to incur every year for the benefit of the College, that the students may have the means of getting a thoroughly practical knowledge of live stock—that they may have both male and female of all the principal breeds of farm animals for daily inspection and class-room work. See Superintendent's statement, part XI. of this report.

The Horticultural Department is also entitled to credit for a regular supply of fruit, vegetables, and flowers furnished to the College throughout the year.

JAMES MILLS,

President.

PART II.

REPORT OF THE LECTURER IN ENGLISH LITERATURE AND PHYSICS.

To the President of the Ontario Agricultural College:

SIR,—The tenor of my report for this year will be seen to differ somewhat from that of last year. Then I reported on three departments of my work, viz., the Residence, the work in English and the work in Physics. Having been relieved of the Residence duties, and also of some of the numerous subjects belonging to the College curriculum for which I had previously been held responsible, I have been enabled to devote more time to the two departments, English and Physics.

ENGLISH LITERATURE. In this work no new features have been introduced. The aim has been to make both the study and the practice as immediately practical as possible. Considerable emphasis has been laid upon the writing of essays by the students of all years, and the marked improvement that has taken place in this direction is very gratifying. Essay writing at this institution has proved to be a very efficient means of education. The subjects assigned are those upon which they can write with interest and profit; not too difficult, but yet of such a nature as to encourage and even necessitate reading; not slavishly confined to purely practical subjects, but such as demand general information on the questions of the day. Numerous topics are suggested by the different selections of English literature studied in the class. The improvement in neatness, correctness, and facility of expression is quite marked. Usually, the essays are handed in to be read, marked, and evaluated. They are then returned to their respective authors, and a few minutes of the period are allotted for writing correctly the words misspelled and for discussing some of the errors in construction, use of words, etc. I have found this plan of handing back the corrected papers very successful, both in convincing the students of their need of literary training and in affording them the means of obtaining it. It requires a great deal of time to mark and evaluate every paper, even when done only once in two weeks, there being more than seventy of such papers for the first year alone; but the results that immediately follow more than repay for the time given to the work. Occasionally the exercise is varied by requesting a number of the students to read their essays in class. More of this work should be done, but time will not allow. And another very important part of the literary training of our students is, on account of lack of time, almost entirely neglected, and that is, extempore speaking. Our graduates should certainly be trained in this accomplishment, but the only training that they get is that afforded by the transaction of business and by the debates of the Literary Society. This society is of great benefit to the students, especially along the line of training in oratory, but, meeting only once a week as it does, the opportunities for improvement in public speaking afforded to each individual member are necessarily few. If a competent instructor could be provided, some time, perhaps one hour a week, might be afforded to the first year during afternoon study in the class-room, where, as a matter of fact, the time is not always profitably employed, since the strictures that are there unavoidably laid upon freedom of movement are conducive to drowsiness, and a break in the middle of their period would be a gain rather than a loss. If this suggestion is considered practicable, I hope that you will soon be in a position to afford the students this opportunity for instruction in a hitherto neglected department of their literary training.

PHYSICS. This work at an Agricultural College should consist of two parts: first, general Physics, in which the principles of the science are studied, viz., the laws of matter; the forces of nature; the property of solids, liquids, and gases; the nature and phenomena of heat, light and electricity; the physical structures of different bodies. Secondly, the application of these physical principles to the science of Agriculture. The latter may be called Agricultural Physics.

The experimental application of Physics to Agriculture is of recent date. Physics has been called upon to explain certain phenomena with regard to soils and plants, such as the movements of water in the soil, and the peculiar manner in which plants appropriate food to themselves from the soil about their roots; but experimental research, either in the laboratory or in the field, along the line of Agricultural Physics, has by no means been given much attention. Something has been done in Germany and in the United States, but nothing has been done in Canada. An understanding of the physical constitution and behavior of soils and plants is of the utmost importance in the science of Agriculture. Realizing this, during the past year I have been devoting some attention to laboratory work in Soil Physics. Results of considerable importance have been reached, even in a few weeks' investigation. But since the time devoted to this study has been so short it would appear presumptuous to dogmatize upon what may be insufficient data. I shall not, therefore, trouble you at this time with the details of my investigations. I hope, however, in a short time to present for your approval a bulletin upon this subject, and in the meantime I shall make use of my results in addresses to be given to Farmers' Institutes in January. As the subject is almost unknown, I beg to offer at this point a brief explanation of what is implied by the term "Agricultural Physics," with some of the methods employed in investigation.

PHYSICAL ANALYSIS OF SOILS. This differs materially from chemical analysis. The latter determines the elemental constituents of which the soil is composed; the former analyses with reference to the size of the soil particles. An analysis of a sample of heavy clay soil obtained from a farm in Pickering Tp., Ontario Co., gave the following result:

Sand	13	per cent.,	average	diameter	.01 of an inch
Silt	23.1	"	"	"	.0012 "
Clay	63.9	"	"	"	.0001 "

In the sand, from a sample of the soil weighing 5 grams, were a few coarse grains averaging .05 ($=\frac{1}{20}$) of an inch; the rest of the sand was made up of particles varying from $\frac{1}{500}$ to $\frac{1}{50}$ of an inch, the average diameter being $\frac{1}{100}$ (.01) of an inch. The silt particles varied in diameter from $\frac{1}{1000}$ to $\frac{6}{1000}$ of an inch, the average diameter being $\frac{1.2}{1000}$ (= .0012) of an inch. The clay particles varied in diameter from $\frac{1}{24000}$ to $\frac{1}{8000}$ of an inch, the average diameter being $\frac{1}{10000}$ (=.0001) of an inch. An analysis of a sample of soil taken from the experimental field at the College gave the following result:

Sand	66.6	per cent.
Silt	24	"
Clay	9.4	"

It must be understood that the names given to distinguish these different grades of soil particles are merely conventional. In my definitions of sand, silt, clay, I have followed Hilgard. It will be observed by these figures that the *physical* difference in soils consist in the difference in *size of particles*. To the physicist, the differences between sandy soil and clayey soil is that the sandy soil has a larger proportion of comparatively coarse particles, while the clayey soil has a larger proportion of fine particles. This difference explains the friable nature of sandy soils, and also the tendency of clay to *bake*, or form into solid blocks. The fineness of the particles in the clayey soil allows those particles to lie very close together; and when the particles lie sufficiently close together, there is a possibility of the separate grains becoming fused, or welded, into one solid mass. Water in clay is the fusing element, just as fire is in metals. When water has been absorbed by clayey soil, and then allowed to dry out, the separate particles become welded together; and the clay mass approaches the solid condition. But in sand, the comparative coarseness of the particles will not admit of that intimate relation between the parts, and hence the force of *cohesion* either does not act at all, or is very weak, and the separate grain structure is soon restored. This difference of physical condition explains what is meant by the terms, when popularly used, "heavy" and "light" soils,—heavy soil being that which is comparatively difficult to work, and light soil easy to work. As a matter of fact, however, the popular meaning of the terms "heavy" and "light" when applied to soils is just the opposite from their meaning when referring to the relative weight of the soils. Sand is really heavier than clay, bulk for bulk. Comparing the weights of known volumes of pure sand, clay, and humus respectively, with the weights of equal volumes of water, we deterimine their *specific gravity* as follows: Sand, 2.64; clay, 2.5; humus, 1.48.

Humus. Humus in soils is detected by the following physical peculiarities:

1. By the dark color imparted to the soil.

2. By the specific gravity; soils with humus are lighter, bulk for bulk, than soils without humus, other constituents being equal.

3. By its power to absorb and hold more moisture.

4. By the rate which water will move through or from the soil, by capillarity, evaporation, or percolation.

The greater the humus content, the slower the movement of water.

5. By the expansion of the soil when absorbing moisture.

The following experiment was conducted to demonstrate some of the properties of humus mentioned above. Some pure sand and pure humus were thoroughly dried, and weighed out in the proportions mentioned below; the proportions were then mixed in six different lots, and the mixtures poured into six zinc cylinders of nearly equal dimensions, filling the cylinders to exactly the same height. The cylinders are about six inches high and one and a half inches in diameter. To the bottom of each is attached fine wire gauze. Below the gauze is an extension of the cylinder about one inch in length, with peforations in it for admitting the water. The cylinders were placed in water which was just deep enough to stand above the gauze, thus bringing the soil into contact with the water below. The water rises to the surface by capillary attraction. A linen disk of the same size as the cylinder was introduced between the gauze and the soil to prevent the latter from sifting through. The following figures are the result of the experiment:

Sample.		No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.
Proportions.	Sand	95	90	80	70	60	50
	Humus	5	10	20	30	40	50
Weight of dry soil in grams		270	249.83	218.12	194.25	175.95	163.54
Volume of dry soil in cubic centimeters		156.56	148.43	156.56	164.91	156.56	156.56
Time before water reached surface		30 mins.	30 mins.	80 mins.	150 min.	175 min.	9 hours.
Weight in grams of water absorbed	1st weighing	59.43	67.76	80.04	83.62	78.36	93.11
	2nd weighing	60.95	68.72	81.49	86.24	83.68	96.36
Gain in volume		3.6%	6.%	9.4%	10.%	8.7%	14.5%
Water coefficient		39.	46.3	52.	52.3	53.4	61.5

The cylinders were weighed as soon as the water in the last had reached the surface. They were weighed again twenty-four hours after. It should be noticed that the sandy samples gained but little after the first weighing, but the samples that were richer in humus gained more. They had not so nearly approached saturation. The *water-coefficient* in the table is obtained by dividing the column of water absorbed, (expressed in cubic centimeters by the same *number* as that which expresses the weight in grams) by the volume occupied by the soil. It expresses the *capacity* of the soil for holding moisture. The gain in volume is simply the expansion or swelling of the soil under the action of water. This property of humus soils, added to the lack of *cohesiveness* of such soils, is of considerable economic importance. When the water dries out, the soil is left loose and open, thus affording space for the roots of plants to move and expand, and for the air to circulate. Clayey soils expand also under the action of water; although not to so great an extent as humus soils; but the clayey soils possess great adhesive force, as explained above, and when the water dries out, the soil forms into solid blocks, and the spaces left by the water, instead of being uniformly distributed throughout the soil mass, appear in the shape of wide cracks or fissures in the soil. Another important conclusion from the figures given above is that the water content of the soil increases with its humus content, and hence increased fertility and an increased water-supply for crops are obtained by one and the same means, viz., by increasing the vegetable matter in the soil.

One great source of loss of plant food is the leaching that takes place after rainfalls and during winter. The following experiment demonstrates the value of humus as a preventive of this leaching. Two glass cylinders open at both ends, about three feet in length, we nearly filled one with sand and the other with humus, both perfectly dry, the lower ends of the tubes being stopped up with a linen disk and a perforated rubber stopper. Water was then poured in at the top and the time required to percolate to the bottom was observed. The water reached the bottom of the sand column in four hours. The humus is still under consideration. The experiment was begun on December 4th and at the time of writing, (December 23rd), the water has reached a point just two feet from the surface, although water has been standing above the surface of the soil to the depth of three inches or more since the commencment of the experiment.

The *retentive* power of humus is shown by the following experiment in evaporation. Some samples of soil were allowed to absorb water by capillarity, by the method explained from the previous table. They were then set out to evaporate. The amount of water contained in each sample before evaporation is given as the water-content.

Sample.	Humus.	Sandy soil. rich in humus.	Clayey soil. not rich.	Pure sand.
Water content	39.94	34.69	34.58	21.77
Weight in grams evaporated in 2 days	3.43	2.83	4.02	5.75
Weight in grams evaporated " 5 days	4.17		7.12	10.2
Weight in grams evaporated " 7 days	4.74	4.81	8.25	10.56

The value of humus as a preventive of evaporation is seen best by comparing columns two and four, where the evaporation from the sandy soil containing humus is less than half of that from the pure sand, although the latter has considerably less water to lose. Expressed in tons per acre, the amount of water evaporated from number four in seven days was at the rate of about forty tons per acre; from number two, about eighteen tons. There was no stirring of the surface in any case. That will be a subject for future investigations.

These few notes are sufficient to indicate the line to be followed in our investigations on Soil Physics. The apparatus required is not elaborate or costly (a great deal of it being zinc or tinware), and it can be manufactured by local tinsmiths. The room in which these investigations have been carried on is the Physical Laboratory and class-room. This room was intended primarily for instruction in lectures and practical work, and is not adapted for Soil Physics. As was mentioned in my last report, a room for Agricultural Physics was set apart in the Experimental building, but it has not yet been fitted up. If this matter can be attended to before the spring, I shall then be able to work to better advantage.

All of which is respectfully submitted.

December 23rd, 1896. J. B. REYNOLDS.

PART III.

REPORT OF THE

PROFESSOR OF BIOLOGY AND GEOLOGY.

To the President of the Ontario Agricultural College:

SIR,—The year 1896 has been one in which more work than usual has been done in the department of Biology. It was a favorable year for the development of insects, which attracted much attention in several parts of the Province, and brought many inquiries to the College.

Much correspondence has been necessitated on account of the rapidly growing desire among farmers for further knowledge of plants and insects. This outside work is increasing yearly, and demands much time from the head of the department. For the first time I was detailed to visit several places where insects had caused considerable damage.

1. WORK IN LECTURE-ROOM AND LABORATORY.

First Year. The first six weeks of the fall term are devoted to the study of general Biology, and the remainder to that of Zoology. The winter term is occupied by a continued study of Zoology, and also by a course of lectures on Geology, as it relates to agriculture and the economic products of the rock formations in the Province of Ontario. The spring term is spent in gaining a knowledge of Botany. In the study of this subject a specimen plant is brought into the class-room at each lecture and used in practical instruction relating to the analysis and identification of plants.

Second Year. The fall term is devoted to Entomology. To aid in this study a collection of insects in the various stages of development (larva, pupa and imago) is used, and is accessible to the students at any time they wish to examine it. The afternoons of two days in each week are spent in the very careful analysis of plants, and the drawing of characteristic parts.

During the winter term practical work, two afternoons a week, continues, attention being directed to the microscopic structure of plants. Botany is taken up in the lecture-room during the spring term. A further practical study of plant analysis is followed and twenty-five species of plants identified, mounted and labelled.

Third Year. During the fall term a course of lectures is given in Structural and Physiological Botany, and also in Geology, with special reference to the rock formations found in Ontario and their economic products. Two afternoons are occupied in a practical study of Zoology and Plant Physiology. A course of lectures in Biology is given to the special students in this department. The theoretical course in Botany and Geology is continued through the winter term, and a course in Zoology given to the special students in Biology. During the winter term four afternoons are spent in the laboratory, two in Botany and two in Zoology.

As the examination of third year students commences early in May, no regular course is laid out for work in the spring term, but the time is spent in what seems best for the students' success. During the third year, students making a specialty of Biology require to mount one hundred species of plants.

2. Correspondence, Lectures, Etc.

The time required to answer the innumerable questions connected with my department leaves me little time to prepare material for the illustration of lectures in the class-room. Besides, during this summer, articles were prepared for several papers, to give publicity to information relating to the army worm, tussock moth and other pests. During the year four special articles have been written for agricultural journals: "Importance of Water in Plant life," "Agricultural Science in Rural Schools," "The Army Worm," and "The Tussock Moth." Two addresses were delivered before the Entomological Society of Ontario at its annual meeting, Oct. 21st and 22nd. A report on economic entomology and botany was prepared and read before the Experimental Union. During January I made my annual tour to the Farmers' Institutes.

From the experience of 1896, this being the first year that students of the third year were allowed to make any department a special study, we are able to make some suggestions. A comparison of the work required in the first and second years, will at once reveal a great difference in the amount and character of this work. We are doing about as much as can be done in the two years, and the question naturally arises, what can be done to bridge this wide space between the second and third years? The time is now so fully occupied in the first and second years that there seems no more room for either practical work or theory. I feel this especially in Biology, as the students of the second year have no Zoology except in reference to Entomology. I think if an arrangement could be effected by which students intending to take the third year could be given extra instruction in Microscopy and Biology, it would place them in a better position to continue the extended study of these subjects as required by the curriculum of the third year.

We are attempting a great deal in trying to complete in three years the course laid down in the curriculum.

From a consideration of the work which is connected with the department of Biology it will appear that assistance is required. I am not purposing to urge a regular assistant for the entire year, at present, but will wait until experience shows fully the work necessitated by the curriculum, and the correspondence involved as consulting botanist and entomologist.

However, in the meantime, there should be some assistance, which might be obtained as follows: The assistance of the librarian, from ten to twelve a.m., from October to May, and that one hundred and fifty dollars be set apart for assistance during the remaining months, when constant aid is required:

Another and probably better solution of the difficulty would be the appointment of a Fellow to assist in the work of the department of Biology.

3. The Museum.

During the year 1896 very few additions have been made to our collection. There is little use obtaining specimens until we have proper cases to contain them. We have learned from experience that it is a mistake to have specimens exposed in such a way that the public can handle them. The cases we have are quite unsuitable for specimens, and I think the time has arrived when we should increase our accommodation and the number of our specimens. As you are well aware, many of ours are animals from foreign countries, interesting to the ordinary visitor, but of very little use for instruction. Now, since we have begun to emphasize the study of Biology, we should add to our collection such specimens as would be useful to the students in Botany and Zoology. I would therefore suggest to you to ask for a grant of five hundred dollars for the purpose of getting some new cases and additional specimens.

4. Practical Work.

During 1896 attention was given to some investigations, but my work, in connection with answering correspondence relating to injurious plants and insects, became so great that I had little time to attend to anything else. This work is increasing yearly, and the time is not far distant when there must be a regular assistant in the Department of Biology to aid in this work. Many weed seeds have been identified, and much information referring to spraying given.

(a) Bordeaux Mixture as an Insecticide.

During July of 1895, while conducting some experiments with Bordeaux mixture as a fungicide to destroy the leaf-spot on the currant and gooseberry, I observed that the unsprayed bushes were badly attacked by the currant worm (*Nematus ribesii*), while the sprayed bushes were untouched. This year I resolved to experiment with Bordeaux mixture on or against the currant-worm. Twenty-five bushes were selected; every fifth one was omitted, and the remainder were sprayed with Bordeaux mixture made from four pounds of copper sulphate, four pounds of lime, and forty gallons of water.

The following results were attained:

1st application, April 22nd. Some currant-worm flies were seen on the bushes at this time.

2nd application, April 30th.

3rd application, May 7th. Flies quite common on the unsprayed, but they did not appear to stay on the sprayed or be inclined to light upon them. The unsprayed bushes were completely defoliated, while the sprayed bushes were not touched.

On May 19th the injured bushes were sprayed to see the effect upon the worms, which now covered the bushes that had not been sprayed.

June 2, an examination of the bushes showed no worms, and the bushes were apparently freed from the pest.

July 15, an excellent crop was gathered from the sprayed bushes, but a very light one from those that had not been sprayed till May 19th; but the leaves on these were fully restored, showing that the spraying on the 19th had killed the worms and prevented further injury, so that in a short time the bushes regained their normal condition.

From this experiment it would seem Bordeaux mixture is an insecticide against the currant-worm. Further tests will be made in 1897.

(b) Vitality of the Common Bindweed (*Convolvulus arvensis*)

During my tour attending Farmers' Institutes this year I had many questions put to me regarding Bindweed, which seems to be rapidly gaining ground in Ontario, and appears to offer serious obstacles to being got rid of.

Some farmers declared it could not be killed. As soon as spring appeared some plots on the College lawn, where this weed has held possession, though regularly hoed and kept from seeding for years, were set apart for the purpose of experimenting with this plant. Four plots were selected, each a yard square. No. 1 was covered with salt, May 6th, three pailfuls of salt being used. No. 2 was covered with the same quantity of gas lime. No. 3 was sprinkled with a solution of sulphuric acid (one pint to a pailful of water.) No. 4 was hoed as often as a leaf appeared, until September 20th.

The following results were obtained:

May 27th, some more gas lime was added as the plants had began to reappear, and another dose of acid required to be applied to plot 3. No. 1 at this date showed no signs of life. Hoeing plot 4 was stopped September 20th.

An examination of the plots October 21 revealed as follows: No. 1, no vestige of plant. No. 2, no Bindweed except at the edge. No. 3 had been dropped out as it was found that the acid application lost its effect owing to the quantity of lime in the soil. No. 4, which had been hoed almost daily till Sept. 20th, showed twelve weakly plants.

This experiment will be continued in 1897 to ascertain if the salt is effectual, and how much longer hoeing is necessary to kill this persistent weed.

(c) Identification of Plants, 1895.

Common Name.	Scientific Name.
1. False flax.	Camelina sativa.
2. Toad flax.	Linaria vulgaris.
3. Birdfoot trefoil.	Lotus corniculatus.
4. Perennial Sow Thistle.	Sonchus arvensis.
5. Wild bugloss.	Lycopsis arvensis.
6. Black bindweed.	Polygonum convolvulus.
7. Ginseng.	Aralia quinquefolia.
8. Low cudweed.	Gnaphalium uliginosum.
9. Viola arvensis.	Viola arvensis.
10. Cypress spurge.	Euphorbia cyparissias.
11. Herb Robert.	Geranium Robertianum.
12. Wild mustard.	Brassica sinapistrum.
13. Blue bottle.	Centaurea cyanous.
14. White cockle.	Lychnis vespertina.
15. Neckweed.	Veronica peregrina.
16. Perennial rye.	Lolium perenne.
17. Orchard grass.	Dactylis glomerata.
18. Canary grass.	Phalaris arundincea.
19. Field peppergrass.	Lepidium campestre.
20. Oak leaved goosefoot.	Chenopodium glaucum.
21. Salsify.	Tragopogon porrifolius.
22. Cancer root.	Conopholis Americana.
23. Bladder campion.	Silene inflata
24. St. John's wort.	Hypericum perforatum.
25. False Solomon's seal.	Smilacina racemosa.
26. Smaller Solomon's seal.	Polygonatum biflorum.
27. Bellwort.	Uvularia perfoliata.
28. White baneberry.	Actæa alba.
29. Shield fern.	Aspidium intermedium.
30. Moonwort.	Botrychium virginicum.
31. Wormseed mustard.	Erysimum cheiranthoides.
32. Spice bush.	Lauris benzoin.
33. Slender chess.	Bromus tectorum.
34. Rust.	Puccinia graminis.
35. Anchusa.	Anchusa officinalis.
36. Burr.	Cynoglossum virginicum.
37. Fleabane.	Erigeron Philadelphicum.
38. Bindweed.	Convolvulus arvensis.
39. English blue grass.	Poa compressa.
40. Lucerne.	Medicago sativa.
41. Ribgrass.	Plantago lanceolata.
42. Birdrape.	Brassica.
43. Silver weed.	Potentilla anserina.
44. Moth mullein.	Verbascum blattaria.
45. Laurel.	Kalmia Augustifolia.
46. Labrador tea plant.	Ledum Latifolia.
47. Leather leaf.	Cassandra calyculata.
48. Partridge berry.	Mitchella repens.
49. Red root.	Lithospermum arvense.
50. Dock.	Rumex crispus.
51. Wild carrot.	Daucus carota.
52. Blue weed.	Echium vulgare.
53. Medick.	Medicago luplina.
54. Fringed polygala.	Polygala paneifolia.
55. Anthracnose.	Glœosporium venetum.
56. Smartweed.	Polygonum persicaria.
57. Wood sorrel.	Oxalis stricta.
58. Chess.	Bromus secalinus.
59. Wild oat.	Avenæ fatua.
60. Field sorrel.	Rumex ascetosella.
61. Sow-thistle (a).	Sonchus oleracea.
62. Pearly everlasting.	Antennaria Margaritacea.
63. Grass smut.	Ustilago hypodytes.
64. Spreading pigweed.	Amarantus paniculatus.
65. Nightshade.	Solanum nigrum.
67. Spurge.	Euphorbia hypericifolia.
68. Boneset.	Eupatorum perfoliatum.
69. Mayweed.	Maruta cotula
70. Wild cucumber.	Echinocystis lobata.
71. Willow herb.	Epilobium coloratum.

Identification of Insects in 1895.

Common Names.	Scientific Names.
1. Buffalo carpet beetle.	Anthrenus scrophulariæ.
2. Tussock moth.	Orgyia leucostigma.
3. Onion fly.	Phorbia ceparum.
4. Pear-tree slug.	Eriocampa cerasi.
5. Turnip aphis.	Aphis brassicæ.
6. Army worm.	Leucania unipuncta.
7. Abbot sphinx.	Thyreus Abbotii.
8. Joint worm.	Isosoma hordei.
9. Ladybug.	Coccinella.
10. Blister beetle.	Epicauta Pennsylvanica.
11. Mossy rose-gall.	Rhodites rosæ.
12. Croton bug.	Phyllodromia Germanica.
13. Maple borer.	Clytus speciosus.
14. Midas fly.	Midas clavatus.
15. Grape sphinx.	Darapsa myron.
16. Plum curculio.	Conotrachelus nenuphar.
17. Red ant.	Monomorium pharaonis.
18. Apple aphis.	Aphis mali.
19. Spruce sawfly.	Lyda.
20. Running spider.	Lycosa.
21. Canker worm.	Paleacrita vernata.
22. Horn fly.	Hæmatobia serrata.
23. Greap-leaf phylloxera.	Phylloxera gallaecola.
24. Celery caterpillar.	Papilio asterias.
25. Milkweed caterpillar.	Anosia plexippus.
26. Cutworm (glassy).	Hadena devastatrix.
27. Bean weevil.	Bruchus fabæ.
28. Peach-tree borer.	Sanina exitiosa.
29. Flat headed borer.	Chrysobothris fermorata.
30. Bud moth.	Tmetocera ocellana.
31. Squash bug.	Anasa tristis.
32. American tent caterpillar.	Clisiocampa Americana.
32. Ichneumon.	Thalessa lunator.
34. Leaf cutter and carpenter.	Megachile acuta.
35. Pigeon tremex.	Tremex Columba.
36. Nematode worms.	Tylenchus.
37. Fall webworm.	Hyphantria cunea.
38. Bee moth.	Gallera mellonella.
39. Grain louse.	Siphonphora avenae.
40. Pear borer.	Aegeria pyri.
41. Clover worm.	Mamestra trifolii.
42. Hessian fly.	Cecidomyia destructor.
43. Apple tree borer.	Saperda candida.
44. Ips.	Ips fasciatus.
45. White grub.	Lachnosterna fusca.
46. Oak pruner.	Elaphidion villosum.
47. Tree cricket.	Æcanthus niveus.
48. Flea beetle.	Graptodera chalybea.
49. Ichneumon.	Ichneumon flavicauda.
50. Emperor moth.	Platysamia cecropia.
51. Tachina fly.	Tachina leucaniæ.
52. Ground beetle.	Harpalus caligonsus.
53. Tomato worm.	Phlegethontius celeus.
54. Viceroy butterfly.	Basilarchia archippus.
55. Slug caterpillar.	Euclea delphinii.
56. Red humped caterpillar.	Oedemasia coccinea.
57. Luna moth.	Tropæa luna.
58. Ground beetle.	Calosoma scrutator.
59. Water beetle.	Hydrophilus triangularis.
60. Larder beetle.	Dermestes lardarius.
61. Eyed elater.	Alaus ocalutus.
62. Currant worm.	Nematus ribesii.
63. Ichneumon.	Apanteles congregatus.
64. Pelecinus.	Pelecinus polyturator.
65. Rat-tail larva.	Mallota posticata.
66. Ox-bot.	Hypoderma lineata.
67. Grasshopper mite.	Trommbidium locustarum.

The three following weeds are those about which the most information was sought:

English Plantain or Ribgrass (*Plantago Lanceolata*).

A large number of specimens of this plant were received for identification. It is often in clover seed, which no doubt accounts for its apparently wide distribution. It is readily identified from its long narrow-ribbed leaves and short spike-like cluster of flowers.

Among European seedsmen, the seed of this plant is often put in grass mixtures, and by some is claimed to be good for sheep, hence it is sometimes called sheep-grass.

It is not a grass, as it belongs to an entirely different family (*Plantaginaceæ*).

The common plantain (Plantago major) is in the same order. Ribgrass is sometimes called English plantain. It is perennial, and on this account becomes somewhat troublesome in meadows and pastures; but it is not considered very injurious in cultivated fields, as it is soon overcome by cultivation.

RIBGRASS.
(*Plantago Lanceolata.*)

It can scarcely be considered a very bad weed, and can soon be destroyed by thorough cultivation. The seed has a glistening appearance, something like flaxseed in color, and oval in shape, but much smaller. It is largely distributed in grass and clover seed, especially where such has not been properly cleaned. Where it appears to be getting possession of meadows, the best thing to do to overcome it is to break up such fields and sow them with a crop that requires considerable cultivation. Ribgrass will not survive long where thorough cultivation is followed.

SOW THISTLE (*Sonchus Arvensis.*)

Perennial Sow Thistle (*Sonchus arvensis*).

This is a weed that is beginning to attract considerable attention, and seems to be rapidly gaining a foothold in different parts of the Province.

Many specimens have been sent to the College for identification, but more this season than in any other. It belongs to the same order of plants (*Compositae*) as the common Canadian Thistle. There is an annual variety of sow thistle which this resembles; but it can be readily distinguished. Its flowers are a paler yellow, smaller and smooth below, while this bears very bright yellow flowers about the size of the dandelion, and very bristly along the flower stems and around the flower.

The bristles have a somewhat brownish color. The root is a creeping rootstock, each joint of which will grow and give rise to a new plant, much in the same way as the common thistle. The stem grows two to three feet high, with no leaves on the upper part. It is hollow and, when cut, a milky juice is seen. In young plants the leaves lie close to the ground, and smother other plants.

This plant is often seen forming masses, and presents a conspicuous appearance with its bright yellow flowers among the grain of infested fields. As the seeds are provided with a silky down, like the thistle, they are well adapted for wide distribution. Spreading by seeds and roots, if not checked it will soon become one of the most noxious weeds in our Province. Wherever it appears every effort should be made to keep it from spreading. Nothing but the most thorough cultivation and vigilance can overcome it. Although the annual sow thistle is common, it is not considered a difficult weed to overcome.

BINDWEED (*Convolvulus arvensis.*)

BINDWEED.
(*Convolvulus arvensis.*)

This creeping perennial appears to be rapidly increasing. Many specimens were received at the College during this summer. Formerly it was largely confined to gardens, but it seems to have begun to take possession of the fields. It possesses great tenacity of life, and is able to resist very adverse conditions. It is readily known by its flowers that bear a close resemblance to those of the morning glory (which belongs to the same order of plants, *Convolvulacea*), but somewhat smaller.

The stem usually twines around the objects near, or simply lies prostrate upon the ground. The leaves are somewhat triangular in outline, and narrow-shaped at the base, in some respects resembling an arrow-head. Cutting this weed from time to time seems to increase its vigor, and aids in spreading it. Although cut this season as often as leaves appeared, it still lived, but was considerably weakened.

The roots are very marked, spreading in all directions through the soil, some over two feet in length, and made up of innumerable joints, each ready to sprout under favorable conditions. It continues growing throughout the whole summer. There is no specific remedy to get rid of it. The most thorough cultivation is required to destroy it. Never allow it to develop leaves, and thus exhaust the store of food in its network of roots, which are frequently much larger than the stems above ground.

A proper rotation of crops will do much to destroy this weed, which certainly is exceedingly difficult to kill.

(*d*) INSPECTION OF LOCALITIES WHERE INJURIOUS INSECTS AND PLANTS WERE DOING MUCH DAMAGE.

This is a new feature in the work of my department, but a popular and practical one. At your suggestion I made visits to several parts of the Province and investigated the places where much injury was being done by insects, etc.

Having visited Hamilton, July 11th, at your request, to investigate the cause of a blight which had appeared upon the apple and pear trees in that district, I examined the trees in several orchards, and at once saw that they were attacked by pear blight.

On my return to Guelph I sent the following information in a letter to Mr. Grigg, of Hamilton:

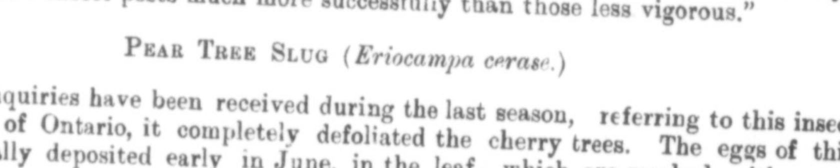
"Having examined the blighted pear and apple trees in your orchard, and several others in the vicinity, I am able to inform you of the cause of the unfortunate condition of affairs. The trouble is caused by a germ known to science as *micrococcus amylovorous.* The terms "pear blight," "twig blight," and "fire blight" are applied to this condition in fruit trees; the first to the attack upon the pear, the others when it affects apples. It also attacks the quince. This bacterial disease causes the foliage to turn to a uniform brown, sometimes in two or three days. The leaves do not fall, but remain on the branches, giving the parts affected the appearance of having been scorched by fire, hence the term "fire blight," sometimes applied to the disease. The bark of affected stems becomes brown and shrunken. The microscopic germ which causes this trouble enters the tree through the blossoms, and also through the growing tips. The injury may be confined to one or a few limbs, or it may extend to the whole tree. Slow growing trees seem less liable to injury by blight than those of rapid growth, hence the importance of a steady growth in fruit trees. After the germs gain access to the tissues of the tree they multiply rapidly and in a short time show their presence by the dark discolored bark. Unfortunately, as yet, there is no known remedy, the only way of checking the disease being to cut out affected parts, about a foot below the lowest point of injury, and burn the refuse. It is a great mistake simply to cut out the twigs, etc., and throw them aside. They are full of germs and should be burned, or they will soon scatter about and increase the trouble.

"In planting new trees it would be well to select, as far as possible, such varieties as are known to show the least tendency to attacks of this disease. Endeavor as far as possible to keep the trees in a thrifty condition, remembering that healthy trees always resist fungoid and insect pests much more successfully than those less vigorous."

Pear Tree Slug (*Eriocampa cerasæ.*)

Several enquiries have been received during the last season, referring to this insect In some parts of Ontario, it completely defoliated the cherry trees. The eggs of this insect are usually deposited early in June, in the leaf, which are marked with semi-circular incisions.

These have been made by a peculiar structure that the female has for the purpose. They soon hatch (in about two weeks), and the young slug develops, until it is about half an inch in length and has many legs. It presents an unattractive appearance, somewhat blackish, or bottle green in color, covered with slime. The front part of the body is larger than the back, which gives the slug a tadpole appearance. It has a disagreeable odor.



Pear-tree slug. 1. Insect. 2. Slug feeding on leaf. 3. Slug enlarged size.

During the larval period (four or five weeks) it feeds upon the foliage of the pear, cherry and plum.

This stage being completed, it leaves the tree and spends a portion of its existence in the ground. It emerges from the pupal stage in two weeks, a perfect insect. The imago is a glossy black insect, with four transparent wings, and dull yellow legs. The female is one-fourth of an inch long, and the male somewhat smaller. Cherry and pear trees should be examined for this slug about the middle of June, and again early in August, as another brood sometimes appears.

They are very voracious and can soon destroy the foliage of a tree. When attacked the leaves wither and look as if scorched by fire.

Remedies. 1. Spray with Paris green, 1 pound to 200 gallons of water.

2. Spray with hellebore, one ounce to two gallons of water.

3. Dust fresh air-slaked lime upon the foliage.

Pea Blight.

A letter having been received by the Agricultural Department from Mr. Wm. B. Leavens, Chisholm, regarding a blight upon the pea crop of Prince Edward County, it was forwarded to you for consideration. At your request I went, July 3rd, to investigate the trouble.

On arriving at Bloomfield, I met Mr Saylor, who was engaged in canning peas in that village. The object of my visit being stated, he kindly offered to drive me to places where the blight had appeared in pea fields. After I had interviewed several farmers upon the nature of the trouble, he drove me to Mr. Wm. B. Leaven's, farm, near Chisholm, and left me in his charge to examine fields in that neighborhood, and to gather what information I could from farmers who had given the subject considerable attention. The next day we visited several affected fields and examined their condition.

On my return I brought to Guelph specimens diseased plants, and some samples of soil for further investigation. In a few days, over 100 circulars were sent out containing a number of questions bearing upon the subject, for the purpose of getting the opinions of those most interested in this trouble. Having thus an opportunity of seeing several affected fields and discussing the subject with pea growers, altogether with the replies received in circulars returned, I set about seeking for the cause.

Affected vines fade and appear prematurely ripe, while the peas are scarcely formed in the pod. Such vines appear in patches over the field, but they soon spread and cover larger areas. Often on close examination, the plants show that they are decaying at the surface of the ground, and in some cases, the mycelial threads of a fungus can be readily seen. In some instances, only single plants appear affected, and present the usual dead, withered appearance. Such are likely the results of a cutworm's work, but, in the majority of cases, the affected spots were quite marked, and sometimes of considerable extent, increasing as time advances. This blight is not new. It has existed for several years, but lately it appears to have increased, likely because peas are now more sown throughout the county. I find there are three types of peas sown.

1. Extra early dwarfs, including the different varieties of Kent's early, Alaska, American Wonder, Nott's Excelsior and the Little Gem.

2. Medium early, largely used for canning, such as the Advance, Admiral, Everbearing, French Canner and Abundance.

3. Late peas, which form the main crop, Telephone, Black-eyed Marrowfat, Golden Vine, Stratagem and the Common White. In replies received, nearly all speak of Kent's as the worst for blighting. Some give American Wonder; very few indeed refer to the medium early as liable to attack, and none to the late. The nature of these early varieties requires to be considered in seeking the cause of blight. They are the product of man's skill, through selection and cross fertilization. He has by these means succeeded in developing a plant with small vine, and consequently little power to shade the ground in a dry time. It is a good feeder under proper conditions, growing rapidly and maturing early. In fact it is a short-lived plant with such a nature that, as soon as it begins to grow, the growth must not be retarded or the plant will die. Consequently, it cannot withstand adverse conditions, and becomes very susceptible to the influence of weather.

In some of the fields inspected the soil was so dry, hard and firm that it was difficult to get a plant out without injuring the roots. Where early peas have blighted late ones (more vigorous) have succeeded. It will seem strange to some readers to learn that it is no uncommon thing in Prince Edward county to see peas in the same field for two and even more years in succession; and it will not be a matter of surprise to hear that several replies stated that blight was worst where peas followed a crop of peas. The places most likely to be attacked first in a field are the high knolls. Soils in which clay predominates are usually the most affected. Dry seasons are generally accompanied with blight. It appears when the plants are blossoming and the pods forming; none report earlier. Even when the blight has begun it has been noticed that a good rain stops its increase. The question that naturally presents itself after reading over the data collected so far is, what is the cause?

Two fungi sometimes attack the pea, one called a mould *(Peronospora viciae)*; the other, a mildew, *(Erysiphe Martii)*. Neither of these was present on any vine examined. No examination revealed the work of an insect, and only very few persons have attributed it to an insect attack. Sometimes there is in the soil a minute nematode worm (*Tyleuchus*) that is injurious to plants. By many it is claimed to be the cause of "clover sickness." When this is present, the infested shoots show more or less deformed growth. It is about 1-24 of an inch long, and can be seen only by means of the microscope. Plants taken from infested spots were examined for this, but no nematodes could be seen; in fact, the roots in most cases presented a normal appearance, and in many instances were well supported wish root tubercles, so important to legumes in the fixation of the nitrogen of the air. I have learned from Mr. Dearness, of London, that he saw some upon a plant sent to him from another locality in the county.

But nematodes may be present in decaying parts and yet may not cause the condition of the plant that is producing the decayed material in which they are found. The absence of effects usually found upon plants attacked by these minute worms would seem to indicate that we must look for another cause of the blight. Among the roots examined were found a fungus (*Fusisporium*) which bears very characteristic spores that are readily known under the microscope by their elongated, curved and spindle-shaped forms. But this is a fungus associated with decaying matter, and its presence is more likely the result of disease than the cause. Owing to our new chemical laboratory being in course of erection this year, Prof. Shuttleworth was not in a position to make an analysis of soil submitted to him from unaffected and affected fields. However, I do not think an analysis of the soil will reveal any lack of ingredients necessary to the successful growth of the pea; but I shall keep the question before him for future consideration. From the study made so far I am strongly inclined to attribute the blight to a physical condition of the soil and to the weather during the season of growth. I was much impressed with what I saw in a field owned by Mr. Edward Purtelle, near Bloomfield. He called my attention to a strip of land extending four rods from the fence; the crop of peas was completely gone, while the remainder of the field was showing the blight only in places. This field was sowed the same day, with the same sample of seed, and yet one part was entirely lost, the other only in spots. The former was sowed on a portion worked after a rain; the latter before the rain, seeming to indicate that the wet land had not worked so well. In some trial grounds near Picton, where the plots were in splendid condition, being constantly worked and very friable, there was no blight, while but a short distance away, the blight was common in a pea field. Of course the sowing of peas after peas, for two or more years, cannot be expected to yield favorable results, and this has been illustrated in many cases throughout Prince Edward County.

Mr. Williams, near Picton, being an extensive cattle breeder, has been able to keep his land in excellent condition, and thus has escaped blight until this year, when it appeared in a field where successive crops of pease had been raised. Further investigation may reveal another cause; but, it the meantime, it appears that blight is a diseased condition of the plant, due to an adverse physical condition of the soil, a dry time, and continuing to sow the same kind of crop year after year on the same field.

In conclusion we would suggest as follows:

1. Sow the best seed, obtained from healthy plants.
2. Have the soil in the best condition for a tender plant, remembering that you are

growing a plant whose habit of growth is largely artificial, and unable to resist the least unfavorable conditions.

3. Avoid sowing peas after peas.

4. Where the blight is very bad, stop growing the tender varieties of peas for a time.

Spring Canker Worm. (*Paleacrita Vernata.*)

In the vicinity of Guelph, Galt, and some other places, the canker worm was exceedingly common and did much damage by completely defoliating the apple trees in the spring. This might have been easily prevented had the owners of the orchards known the nature of the insect and the remedy. The writer visited some orchards and saw the disastrous condition of affairs.

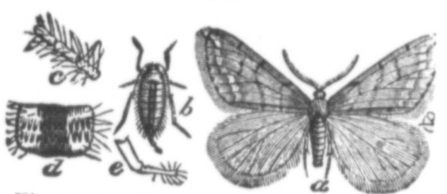


Fig. 10 A.—Canker worm. *a*, male moth; *b*, female moth.

Fig. 10 B.—Canker worm. *a*, larva, natural size; *b*, eggs natural size and enlarged.

By some it was called the fire worm, from the brown scorched-like appearance the leaves presented after an attack. Little had been done to prevent the work of this insect until the trees in many cases presented a very deplorable sight; some had resorted to spraying, and succeeded in lessening to a marked degree the destructive effects of the worm. One of the orchards examined was completely defoliated. At one place the value of spraying was well illustrated on a tree. It was the last to be treated. There was sufficient mixture in the barrel to spray only half of the tree; this retained its foliage, while the unsprayed part was defoliated.

This worm is easily controlled by the proper application of Paris green, and had the farmers been prepared to spray when the worm appeared there is no doubt that the trees would have escaped. The following description of the canker worm may prove interesting to many and useful to some in the future. There are two kinds of "canker worms," the spring canker worm, the moths of which usually appear in spring, and the fall canker worm, the moths of which appear in autumn. Both are very similar in their habits and injuries, and to the ordinary observer seem to be the same species. It was the spring canker worm that appeared here this season.

The oval eggs of this species are usually laid in masses between the leaflets of exposed buds, sometimes close to the ground on the trunk of the tree, and often under the loose scales of bark. They hatch about the time the buds unfold. The young caterpillars are referred to as "measuring worms," or "loop worms," from the peculiar way in which they crawl, arching themselves up as they progress. They feed upon the leaves, and when full grown are about an inch long, dark brown color, with light colored lines extending lengthwise along the body. This species have only four pro legs besides the six in front. Sometimes the caterpillars vary in color. They can suspend themselves from the trees by a silken thread; and when fully grown they drop to the ground by these threads and burrow into it three or four inches, where they spin a silken cocoon and enter the pupa stage.

A few moths emerge in the fall and lay eggs, but most of them appear in spring and lay their eggs then.

The females, about one-fourth of an inch in length, are wingless and of a grayish color, with the abdomen tapering to a point. Thus they are forced to crawl up the trunks of the trees when seeking places to deposit their eggs. The males have wings and are of a pale ash color. When expanded they measure about one inch across. The front wings are of a brownish gray color, while the hind are a pale ash, seldom with any dots or markings. The moths are most active at night. Canker worms are not confined to the apple, but are sometimes found upon elm, black ash, plum, and cherry trees, but seems to prefer the apple and elm.

The spring species is readily distinguished from the fall (*anisopteryx pometaria*) as follows:

The Spring Canker Worm. Eggs oval, with thin covering in irregular masses, more or less concealed; larva, 10 legs (6 true, 4 false); moths, the body bearing spines and the antennae less than 40 joints.

The Fall Canker Worm. Eggs, with tough covering, resembling a flower pot in shape, exposed on twigs, etc., or on the bark of the trunk and laid in regular rows, larva, 12 legs (6 false, 6 true); moths, the body without spines and the antennae over 50 joints.

Natural Remedies. Canker worms have many enemies, and consequently seldom continue a source of alarm for a long time. Among insects, the ichneumons, tachina flies, ground beetles, and some wasps prey upon them and destroy many. Among birds a host of foes feed upon it; the bluebird, cedar bird, vireos, song sparrow, robin, warblers, catbirds, purple finch, indigo bird, bobolink, Baltimore oriole, king bird, cuckoos, high holder, purple grackle, and some of the woodpeckers. With such an array of natural enemies it is quite evident that this insect is not likely to gain ground often, or to become a serious pest. Several years ago it appeared around Rockwood (8 miles east of Guelph), but since then my attention has not been directed to it. However, if natural enemies fail, man has now other means by which it can be controlled.

Artificial Remedies. 1. Paris green, one pound to 160 gallons of water and one pound of lime, sprayed upon infested trees will soon destroy the canker worm.

2. Painting a ring of tar or other adhesive substance around the trunk of the trees will prevent the female from ascending the tree to lay her eggs.

3. The use of "tree protectors" (funnel shaped structures which can be put around the tree) will also prevent the ascent of the females.

But by far the most simple and most effectual is the use of Paris green as given above.

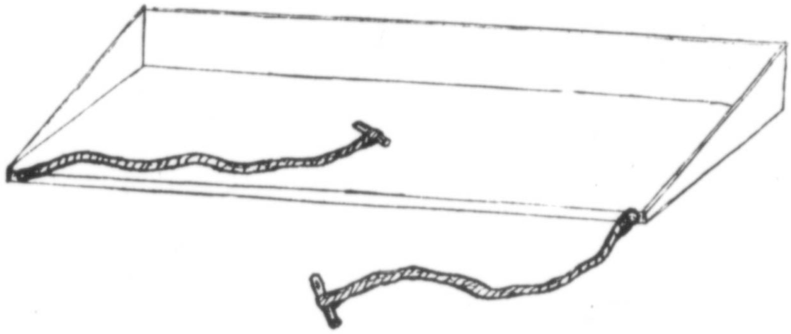
RED-LEGGED GRASSHOPPER. (*Melanoplus femur-rubrum.*)

This is the common grasshopper that sometimes does considerable injury to crops in different parts of our Province. Many inquiries were received during this summer, indicating that this insect was troublesome in a number of counties. It resembles the Rocky Mountain locust, but has much shorter wings, and is therefore not so well fitted for extended flights. These insects hibernate in the egg and hatch in the spring or later.

The eggs are laid about September, being deposited in the earth in cylindrical holes which the female bores with her abdomen; they are laid in regular masses imbedded in a sort of case formed from hardened mucus which is deposited with them. Egg-laying commences about a month after the female has acquired her wings.

As soon as this work is finished she dies. Roadsides and pastures are usually resorted to to deposit the eggs. They are not commonly laid on ground covered with much vegetation. It is seldom or never that the eggs are deposited in cultivated ground, the insect invariably preferring for this purpose the meadows and pastures, the hard and dry ground. These do not hatch till spring, when the young (nymphs) appear and pass through five moults, until they reach the mature form *(imago)* with wings. There is very little difference in form between the *nymph* and *imago* except in size and the presence of wings on the latter. Grasshoppers are greedy feeders, and, usually being in great numbers, they soon do much damage. Fortunately they have many enemies; the blister beetles *(epicauta)* in the young form feed upon their eggs; small red mites (*trombidium locustarum*) are seen attached to the bodies of mature grasshoppers just beneath the wing, where they feed upon their host.

The young of ground beetles (*Carabidae*), also aid in lessening their numbers.



ARTIFICIAL REMEDIES 1. *The Hopper Dozer.* This is made of a strip of sheet iron, 8 feet long and 1 foot wide, turned up 1 inch in front and 1 foot behind, with pieces attached to the end; the whole forming a sort of scraper-like structure. Ropes can be attached to the front corners, by means of which it may be drawn about, either by man or horse. When used, a layer of coal tar or water and coal oil is put on the bottom. So it is dragged along, the insects spring into it and are destroyed. This is most effective when they are young and unable to fly. If the conditions are favorable to use this apparatus, it is likely to be very effective in destroying great numbers of the insects. In the United States, where locusts are common, this so called "hopper dozer" has done excellent work. When the grasshoppers are very young, a piece of sheet iron smeared with coal tar will trap a great many.

Where this insect is likely to be troublesome, an early examination should be made and measures adopted while it is young.

2. *Burning.* This is done by scattering straw over the field in heaps, or windrows, in such a way that the insects may be driven upon them, and the heaps fired.

3. *Crushing.* In some cases, it is possible to use a roller effectively.

4 *Poison Mixtures.* (*a*) By weight, 1 part arsenic, 1 sugar, and 5 bran, with some water. First mix the bran and arsenic; then dissolve the sugar in water and add it to the mixture. Water is then added, to make the whole in a sort of mash. This may be spread about in such quantities as are suitable to attract the insects; (*b*) 100 pounds bran, 3 pounds Paris green and 2 quarts old molasses. Add water and mix well. This may be spread about, so as to be accessible to the insects, which eat it readily and are killed. In using poison mixtures, care must be taken not to put it where it may be eaten by stock, etc.

5. *Harrowing.* Harrowing or shallow plowing the breeding grounds of the insect is likely to destroy many of the eggs, by exposing them to the weather or enemies that feed upon them. Meadows and pastures are the places most commonly selected for the deposition of eggs.

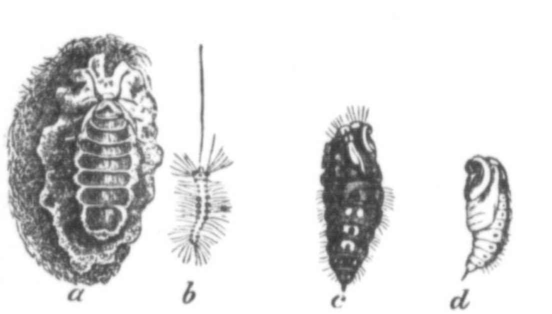
TUSSOCK MOTH. (*Orgyia Leucostigma*).

The Tussock Moth is another insect pest which attracted considerable attention during July, 1896. Though not widespread in its attack, it occupied considerable space in the newspapers.

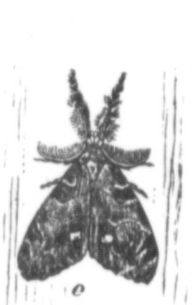
Its ravages were largely the defoliation of shade trees in the city of Toronto; but appearing at a place where several daily papers are published, it received much notice.

Although in Toronto, this caterpillar confined itself largely to an attack upon the horse-chestnut trees, yet, it feeds upon the foliage of other trees. It has been found doing much injury to the elm and apple, and also to the plum, pear, maple, oak, walnut, butternut, locust and spruce. Few, if any, trees are exempt from its attack. It made its appearance in Toronto about July 1st, and remained for about three weeks, during which time it defoliated many of the horse chestnut trees on Jarvis street and College avenue, and in some other parts of the city. The writer visited the city July 7th, and had an opportunity to investigate its ravages.

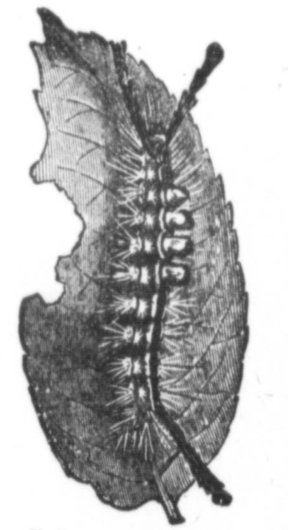
This insect is readily identified in all its stages, *egg, larva, pupa and imago.*



a.—Female (wingless) attached to cocoon.
b.—Young caterpillar suspended by silkenlike thread.
c.—The female chrysalis.
d.—The male chrysalis.



Male moth.



Fully grown larva of Tussock Moth.

The eggs appear in masses (400-700) covered with a froth-like substance that dries and hardens upon them, and serves to protect them from injury by the weather (rain), predaceous insects, and birds. This covering is very white, and thus renders the egg masses quite conspicuous at considerable distance from whare they are deposited. These masses may be found on the trunk of the trees, in crevices of the bark, on the larger limbs, or in sheltered spots, such as as on fence boards, and on bunches of dead leaves hanging upon the trees. In Toronto, the trunks of the horse-chestnut trees attacked, presented, in some cases, quite a spotted appearance, from the innumerable white masses of eggs and cocoons attached to the bark.

As soon as the eggs hatch, tiny caterpillars make their appearance (usually about June), and, as development proceeds, they pass through a series of moults (three—one a week.) After the third, the larva presents all the striking characters which make it so readily identified. The head and two spots on the ninth and tenth segments are a bright red color; the back is black, with yellow lines along the sides; the body is sparsely covered with long, pale yellow hairs, giving the caterpillar a yellowish appearance. Four cream colored dense tufts of hair form a row upon the back of the fourth, fifth, sixth and seventh segments; while, from each side of the head, a long black tuft extends forward, and a single one projects backward from the posterior end of the body.

The young caterpillars soon after hatching scatter over the trees, feeding upon the leaves; when disturbed, they drop by a silken thread to the ground and wander about, many ascending the tree again.

Having reaching full development, which occupies six weeks, during which time they have grown a little over an inch in length, they enter the pupa stage, which lasts less than two weeks. The cocoon of the male is whitish, or yellowish and very thin; and that of the female is much larger, of a grey color and firmer texture

The male chrysalis is brownish and shows rudimentary wings; the female is much larger and shows no wing sheaths.

The cocoons may be found in crevices of the bark on the trunk and large limbs, or in sheltered spots near where the caterpillars have been feeding. In Toronto, the trunks of the trees were, in some cases, almost covered with them; and very many were found beneath the window sills and on the top boards of fences.

In about a week the imago appears. The male moth is winged, and measures about 1¼ inches across the expanded wings; has feathery antennæ and very hairy front legs. The general color is ash grey; the front wings are crossed by heavy bands of darker shade, with two black markings on the outer edge, near the tip, and a white spot on the inner edge, also near the tip. The writer succeeded in getting very few of the males, but got any number of females. The female is wingless, of a pale grey color, with short antennæ, not feathered. She is scarcely able to walk. Soon after emerging from the cocoon, she begins to lay her eggs upon the old cocoon, and covers them with a frothy substance. As soon as this is done, her life work is at an end. She drops exhausted and dies. The winter is usually spent in the egg stage, when clusters of them may be seen upon the trees.

Much depends on the season, whether there will be one or two broods (a brood occupies about two months in completing its development.

Natural Remedies. Very few birds care to swallow this heavy caterpillar; the only ones that seem to feed upon it are the robin, the Baltimore oriole, and the yellow-billed cuckoo. Some bug[illegible]*ionidus crislatus*) occasionally attack it. A large number of parasites follow in its trail and do good work in checking its increase.

A great many ichneumons (*Pimpla*) developed among the cocoons brought from Toronto for further examination.

Two tachina flies also were developed in the cages. They resembled those that attack the army worm but were smaller.

Artificial Remedies. 1. Spraying with Paris green mixture (1 pound in 150 to 200 gallons of water) will destroy the caterpillars feeding upon the leaves. If there is any danger of injurying the foliage, 1 pound to 160 gallons of water, to which is added 1 pound of quicklime, may be used.

2. Gather the eggs in winter, as they are very conspicuous at that time and may be readily destroyed.

3. Bands of adhesive material may be painted around the trunk. These will prevent the caterpillars from ascending the tree.

This caterpillar, though capable of doing much injury, is not considered to be a difficult one to control. Spraying, as above, is very effective, and this followed by collecting and destroying egg masses when the leave have fallen, cannot fail to be successful. In the case of the attack in Toronto, active measures were not adopted until the caterpillars had almost completed development, and were about to enter the pupa condition.

Energetic efforts were then put forth to destroy the innumerable cocoons that were soon visible. No doubt thousands of egg-masses were destroyed upon the trunks of the trees in the work of rubbing the bark with a coarse brush. At first a band of adhesive material was painted on the trunks and thus many caterpillars were prevented reascending the trees; but, as soon as cocoons were discovered this method was abandoned, and that of destroying the cocoons followed. It will be well for those interested to be on the watch the coming season, and, if caterpillars appear at once resort to spraying. During the winter all egg masses should be destroyed as far as possible.

CONCLUSION.

In closing this report, I wish to bear testimony to the valuable assistance given me by M. Doherty, B.S.A., while acting as assistant, and to that of W. McCallum, B.S.A., whose patience and accuracy in details have enabled me to place on record much interesting informatian regarding the attack of the army worm during July of 1896; and also to express my thanks to yourself and the Minister of Agriculture for the liberality manifested in assisting me to make the department over which I preside more and more useful to the public.

Respectfully submitted,

J. HOYES PANTON,
Professor of Biology and Geology

GUELPH, December 31, 1896.

PART IV.

REPORT OF

THE PROFESSOR OF CHEMISTRY.

To the President of the Ontario Agricultural College:

SIR,—The experience in this department during the past year has been exceptional. The chemical building, erected in 1887, was destroyed by fire between four and five o'clock on Friday morning of February the 28th, and it is to me a regrettable fact that we have not been able to obtain the slightest clew as to the cause of the fire.

Immediately after the fire steps were taken towards the erection of a new building, which was practically completed and ready for occupation early in December.

It is quite unnecessary to dwell upon the seriousness of the interruption to the work in this department caused by the sudden loss of one building and the hasty erection of another. This interruption, occurring as it did in the very middle of the session, produced a condition of affairs which was serious and perplexing. One of the worst results was that four members of the graduating class, honor men in chemistry and physics, who required every moment of their time to accomplish the prescribed work, were left without a laboratory.

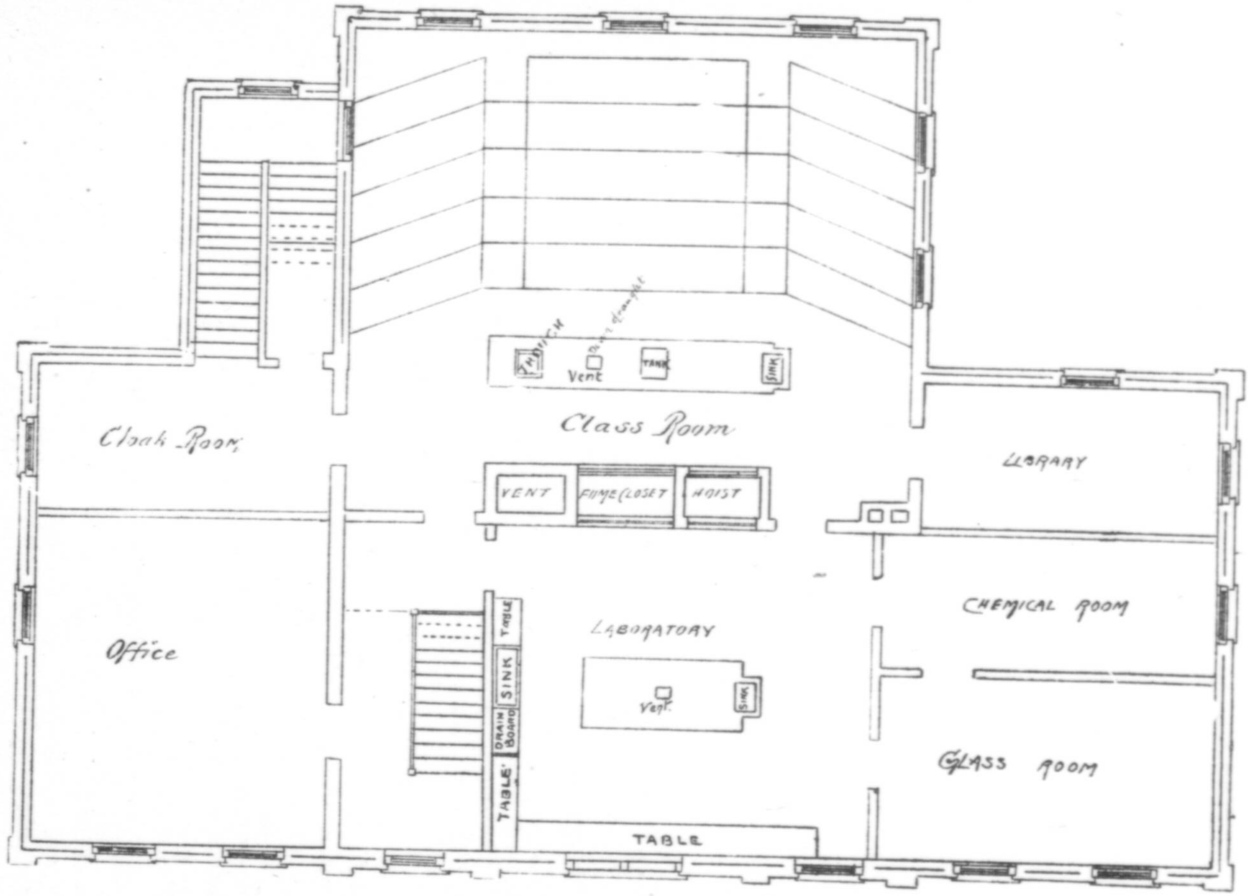
For the very prompt and earnest manner in which you came to our assistance, I respectfully beg to convey to you my sincere thanks. Temporary quarters and fittings to proceed with the work you promptly provided.

INSUFFICIENT ACCOMMODATION IN THE OLD BUILDING.

Through the gradual introduction of modern educational methods, in which students do more laboratory work, the accommodation afforded by the old laboratory became quite inadequate; consequently you were advised to consider the question of fitting up the basement of the old building as a laboratory for first and second year students. As we were situated, you were inclined to view favorably this proposal. Estimates for the work were submitted, and the necessary amount granted; and the work of altering the basement was about to begin when the fire occurred.

THE NEW CHEMICAL BUILDING.

The new chemical building, which is practically completed, and of which the plans of the ground and first floors are given, surpasses in workmanship, comfort, and convenience of arrangement, my highest expectations. It contains, as the plans shew, three large laboratories, two of which are for students' use and one, the station laboratory, for assistant chemists. In the latter the analyses belonging to investigations and experimental study are conducted. The advantage of having the laboratory for these lines of work distinctly separated from those occupied by students is very great. The building contains, in addition, a large well-lighted class-room, a well furnished preparation-room, glass and chemical rooms, the necessary balance and blast rooms, and two good offices. In a word, the building is complete.

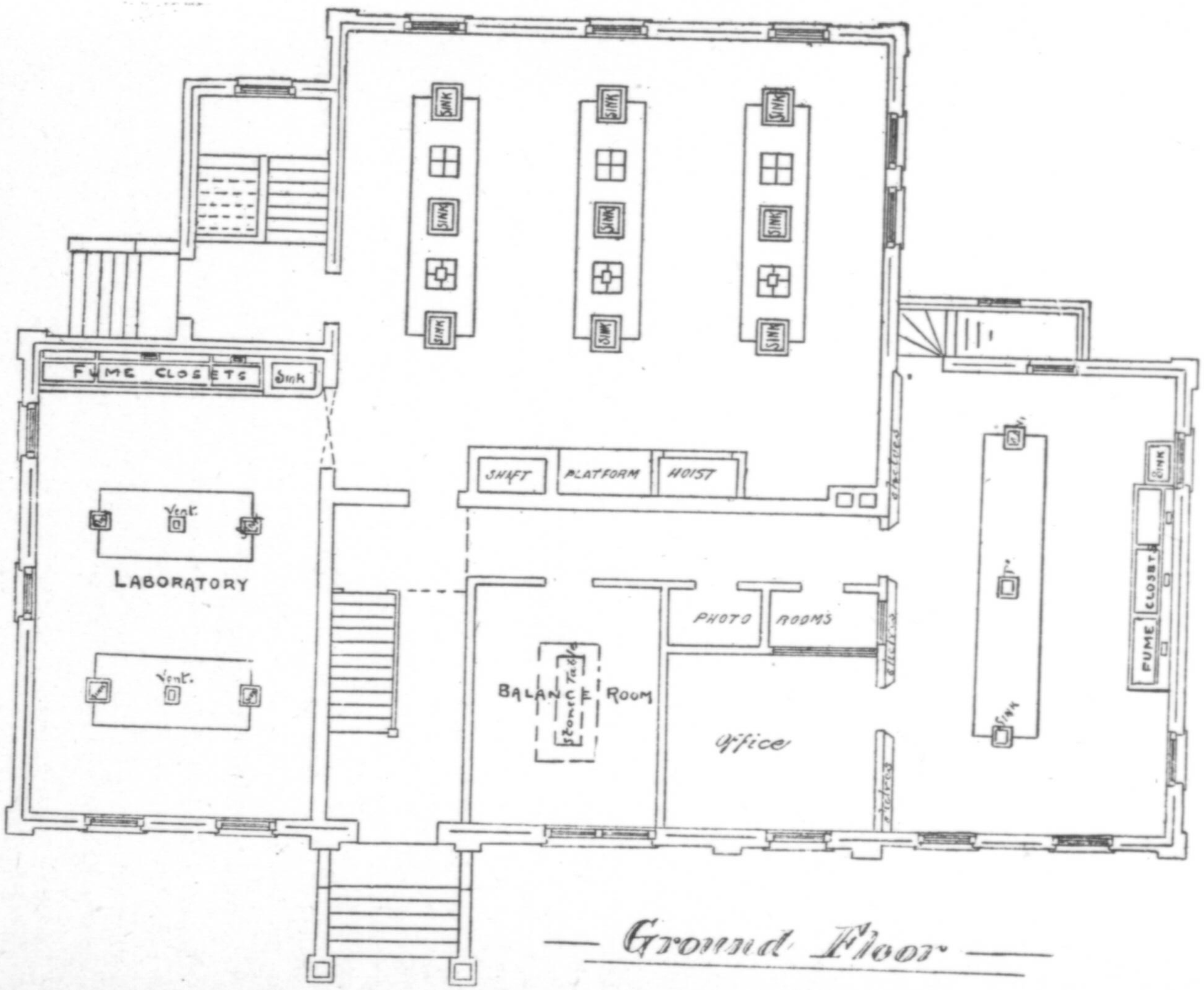


First Floor

NEW CHEMICAL LABORATORY—ONTARIO AGRICULTURAL COLLEGE, GUELPH.

First Floor

NEW CHEMICAL LABORATORY—ONTARIO AGRICULTURAL COLLEGE, GUELPH.



Ground Floor

NEW CHEMICAL LABORATORY—ONTARIO AGRICULTURAL COLLEGE, GUELPH.

Composition of Ashes of Different Woods.

A great deal has been written in recent years about ashes as a fertilizer. Their use in the garden, on the farm, and in the orchard is a matter of importance to the gardener, the farmer, and the orchardist. This is owing partly to a growing desire to increase the yield and to improve the quality of produce, but chiefly because of the lack of the essential constituents to plant growth in long cultivated soils.

Potash, phosphoric acid, lime, magnesia, iron, etc., in various forms of combination, are essential plant food substances, taken by the plant through its roots from the soil. Potash and phosphoric acid, particularly in average cultivated Ontario soils, are by no means too abundant. Our soils, particularly for the growth of certain crops, are beginning to require potash and phosphoric acid, and these are contained in available forms in wood ashes. Hence the value of good ashes as a fertilizer.

Very large quantities of wood ashes are annually exported from the Dominion. The amounts, however, which have been exported since 1890 are considerably less than between 1885 and 1890. During the fiscal years, 1885 to 1895 inclusive, 31,251 bushels of unleached wood ashes have been exported from Canada. This quantity represents a large amount of potash and phosphoric acid taken from soils which need them badly.

The subject of wood ashes and their use on the farm is one which demands careful study and publicity. As a beginning, analyses of the ash of many varieties of Canadian woods and several fruits have been made in our laboratory during the past year. The table gives the analyses of five samples of mixed wood ashes, Nos. 4 and 5 of which were sent to us by an ash exporter, and Nos. 1, 2, and 3 by three fruit farmers who had purchased them in large lots for application on their farms. The samples under "American Analyses of Canadian ashes" are from lots exported from Canada into the United States. The analyses of these samples were made at the Connecticut Agricultural Experiment Station, New Haven, Conn. It appears that the samples were analysed as received, and the results not reduced to a uniform, or anhydrous, basis.

The samples of the ash of woods and small fruits were obtained by carefully reducing the whole or portion of the tree or bush to a comparatively white, anhydrous ash, which was tightly bottled and labelled for analysis. Each sample, therefore, was true to representation. The figures here given express the percentages of the various constituents contained in the dry ash.

Samples 1 to 5 inclusive, were taken just as received from the persons who sent them, and the figures here given are calculated to the dry or anhydrous ash.

The sampling for the American analyses of the Canada ashes was as follows:

No. 3360, carelessly taken by a hired man from a pile supposed to be made entirely from elm wood;

No. 3362, said to be taken from a boat load by the Canadian dealer and sent to the American purchaser, who forwarded the same to New Haven;

No. 3367, taken by the American purchaser from a lot of 15½ tons collected and sold in Ontario;

No. 3368, collected from a car load of Canada ashes by the American purchaser;

No. 3378, very carefully taken by the purchaser from the same lot as No. 3362, but a few days later, after they had arrived in the States;

No. 3384, taken by the Canadian dealer himself from the remaining ashes of the pile from which 15½ tons were shipped from Ontario and from which the American purchaser, upon the arrival of the shipment, drew sample 3367.

Analyses of the Ashes of Canadian Woods and Small Fruits, and of Commercial Wood Ashes.

Varieties.	Potash.	Soda.	Phosphoric acid.	Lime.	Magnesia.	Oxide of iron.	Sulphuric acid.
Blackberry, the canes of	10.34	....	7.26	35.14	....	....	1.24
Strawberry, the whole plant of	15.90	....	9.17	17.44	....	....	4.58
Gooseberry, the branches of the	13.07	.49	6.99	20.64	2.61	1.08	2.01
Raspberry, the canes of	7.90	.81	6.54	23.08	8.54	1.19	2.60
Grape-vine, the whole	8.33	....	3.376	26.74	....	....	1.39
Maple, hard, the trunk of large tree of	9.31	....	2.03	45.24	....	....	1.14
Maple, soft, "	9.52	....	1.29	41.97	5.38	.12	1.39
Ash, black, "	25.30	4.22	1.20	49.04	7.42	.22	.71
Hemlock, "	8.73	3.88	2.76	45.83	4.78	.36	.98
Pine, "	11.22	8.44	4.03	20.28	6.53	1.52	5.85
Cedar, "	3.30	3.08	.98	49.06	2.49	.70	.77
Ironwood, "	8.15	4.95	1.71	42.61	5.63	.50	.79
Oak, "	9.39	2.88	1.69	43 54	4.39	.25	.91
Birch, "	8.58	1.47	1.81	37.10	5.65	.39	1.90
Elm, "	35.37	Traces	.45	23.64	6.48	.19	Traces
Beech, "	7.58	4.09	1.39	41.21	6.16	.30	Traces
Spruce, an entire small tree of	8·98	.15	4.00	25.82	4.04	1.52	2.61
Willow, the trunk of large tree of	9.59	1.51	2.16	35.55	3.21	.55	2.38
Apple, the entire tree of	4.84	4.02	1.81	44.93	3.28	.70	.41
Ash, white, the trunk of large tree of	16.88	12.90	.93	37.14	3.98	.32	.67
Balsam, "	17.53	1.54	2.39	22.63	4.04	1.08	.88
Basswood, "	9.39	.10	5.28	33.42	4.28	.44	Traces
Poplar, "	10.42	1.76	2.98	28.38	4.54	.36	Traces
No. 1	5.53	....	1.34	....	....	....	....
" 2	4.55	....	3.57	....	....	....	....
" 3	5.14	....	1.32	36.45	....	....	....
" 4	4.98	....	1.45	33.39	....	....	....
" 5	13.40	....	1.18	28.73	3.64	1.43	1.67
American analyses of Canada ashes.							
No. 3360	14.49	....	1.13	35.39	....	....	....
" 3362	11.14	....	1.27	....	....	....	....
" 3367	3.19	....	1.06	37.24	....	....	....
" 3368	4.10	....	1.44	32.20	....	....	....
" 3378	5.01	....	1.50	28.84	....	....	....
" 3384	4.00	....	1.53	47.73	....	....	....

The percentage of potash is exceptionally high in the ash of the strawberry plant and in the wood of the black ash, elm, white ash, and balsam; but low in the ash of the wood of the apple and cedar. It is interesting to note the high percentages of potash in the commercial ashes Nos. 5, 3360, and 3362, each of which was sampled by the dealer, who, being the seller, is interested in a high percentage of potash. It is also important to compare the potash in Nos. 3360 and 3368, the former being the seller's and the latter the purchaser's sampling of what is represented as the same lot of ashes.

In the ash of the small fruits, the percentage of potash is much higher than in the ash of woods. In most samples of commercial ashes, the percentage of phosphoric acid varies between 1 and 2. Lime is by far the most abundant constituent in all wood ashes; and because of this large amount of lime and potash—constituents which liberate nitrogen as free ammonia from ammonia salts—ashes should not be mixed with stable manure.

It is the intention of this department in a future publication to deal exhaustively with the subject of wood ashes and their use on the farm and in the garden. In the meantime, analyses of all authenticated and properly collected samples of wood ashes received in this department will be made. An invitation to all dealers, farmers, gardeners, and others interested in wood or other ashes, is given to send samples for analysis.

THE SAMPLING OF ASHES.

Considering the work and expense incurred in making a quantitative analysis of ashes, and that it is made in the general interest rather than for an individual, the one who prepares the sample should do his work very carefully. If the sampling is not accurately done, the analysis, however accurate, cannot correctly represent the composition of the lot from which the sample was taken. Careful sampling is as important as correct analysis. The potash and several other constituents of ashes are soluble in water; consequently rain falling upon a pile will wash these soluble substances down into the pile. The surface, therefore, of such a pile would contain leached ashes; but the centre or lower layers may contain considerably more potash than the average of the whole pile. But upon the ashes drying by evaporation, the soluble substances will be collected as an incrustation at the surface. It is, therefore, not easy to get a perfectly fair sample from a pile or car load. In taking a sample for analysis from a car load, throw a shovelful at regular intervals into a tight barrel, aiming to fill the barrel by the time the car is unloaded. When the car is empty, pour the ashes from this barrel upon the floor, mix thoroughly, and gather a peck in small portions from all parts of this mixed pile. Box securely and send at once to the chemical laboratory. In taking samples from large piles of ashes, dig several holes, not less than ten inches in diameter, from the upper surface of the pile through to the bottom. Throw the contents of each into a tight barrel or box, in which they can be carried to a clean floor and thoroughly mixed and boxed as described above.

FOOD AND MILK PRODUCTION.

Common observation on the farm has led to the general opinion among farmers that the composition of milk is affected by food. Yet scientific investigations have not shown that food changes the percentage composition of milk. Food undoubtedly affects the flavour, color, etc., of milk, but the opinion is pretty generally held by experimenters who have investigated food and milk production, that food influences the yield, but not the composition of milk. Yet so eminent an investigator as Dr. Gilbert, of Rothamsted, England, says "it may be taken as clearly indicated that within certain limits, high feeding, and especially high nitrogenous feeding, does increase both the yield and the richness of the milk." It is not surprising that opinions upon the question are a little conflicting. Numerous circumstances, such as the character of the individual animal, the period of lactation, etc., largely influence results in experiments on milk production. Is the butter fat of milk derived largely from the albuminoids of the food? Is the fat of milk formed in the same way as the fat of fattening animals? What are the functions of the carbohydrates in milk production? These and others are important but unsettled questions. Much has been done, but much is yet to do before the best and most economical method of feeding for the production of milk can be stated with confidence.

FOOD AFFECTS THE YIELD OF MILK.

On the 18th day of February last, two fresh cows, one a pure Ayrshire and the other a pure Holstein, were set apart, for the purpose of observing the effects of two opposite rations on the yield and the composition of milk. The one ration consisted of oat straw, chopped oats and sliced turnips, the other consisted of hay, chopped oats, chopped pease, bran, oilcake, and turnips. The former ration is composed chiefly of carbohydrates, but is very poor in protein; and the latter is abundantly rich in protein as well as in the other nutrients. Each ration was supplied to the respective cows in as large quantities as they would consume.

The experiment, however, was only nicely begun when it was interrupted by the loss of our chemical laboratory. It was not until the 1st of April that temporary quarters was provided, and the experiment begun again. During this interval of about forty-two days, the cows were kept upon their respective rations. The Ayrshire, receiving the poor ration, failed considerably in weight, while the Holstein, receiving the rich ration, increased in weight.

The time of the experiment, beginning on April the 2nd and closing on July the 21st, both days inclusive, was divided into five periods. Each of the periods, fourth and fifth, lasted twenty-one days; the other three were fourteen days each. To bring the animals into condition with the new rations, eight days between the first and second periods, twelve days between the second and third periods, and seven days between the third and fourth, were allowed. The Ayrshire, as above stated, was put upon the poor ration and the Holstein upon the rich ration. At the close of the first period, during the first and second days of the transition period the rations were gradually changed. During the second period, the Ayrshires received the rich and the Holstein the poor ration. This period was followed by a similar gradual change of rations; so that, during the third period, the cows were fed again as they had been during the first. Both cows, on the 3rd day of June, were turned on pasture, where they remained during the remainder of the experiment. It only remains to be added that, in the fifth period, both night and morning, when the cows were brought to the stable to be milked, the Ayrshire was given a little oilcake and chopped peas, amounting practically to two pounds of each per day, and the Holstein a little hay.

Experimental periods.		Fodders Consumed.	Animals weighed at		Yield of milk in lbs., during			Average daily yield of milk.
			Beginning of period.	End of period.	First week.	Second week.	Third week.	
First period, April 2 to April 15.	Ayrshire	Oat straw, chopped oats, sliced turnips.	....	855	89.50	96.00	....	13.25
	Ho'stein	Hay, oats, peas, bran, oilcake and turnips.	....	1,067	215.00	210.00	....	30.36
Second period, April 24 to May 7.	Aryshire	Hay, oats, etc..	842	....	174.75	182.00	....	25.48
	Holstein	Straw, oats, etc.	1,040	....	152.75	131 50	....	20.30
Third period, May 20 to June 2.	Aryshire	Straw, oats, etc.	807	866	109.75	100 24	....	15.00
	Holstein	Hay, oats, etc..	977	1,000	181.25	196.50	....	26.98
Fourth period, June 10 to June 30.	Aryshire	Pasture.	....	....	165.75	149.75	162.80	22.80
	Holstein.	Pasture.	....	....	188.00	157.25	176.50	24.84
Fifth period, July 1 to July 21.	Aryshire	Pasture, peas and oilcake.	925	920	145.00	152.50	149.00	21.26
	Holstein	Pasture and hay.	1,040	1,028	168.00	156.50	139.25	22.08

The Ayrshire cow, on February 18th, weighed 944 pounds; her weight was again taken at the close of the first period. These weights show that the cow on the ration of straw, oats and turnips, was greatly reduced in weight. Her average daily yield of milk, 13.25 pounds, was very much less than her normal flow when she was properly fed.

While it could not correctly be said of our best farmers, nevertheless it is true that there are many who, during winter and spring months, feed their cows much as this Ayrshire cow was fed during the first and third period, and as the Holstein was fed during the second period. A glance at the condition of such cows and at their reduced yield of milk, is sufficient to convince anyone that something is seriously wrong.

The last column shows for the Ayshire in the second period, when she was abundantly fed, an average daily yield of 25.48 pounds of milk, being twelve pounds more than in the first, and ten pounds more than in the third periods, when she received insufficient nourishment. The average daily yield of milk by the Holstein in the second period, when she was insufficiently nourished, is 20.30 pounds, being about ten pounds less than in the first and nearly seven pounds less than in the third period, when she was abundantly fed.

It is, therefore, manifest that the ration of straw, oats and turnips, diminished considerably the yield of milk and that the ration of hay, oats, peas, bran oilcake and turnips, considerably increased it.

In the fourth and fifth periods, each cow yielded practically the same quantities of milk; and the addition of peas and oilcake to the Ayrshire's ration of grass did not increase her yield over that of the Holstein.

In the following table, attention is called to the weights of food eaten by each cow, and to the constituents consumed per 1,000 pounds of live weight.

Experimental periods.	Number of days in periods.	Pounds of food actually consumed by animals.	Total dry substances per 1,000 lbs. live weight.	Pounds digestible substances per 1,000 live weight. Nitrogeneous substances.	Non-nitrogeneous substances, as starch, etc.	Albuminoid ratio.	—
Ayrshire— First	14	Straw 238 lbs. Oats, 24½ " Turnips, 476 "	21.50	1.36	11.70		cts. 6.85
Second	14	Hay, 198 " Oats, 40 " Peas, 40 " Bran, 40 " Oilcake, 13¼ " Turnips, 264 "	25.96	4.34	19.92	1 : 4.5	17.33
Third	14	Straw, 238 " Oats, 24½ " Turnips, 476 "	22.65	1.45	12.40	1 : 8 6	6.83
Holstein— First	14	Hay, 280 " Oats, 56 " Peas, 56 " Bran, 56 " Oilcake, 19½ " Turnips, 368 "	28.86	4.84	17.87	1 : 3.6	24.42
Second	14	Straw, 250 " Oats, 25½ " Turnips, 500 "	19.12	1.22	10.47	1 : 8.5	7.17
Third	14	Hay, 210 " Oats, 42 " Peas, 42 " Bran, 42 " Oilcake, 14 " Turnips, 280 "	23.02	3.80	16.11	1 : 4.2	18.30
Per 1,000 pounds live weight: Wolff			24	2.5	13.42	1 : 5.4	11.62

If Wolff's feeding standard for milk cows, given at the bottom of the above table be taken for comparison, it appears that the Ayrshire cow received, during the first and third periods, too little dry, only about half enough nitrogenous, and not quite enough non-nitrogenous substance; but for the same periods, the Holstein received, in one case, too much dry, more than a third too much nitrogenous, and considerably too much non-nitrogenous substance. Reference to the table giving average daily yield of milk, shows that during these periods the Ayrshire's yield fell off greatly, and the Holstein's increased greatly. The Holstein also increased in live weight considerably, while the Ayrshire in one case decreased. Using the same comparison in the second period, when the Ayrshire received considerably too much of all the constituents and the Holstein considerably too little, we find that the Ayrshire's yield is increased about as much as the Holstein's is diminished.

These facts clearly indicate, so far, at least, as yield of milk from these two cows is concerned, that a feeding standard much below Wolff's is not a good one.

The richer ration is unnecessarily expensive, and the increase in yield is not sufficient to justify the increase in expense. In fact, the figures in the last column show that the increase in the expense of the ration, within certain limits, keeps pace with the increase in the yield. But the object of the experiment, which is to show the effect of food on yield and composition of milk, must be remembered.

The daily cost of the rations per 1,000 pounds live weight is based upon the following prices:

Hay	$10 00	per ton
Straw	2 00	"
Roots	2 00	"
Bran	12 00	"
Oilcake	20 00	"

Oats and peas, each one cent per pound.

The following ration corresponds very closely to Wolff's standard for milk cows:

Hay	10	pounds
Straw	12.85	"
Turnips	20	"
Bran	2	"
Oats	2.14	"

The cost of this, based on the same valuations, is 11.62 cents per day.

This ration, no doubt, would have produced as large a yield of milk of as good a quality as the rations costing seventeen, eighteen or twenty-four cents per 1,000 live weight per day. But the richer ration was purposely given to test the effect of feeding an abundance of protein.

Composition of Milk not Affected by Food.

During the progress of this experiment on "Food and Milk Production," chemical analysis of the milk from each cow was made. Unfortunately, owing to the loss of the chemical building and the cramped condition of the temporary quarters, the milk of every day could not be analysed. Had that been done the results thus obtained, would have had greater weight than these based on only a certain number of the milkings. The figures in the second column of the following table of milk composition, give the number of milkings analysed for each cow during each period. However, being taken as they were on alternate days, the sampling was distributed well over the entire time of each period.

COMPOSITION OF THE MILK OF TWO COWS, THE ONE RECEIVING A RATION RICH IN PROTEIN; THE OTHER A RATION POOR IN PROTEIN.

Periods.	Milkings analysed during periods.	Average composition of milk.					Rations.
		Total Solids.	Solids not fat.	Fat.	Casein.	Ratio.	
Ayrshire—							
First	6	....	....	4.1	2.44	.59	Poor.
Second	5	12 77	8.7	4.0	2.66	.66	Rich.
Third	11	12.66	8.7	3.88	2.59	.60	Poor.
Fourth	36	12 71	8.9	3.81	3.01	.79	Pasture.
Fifth	36	12.65	8.6	4.08	2.82	.69	Pasture, and 0.9 lb. of digestible protein daily.
Holstein—							
First	9	....	....	3.42	2.10	.61	Rich.
Second	5	11.29	8 10	3.19	1 82	.57	Poor.
Third	11	11.32	8.21	3.11	2.10	.67	Rich.
Fourth	31	11 36	8.33	3.03	2 05	.67	Pasture.
Fifth	36	10.91	7.80	3.11	2.01	.64	Pasture, and a pick of hay daily.

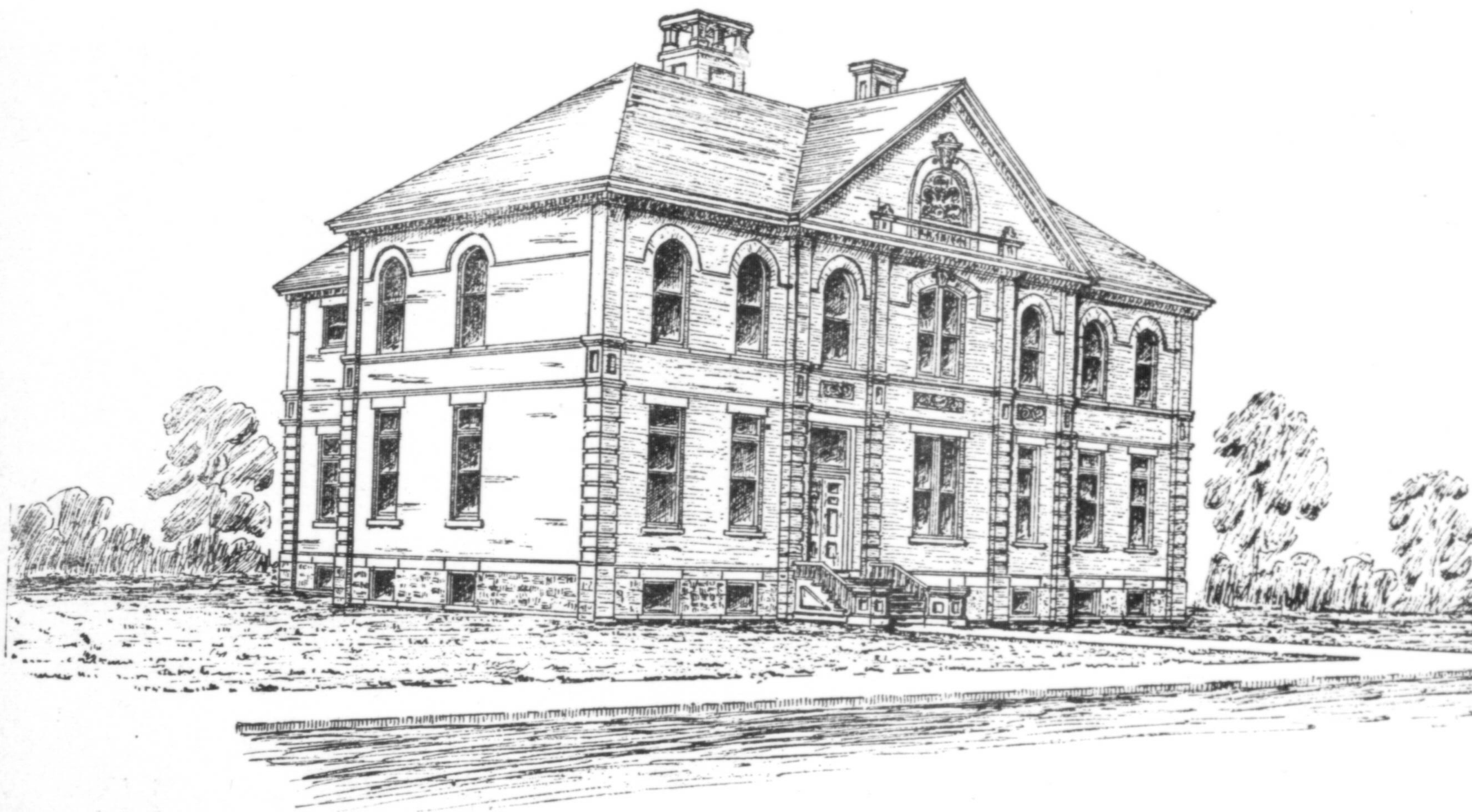
In the previous table the ration, the constituents consumed, and the cost of each ration per day and per 1,000 lbs. live weight, during each period are given.

In the above table the determination of fat in the milk of each cow during the first periods were made by the use of the Babcock tester; all other determinations were made by chemical analysis. While fat determinations by the Babcock tester compare with one another practically as accurately as fat determination by chemical analysis do, the determinations of the former compared with those of the latter are about two-tenths of a percentage too high.

The variations in the percentages of the constituents of the same cow's milk during the several periods, are so little that they come, in nearly every instance, within the limit of experimental error. The food, therefore, has had, apparently, no effect on the composition of the milk.

PRACTICAL POINTS FOR FARMERS AND DAIRYMEN.

1. Do not feed by guess or at random.
2. A cheap, poor ration may not be an economical one.
3. A ration may be too rich, and therefore too expensive.
4. One ration used in this experiment is evidently a poor one, containing insufficient nourishment; the other is evidently too rich and expensive.
5. Wolff's feeding standard is a safe guide.
6. A daily ration of hay, 10 lbs.; straw, 12.85 lbs.; turnips, 20 lbs.; bran, 2 lbs., and oats, 2.14 lbs. per 1,000 lbs. live weight costs at the prices previously quoted, 11 62 cents, and contains, according to Wolff's standard, sufficient nourishment for a milk cow.



New Chemical Laboratory—Ontario Agricultural College, Guelph.

THE COMPOSITION OF HAY AS AFFECTED BY MATURITY.

All vegetable foods are more or less affected in their composition by several conditions, viz: maturity, soil, climate, etc.

Digestibility, and consequently the nutritive value of fodders, is also affected by several conditions, but chiefly by maturity. Warrington in his valuable book, "Chemistry of the Farm," says: "The diminution in digestibility with the increasing maturity of the grass is very striking and is very eqally spread over all the constituents." To illustrate this fact he gives in the following table the digestion of hay by sheep:

Date of Cutting	Proportion of each constituent digested for 100 supplied.				
	Total organic matter.	Nitrogenous substance.	Fat.	Soluble carbohydrates.	Fibre.
May 14th	75.8	73.3	65.4	75.7	79.5
June 9th	64.3	72.1	51.6	61.9	65 7
June 26th	57.5	55.5	43.2	55.7	61.1

The study of these figures impresses one with the great importance of cutting the grasses and clovers at the time when they have reached a certain degree of maturity.

To obtain something definite regarding the time when the most profitable degree of maturity is reached, six plots, each one rod square, were set apart in our experimental grounds in 1895. Three were seeded down with common red clover and three with timothy. All the circumstances were favorable for the production of even and uniform crops. Each of the three plots of clover and of the three plots of timothy was cut on a different date, so that each cutting of clover and of timothy represents a distinct stage in the maturity of the respective crops. The produce of every plot immediately after being cut was weighed and cured as hay in the usual way, but without exposing to rain or dews. This cured hay was then again weighed, and a sample taken for chemical analysis. In four instances (two of clover and two of timothy) the hay, after sampling, was again spread on the ground to expose it to the rain and dew, after which it was cured and sampled for a second analysis, to see the effect of rain on its composition.

POUNDS OF DRY MATTER PER ACRE AT THE TIME OF CUTTING.

Dates of cutting.		Pounds of dry matter per acre.
Clover	June 1st	2948.34
	" 14th	4440.67
	July 7th	6439.36
Timothy	June 15th	5460.76
	July 7th	9114 91
	" 23rd	8537.96

The clover, at the time of first cutting, on June 1st, when the first blossoms were just appearing, stood thirteen inches high. By the time the second plot of clover was cut, on the 14th of June, about one-third of the total number of heads or blossoms had turned brown, when the average height had reached eighteen inches. On July 7th, when the last plot was cut and when the clover had reached an average height of thirty-eight inches, the majority of the heads were considerably browned.

The timothy on June 15th, when the heads were just beginning to appear, stood twenty-six inches high. On July 7th, the date of cutting the second plot, the first blossom had just fallen, and the average height was thirty-six inches. On the 23rd of July, when the last plot was cut, and when the crop still measured thirty-six inches, the second blossom had fallen.

The figures of the above table show considerable growth in the clover after the 14th of June, and in the timothy previous to but not after the 7th of July.

Although after a certain stage in the maturity of the crop growth continues, the deterioration in composition and the decrease in digestibility more than counterbalance the value of the increased yield in dry matter.

Composition of Hay Harvested at Different Dates.

Dates of cutting.	In fresh material.							Calculated to water-free substance.					
	Water.	Ash.	Crude protein.	Crude fibre.	Nitrogen-free extract.	Crude fat.	Amides.	Ash.	Crude protein.	Crude fibre.	Nitrogen-free extract.	Crude fat.	Amides.
	Cured without exposure to rain.												
Clover.													
June 1st	78.32	2.09	3.87	4.46	9.45	1.20	.57	9.66	17.88	20.58	43.62	5.57	2 66
" 14th	76.55	2 03	3.14	6.01	9.97	1.30	.95	8.69	13.42	25.66	42.55	5.58	4.07
July 7th	73.34	2.42	2.64	8.31	11.10	1.47	.46	9.11	9.93	31.23	42.04	5.53	2 13
Timothy.													
June 15th ..	75.26	1.92	1.00	7.75	11.51	1.16	.33	7.80	7.97	*31.36	*46 56	4.73	1.34
July 7th ..	64.61	2.27	1.79	11.67	18 08	1.41	.12	6.43	5 08	32.99	51.12	4.01	.34
" 23rd ..	57.64	3.16	2.11	14.24	21.42	1.14	.15	7.48	5.00	33.63	50.58	2.93	.36
	Exposed to rain.												
Clover.													
June 14th ..	.....	.....	.....	.....	.....	.....	.....	10.04	15.50	25.88	41.48	5.09	1.97
July 7th ..	.....	.....	.....	.....	.....	.....	.....	7.85	10.89	31.86	43.00	5 54	1.83
Timothy.													
June 15th ..	.....	.....	.....	.....	.....	.....	.....	8.01	7.49	33.61	45.42	4.15	1.28
July 7th ..	.....	.....	.....	.....	.....	.....	...	5.99	4.91	34.32	50.99	3.23	.54

* One analysis.

Definitions. *Ash* is the part of the fodder which remains unconsumed by burning to whiteness at the lowest possible red heat. *Crude Protein* is the muscle formers collectively. *Crude Fat* is a mixture of oils, wax, coloring matters, etc.; linseed oil is a common example. *Crude Fibre* is the woody portion of fodder. *Nitrogen-free Extract* is a mixture of substances commonly called carbohydrates; starch and sugar are examples. *Nutrient* is any substance that nourishes. Fat, protein, starch, etc., are nutrients.

The above table of composition shews clearly a decrease in the percentage of water, and therefore in the succulency of the material as maturity advances. Crude protein, like water, decreases considerably with maturity; but fibre, unlike water and protein, increases. It is an experimental fact, that a decrease in the percentage of protein and in the digestibility of the protein accompany each other; and it is also well known that an increase in the percentage of fibre diminishes the digestibility of all the constituents of a fodder.

A comparison of the percentage composition of the water-free substance of the clover and timothy exposed to rain with that of the respective cuttings not exposed to rain, shows that rain acts chiefly on the nitrogen-free extracts and the amides, which to some extent are washed out. The explanation of this effect of rain and heavy dews on cured hay is, that sugar (a constituent of the nitrogen-free extract) and amides are soluble in water.

PRACTICAL POINTS FOR FARMERS.

1. Grasses deteriorate as they mature.

2. Their digestibility decreases with maturity.

3. A given weight of the dry substance of clover cut on June 1st, for example, is more nutritious, *i.e.*, has a higher feeding value than an equal weight of the same crop cut on the 14th of June or on the 7th of July.

4. This is true of timothy also and of other green fodders.

5. Cut hay at the time when the acre will yield the maximum quantity of digestible matter.

6. This will be for clover, about the time a sprinkling of brown blossoms or heads appear over the field; and for timothy, soon after the first blossom falls.

7. Cure hay, if possible, without exposing to rain.

In conclusion, I beg to express to you my sincere appreciation of the valuable service rendered to this department by our assistant chemist, Mr. Robert Harcourt, B.S.A., by whom a large proportion of the analyses of the year have been made. To Mr. W. A. Kennedy, B.S.A., another of our graduates, credit is also due for a portion of the analyses of the year.

Respectfully submitted,

A. E. SHUTTLEWORTH.

January 1st, 1897.

PART V.

REPORT OF THE

PROFESSOR OF VETERINARY SCIENCE.

To the President of the Ontario Agricultural College :

SIR,—I beg to submit to you my annual report for the year 1896.

WORK IN THE CLASS-ROOM.

First Year. During the fall term, the bones, ligaments, tendons, joints, and muscles of the horse are studied ; and where special differences exist between the anatomy of the horse and the ox, notice is taken thereof. We have the skeleton of a horse, and also the individual bones, and I also generally have a living horse in the class-room. When describing any special bone, or part of the anatomy, the bone and its position is pointed out in the skeleton, and also its position in the living animal. By this method we aim at more thoroughly impressing upon the students' minds the points we are teaching.

During the winter term, we take up the anatomy of the digestive, urinary, generative, circulatory, and nervous systems and the organs of special sense, and during the spring or summer term, we study the principal medicines used in veterinary practice. For this purpose, there are samples of drugs ; and when lecturing on a drug, we have a sample of it present in order that the students may become familiar with its appearance, odor, etc.

Anatomy is always a very hard, dry subject for the beginner ; but, as the session advances, most of the students become interested in the work and it becomes very much easier. Whenever we are unfortunate enough to have any animal die during the session, I endeavor to hold a *post mortem* in the presence of as large a number of students as possible, and, if practicable, hold the *post mortem* in the class-room and point out the position of the internal organs, and compare the appearance of the diseased organs or portions thereof with the healthy.

I also gave the first year a course of what we call practical stable lectures, in which we speak of the proper methods of building stables in regard to material, size of building, size and kinds of stalls, floors, ventilation, drainage, etc., pointing out the advantages and disadvantages of each kind, and speaking of the general management, as regards feeding, watering, grooming horses, cleaning stables, harness and saddles, etc., speaking also of the different methods of educating or breaking colts, etc., etc.

Second Year. During the fall and winter terms, I delivered lectures to this class upon the causes, symptoms, and treatment of the ordinary diseases to which farm stock is subject. For this purpose I usually have a living horse in the class-room and explain and point out the difference between the appearance of a diseased and a healthy part or organ. In speaking of the diseases of bone, I hold a diseased bone in my hand and point out the difference between it and a healthy one, explain the causes and effect of the disease, and the proper mode of treatment.

Also during the winter term, I deliver a course of lectures or, more properly speaking, give a series of illustrations upon what is called "Practical Horse." During the course, I point out and explain the desirable and undesirable points of conformation of the different classes of horses, illustrate the manner of securing animals for minor operations, give practical illustrations of dressing a horse's teeth, examining the feet for soreness, examining a horse as to soundness, administering balls, the different methods of administering medicines, with the advantages and disadvantages of each, the different ways of dressing and stitching wounds, checking bleeding, etc. I also take the class to the stables and place a horse in slings, and explain to the class how to sling an animal with material that can be found on any farm, give a practical illustration of passing a probang and a catheter in cattle, show how to secure a cow for an operation on the teat, etc.

During the spring term I lecture to this class on veterinary obstetrics, explaining my lectures from charts. I also speak of breeding horses, noting some of the principal rules or laws of breeding, and endeavor to impress upon the class the importance of giving the act of breeding very careful consideration, as on account of the present state of the horse market, a man might better suspend breeding operations altogether than breed an inferior animal, while by knowing the class of animal the market demands and understanding the laws of breeding, if a man will exercise the knowledge he possesses, he can produce an animal that will sell at a profitable figure.

Third Year. I deliver a few lectures upon the points and characteristics of the different breeds of horses.

To the special dairy class, I gave a short course of lectures, speaking of the ordinary diseases and accidents to which dairy cows are specially susceptible.

I endeavor to make all my lectures and instructions as plain, simple, and practical as possible; and there is no doubt that the knowledge in veterinary science which a student gains at this College will be of great value to him in after life on a farm or among stock. His knowledge of anatomy enables him to be a better judge of the general conformation of an animal; and his knowledge of pathology enables him to discern between a simple and serious complaint or disease, and renders him competent to treat the former.

Treatment of Stock.

Besides my work in the class-room, I have given professional attention to the live stock of the institution; and while we have had a good many cases of illness during the year, our losses have been comparatively light. Below will be seen the particulars.

Horses. There were several serious cases of acute indigestion among the horses, but they all recovered. There were also cases of colic, influenza, lymphangitis, lameness of different kinds, sore necks, sore shoulders, scratches, etc.; but in all these treatment resulted in recovery. During the summer Mr. Rennie's mare (Dolly) stumbled, and then went on three legs. I was sent for and upon examination I diagnosed a longitudinal fracture of the *os suffraginis*, and said that a recovery was doubtful; but Mr. Rennie was anxious to save the old mare if possible; so we got her to the stable, placed her in slings, and commenced treatment. We continued treatment for some days; but she was suffering so much from the heat, flies, and pain of the affected parts—and there was no probability of her being useful after union of the bones, as there would be at the best a stiff joint—that we decided it would be more humane as well as profitable to destroy her. A *post mortem* revealed a triple longitudinal fracture of the bone, involving both the fetlock and pastern joints, which showed the wisdom of our course, as in case of union, both joints would have been stiff and the mare consequently useless.

Cattle. We had several cases of the usual diseases of cattle, such as impaction of the rumen, mammitis, sore teats, enlarged knees, obstruction of teats, retention of the placenta in some cases followed by pyæmia, a case of choking, etc., all of which resulted in perfect recoveries with one exception of obstruction of the teat, which resulted in suppuration and loss of activity of the quarter. A Sussex calf died very suddenly and a post mortem revealed kidney disease, which did not cause noticeable symptoms. The calf was apparently all right in the evening and was dead next morning. Another of the farm calves also died suddenly, and a post mortem revealed the opening from the stomach into the bowel, closed by a hair ball. We also lost a heifer and later on a cow at the dairy from impaction of the third stomach. The heifer died early in the spring; the cow in the fall. At the same time another valuable dairy cow became affected in a like manner; but she yielded to treatment and recovered. Some of the other cows were also acting suspiciously, so we gave each animal in the stable a brisk cathartic and have had no more trouble. I attributed the trouble to the feeding of clover hay of a very poor quality; and by your permission we discontinued its use. There were two or three cases of abortion, not of a contagious or infectious nature, but doubtless due to accidental causes. Some of the dairy cows failed to breed. I did what can be done in such cases, but some still fail to get in calf. A firm in the United States asked me to test some medicine it manufactures that is claimed to remove barreness, prevent abortion, increase the supply and quality of the milk, cure mammitis, etc. We are feeding it to three or four cows, but so far have failed to observe any benefits from it.

Sheep. There have been comparatively little losses in the flocks. We had one death from inflammation of the lungs, one from a clot of blood in one of the large vessels, and one from lung trouble caused by a head of timothy gaining access to one of the bronchial tubes, and one from inflammation of the brain.

Swine. There was no fatality among the pigs in the farm piggery; but we had a fatal case of paralysis in a sow, and two fatal cases of hernia in young pigs at the dairy piggery.

In conclusion I would suggest, for the convenience and comfort of the stock man at the farm stables, and the increased safety of the stock, that a room be fitted up and heated for a bed room. In many cases, it is advisable, and in some cases necessary, for the stock man to spend the greater portion of the night in the stables. This is especially necessary during lambing time; and in cold weather it is very uncomfortable as things now are; while, if a comfortable room were at his disposal, he could remain there every night and thus be enable to give the stock better attention.

I have, sir, the honor to be,

Your obedient servant,

J. H. REED.

December 28th, 1896.

PROF

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PART VI.

REPORT OF THE

PROFESSOR OF DAIRY HUSBANDRY.

To the President of the Ontario Agricultural College :

SIR,—I beg leave to present the report from the Dairy department for 1896. I am indebted to the Instructor of the Dairy School and to my assistants, Messrs. Rogers and Stratton, for their faithful work done during the past year.

I. DAIRY SCHOOL.

The Dairy School of 1896 was not so largely attended as in previous years, owing, no doubt, to the low prices which prevailed for cheese during 1895. There were about seventy-five students in attendance during the term, some of whom remained but for a very short time. A few students come each year for some special line of work, such as milk-testing or judging of cheese or butter, and when they have obtained what they came for, they leave. Some, too, enter with the intention of taking the full course, but for various reasons stay for but a short time and go away with the idea that they have learned all that can be learned at the School. These students go away with wrong impressions as to the work that is done. Because some special subject in which they are interested is not taken up during their short stay, they get the idea that this subject is not taught at all. False reports have originated in this way, and we would specially urge all intending students to remain the full term. To those who are making inquiries regarding the School from students who have been here, we would ask them to inquire particularly whether said students took the full course or not.

This year the College students who are required to take special dairy work took the dairy instruction and practice before the Dairy School proper opened, which we found to be an improvement over past years, when it was crowded in at the close of the school term. Those who took this work were third year specialists in agriculture and dairying, the second year, and those of the first year who desired to do so. Work in the dairy thus commenced on January 6th and continued until March 13th, when the final written examinations were held. The last two weeks of the term were devoted to practical examinations in cheesemaking, separating cream, making butter, and the testing of milk with the Babcock tester and lactometer. We hope to develop the practical side of our work even more than we have done in the past.

In addition to regular dairy work, students were given lessons on microscopy and the pasteurization of milk by Mr. Harrison, the College Bacteriologist.

To give students more practice with the separators, we had the whey from the cheese department run through the separators two afternoons of each week. As whey needs to be handled differently from milk, or else be separated twice, it is a question as to the practical value of this work. We need very much a larger supply of milk, in order that the separators may be kept running for a longer time. The short runs of 600 to 800 lbs. of milk are not sufficient to give a thorough practical test of a separator, such as would be required in ordinary factory work to skim 5,000 to 10,000 lbs. of milk at one time, and for which the conditions are somewhat different from those prevailing in the case of small quantities.

The Home Dairy Course has not been so well patronized as we expected. There are many farmers' sons and daughters who would be greatly benefited by this course. We have added lectures and practical work in poultry for 1897, in order to induce a larger number to avail themselves of this special course.

The term has been extended to ten weeks for 1897, in order to allow more time to cover the practical and theoretical work of the course. During the summer and autumn circulars outlining the course were sent to the press and to all persons likely to be interested, and a series of letters in the papers have kept the work before dairymen and makers.

We sold most of the butter and cheese made at the School on the local market at good prices, considering the state of the markets at that time. A lot consisting of sixteen boxes and two tubs of butter was sent to London, England, through J. F. Brill, of Guelph. It sold for very fair prices; but, after deducting the various charges, we found that the butter would have netted us fully as much at home—possibly a little more. This butter was salted half an ounce to the pound and colored very little. It was packed with an ordinary pounder in square boxes lined with paraffine wax and parchment paper. We asked for criticism, and the persons buying it said that the butter was all right, except that it showed "a little too much moisture." They also recommended having the boxes nailed instead of dove-tailed. These two points are worth noting in preparing butter for the export trade. In my last report this question was dealt with quite fully. The dove-tail box of 1897 is slightly smaller at the bottom than the top and is said to "strip" easily.

DIPLOMAS.

As explained in the circular, students who comply with certain conditions are granted a professional certificate or diploma. The following students have complied with all the conditions and are entitled to receive diplomas: D. McMillan, Poole, Perth Co; W. S. Stocks, Conn, Wellington Co.; D. Richardson, Watford, Lambton Co.; Geo. Kinney, Snelgrove, Peel Co; Robert Stillman, Valentia, Victoria Co.; James Robeson, Iris, Simcoe Co.; James Hill, Napanee, Lennox Co; W. J. Elliott, Thomasburg, Hastings Co.; Louis Wallbridge, Belleville P. O. (creamery in Prince Edward Co); A. R. Baird, Manitou, Manitoba; James Stonehouse, Beachville, Oxford Co.; and K. A. Henrick, now with the Bloomingdale Stock Co., Richmond, Va, U.S.A. The last four are entitled to butter diplomas and the others to cheese diplomas. I visited all of these at their factories, except Messrs. Robeson, Baird and Stonehouse, the latter of whom was officially visited by our experimental buttermaker, Mr. T. C. Rogers. I was pleased to find most of the factories clean and tidy. Some of our students are working in old factory buildings and have old vats and presses and leaky floors to contend with, which makes it very difficult for them to do so well as they would like; but I have yet to see a factory managed by one of our graduates which was positively unclean and untidy, or with cheese not properly and neatly finished.

It takes considerable time and costs something for travelling expenses, but I would like to visit a large number of our graduates each year or have our instructors do so, in order that we may know how they are getting on, and also that we know the difficulties which students meet with in their work.

II. DAIRY EXPERIMENTS.

The experimental work this year has been largely confined to experiments in the Cheese and Butter departments.

Those in the Cheese department cover the following points: Effect of fat in milk on quantity and quality of cheese; ripening of milk before adding rennet; temperature of milk at time of adding rennet; quantity of rennet; acid at dipping; milling of curds; temperature of putting curds to press; salting curds.

In the Butter department the work covers:

(1) *Creaming*—Milk with high and low percentages of fat; best temperature for separating; Jersey cows' milk; cows in different periods of lactation; loss of fat in skim milk from farm dairies.

(2) *Ripening Cream*—Best temperatures; proper percentage of fat in order to obtain best results; pasteurizing cream; "pure cultures" compared with home-made "starters."

(3) *Churning and Salting*—Effects of "washing" butter; different quantities of salt in butter.

Relation of Fat in Milk to Quantity and Quality of Cheese.

For three years in succession we have conducted experiments bearing on this question. The points raised are so important that we deem them worthy of very thorough investigation. It is impossible to settle the questions involved by a few experiments conducted in one season. Every season brings a change of conditions; every year brings a new lot of cows' milk to be studied; every year suggests new thoughts and lines of study. We are satisfied that one year's work is not sufficient to warrant anyone in laying down rules for the guidance of cheesemakers.

Summary: 1. The total number of experiments made in 1896 was 51.

2. Six hundred pounds of milk were used in each vat; total milk used, 60,600 lbs.

3. The percentage of fat in the milk ranged from 2.9 to 5.3; average, 3.68.

4. The rennet test varied from 18 to 26 seconds with both rich and poor milk. During September, October and November the rich milk (known by the letter H for high) was ripened about one second lower than the medium and poor milk (indicated by the letter L for low), as it seemed to work more slowly.

5. About one per cent. of "starter" was used in each vat, when it was needed.

6. H curds were cooked to 100° and the L curds to 98°.

7. Both curds were given about $\frac{1}{8}$ inch of acid before dipping.

8. The time from setting to dipping was a little shorter with H curds in April and May, but longer for the remainder of the season, as compared with L curds. After dipping, however, the H curds mellowed more quickly and were always ready to salt in less time than the L curds. The following table shows the time from dipping to salting:

Month.	H Curds.		L Curds.	
	H.	M.	H.	M.
April	2	54	3	12
May	2	26	2	41
June	2	47	3	06
July	2	50	3	04
August	2	54	3	16
September	2	47	3	21
October	2	40	3	04
November	2	53	3	07

9. The H curds were always salted an excess of $\frac{1}{4}$ to $\frac{1}{2}$ lb. of salt per 100 lbs. of curds.

10. The temperature for putting the curds to press varied from 79° to 83°.

11. The curds were pressed about 20 hours.

12. The curing room was kept at a temperature of 65° to 70°, except in the very hot weather, when it went up to 75°.

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

14. Expert judges scored all the cheese when they were about six weeks to two months old. Some of the cheese were kept during the whole season and were scored from time to time, in order to test the "keeping quality." Those who scored cheese for us were Messrs. A. T. Bell, Tavistock; I. W. Steinhoff, Stratford, and G. J. Brill, Guelph. They used the following scale of points: Flavor, 35; closeness, 20; even color, 15; texture, 20; finish 10.

15. All the work has been done carefully and without fear or prejudice. We have not set up a theory and then tried to make the experiments conform to the theory; but, on the other hand, we have endeavored to make our theories or conclusions correspond with the facts obtained.

The tables show the detailed results of the most important points, by months:

Date.	Per cent. fat in milk.	Lbs. fat in milk.	Lbs. of cheese.		Lbs. 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 10	4.00	24.00	64.50	62.00	.....	.....	.....	.....	.25
	3 35	20.00	59.50	57 25	.....	.....	.....	.....	.20
" 17	4.10	24.60	64.50	62 00	.....	.....	.....	.....	.25
	3.35	20 10	56.00	53.75	.....	.....	.....	.....	.20
" 23	4.05	24 30	65.25	63 00	.....	.....	.....	.....	.25
	3.20	19.20	56.00	53.75	.....	.....	.....	.....	.20
" 24	4.00	24 00	65.00	62.50	.....	.....	.....	.....	.25
	3 00	18.00	53.75	51 50	.....	.....	.....	.....	.15
" 30	4 50	27.00	69.75	67.75	.....	.....	.....	.....	.25
	.320	19.20	55.50	53.50	.....	.....	.....	.....	.20
Average for rich milk	4 13	123.90	329.00	317.25	9.11	9.45	2.64	2.54	.25
Average for poor milk	3.22	96.60	280.75	269.75	10.68	11.12	2.90	2.79	.19
May 1	3.85	23.10	61.50	59.50	.....	.....	.....	.....	.25
	3.10	18.60	56.25	54.25	.....	.....	.....	.....	.20
" 7	4.70	28.20	69.75	67.50	.....	.....	.....	.....	.40
	3.10	18.60	56.25	54.50	.....	.....	.....	.....	.20
" 8	3.90	23.40	64.50	62.50	.....	.....	.....	.....	.20
	3.10	18.60	57.25	54.75	.....	.....	.....	.....	.20
" 14	3.70	22.20	63.50	61.25	.....	.....	.....	.....	.20
	2.90	17.40	56.50	54.00	.....	.....	.....	.....	.15
" 15	3.70	22.20	64.25	61.50	.....	.....	.....	.....	.20
	2.90	17.40	57.50	55 00	.....	.....	.....	.....	.15
" 21	3.65	21.90	63.25	61.00	.....	.....	.....	.....	.20
	2.95	17.70	57.25	55.25	.....	.....	.....	.....	.20
" 22	3.80	22.80	64.25	62.50	.....	.....	.....	.....	.25
	2.90	17.40	58.25	56.00	.....	.....	.....	.....	.20
" 28	4.40	26.40	71.75	69.25	.....	.....	.....	.....	.50
	2.90	17.40	57.50	55.50	.....	.....	.....	.....	.20
" 29	3.90	23.40	66.25	64.25	.....	.....	.....	.....	.20
	3.00	18.00	58.25	56.00	.....	.....	.....	.....	.15
Average for rich milk	3.95	213 60	589.00	569.25	9.16	9.48	2.75	2.66	.20
Average for poor milk	2.98	161.10	515.00	495.25	10.48	10.90	3.19	3 07	.18

Relation of fat in milk to quantity and quality of cheese.—(*Continued.*)

Date.	Per cent. fat in milk.	Lbs. fat in milk.	Lbs. of cheese.		Lbs. milk for 1 lb. cheese.		Lbs. cheese to 1 lb. fat in milk.		Per cent. fat in whey.
			Green.	Cured.	Green	Cured	Green	Cured	
June 4	4.80	28.80	71.50	69.75	......	......	......	......	.50
	3.00	18.00	57.75	55.50	......	......	......	......	.20
" 5	3 90	23.40	65.25	63.25	......	......	......	......	.25
	2.90	17.40	55.00	53.00	......	......	......	......	.15
" 11	3.85	23.10	64.50	62.50	......	......	......	......	.20
	3 00	18.00	55.25	53.50	......	......	......	......	.15
" 18	4.10	24.60	65.50	63.00	......	......	......	......	.20
	3.00	18 00	55.50	53.50	......	......	......	......	15
" 19	3.90	23 40	63.00	60.75	......	......	......	......	.25
	3.00	18 00	55.50	53.25	......	......	......	......	.20
" 25	4.60	27.60	68.75	66.50	......	......	......	......	.40
	3.10	18.60	56.75	54.50	......	......	......	......	.20
" 26	3.90	23.40	63.00	61.00	......	......	......	......	.20
	2.90	17.40	57.00	49.00	......	......	......	......	.70
Average for rich milk	4.15	174.30	461.50	446.75	9.10	9.40	2.64	2.56	.28
Average for poor milk	3 00	103.00	335.75	323.25	10.72	11.13	3.10	2.99	.17
July 2	3.80	22.80	68.00	61.00	......	......	......	......	.20
	3.10	18 60	56.00	54.00	......	......	......	......	.20
" 16	3.90	23.40	61.75	60.00	......	......	......	......	.20
	3.30	19.80	56.75	54.75	......	......	......	......	.20
" 17	4.20	25.20	64.25	62.00	......	......	......	......	.25
	3.30	19.80	56.50	54.25	......	......	......	......	.30
" 23	4.00	24.00	64.50	62 50	......	......	......	......	.20
	3.10	18.60	55.50	53.25	......	......	......	......	.20
" 24	3.80	22.80	61.50	59.25	......	......	......	......	.20
	3.20	19.20	56.50	54.25	......	......	......	......	.20
" 30	3.90	23.40	60.25	58.00	......	......	......	......	.30
	3.25	19.50	55.25	53.00	......	......	......	......	.20
Average for rich milk	3.93	141.60	375.25	362.75	9.59	9 92	2 65	2.56	.22
Average for poor milk	3.21	115.50	336 50	323.50	10.69	11.12	2.91	2.80	.21
August 3	4.00	24.00	61.00	59.00	......	......	......	......	.30
	3.30	19.80	53.50	51.50	......	......	......	......	.20
" 6	3.90	23.40	60.25	58.25	......	......	......	......	.25
	3.20	19.20	54.50	52.75	......	......	......	......	.20
" 10	4.10	24.60	61.00	59 00	......	......	......	......	.20
	3.20	19.20	52.50	49.75	......	......	......	......	.20
" 14	3.80	22.80	59.25	57.50	......	......	......	......	.25
	3.50	21.00	56.50	54.50	......	......	......	......	.25
" 17	3.75	22.50	62.50	60.50	......	......	......	......	.25
	3.15	18.90	55.25	53.50	......	......	......	......	.20
" 21	3.95	23.70	64.50	62.50	......	......	......	......	.40
	3.20	19 20	57.50	55.50	......	......	......	......	.20
" 24	3.80	22.80	63.50	61.50	......	......	......	......	.20
	3.20	19.20	56.25	54.50	......	......	......	......	.20
" 27	3.80	22.80	65.25	63.25	......	......	......	......	.30
	3.20	19 20	59.75	57.50	......	......	......	......	.20
" 31	3.80	22.80	63.75	61.75	......	......	......	......	.20
	3.20	19.20	59.00	57.25	......	......	......	......	.20
Average for rich milk	3.87	209.40	561.00	543.25	9.62	9.93	2.67	2.59	.26
Average for poor milk*	3.23	174.90	504.75	486.75	10.69	11.09	2.88	2.78	.20

Relation of fat in milk to quantity and quality of cheese.—(*Continued.*)

Date.	Per cent. fat in milk.	Lbs. fat in milk.	Lbs. cheese.		Lbs. milk to 1 lb. cheese.		Lbs. cheese to 1 lb. fat in milk.		Per cent. fat in whey.
			Green.	Cured.	Green	Cured	Green	Cured	
September 4	4.40	26.40	21.00	69.00	......	......	......	......	.30
	3.30	19.50	58.75	56.75	......	......	......	......	.20
" 9	3.90	23.40	65.50	63.25	......	......	......	......	.25
	3.40	20.40	60.50	58.50	......	......	......	......	.25
" 11	4.10	24.60	65.00	63.00	......	......	......	......	.30
	3.35	20.10	56.75	55.00	......	......	......	......	.20
" 15	4.10	24.60	64.25	62.50	......	......	......	......	.25
	3.40	20.40	56.25	54.50	......	......	......	......	.20
" 22	4.40	26.40	70.00	67.75	......	......	......	......	.20
	3.50	21.00	60.50	58.50	......	......	......	......	.15
" 24	5.05	30.30	75.50	73.25	......	......	......	......	.40
	3.50	21.00	60.50	58.50	......	......	......	......	.25
" 29	4.50	27.00	71.25	68.50	......	......	......	......	.30
	3.55	21.30	61.50	59.50	......	......	......	......	.20
Average for rich milk	4.35	182.70	482.50	467.25	8.74	8.98	2.64	2.55	.28
Average for poor milk	3.42	144.00	414.75	401.25	10.12	10.46	2.88	2.78	.20
October 2	4.50	27.00	68.75	66.50	......	......	......	......	.30
	3.40	20.40	61.50	59.25	......	......	......	......	.20
" 5	4.30	25.80	68.75	66.75	......	......	......	......	.40
	3.40	20.40	60.75	58.50	......	......	......	......	.20
" 8	5.00	30.00	75.25	73.25	......	......	......	......	.45
	3.70	22.20	62.75	60.75	......	......	......	......	.25
" 12	4.65	27.90	70.50	68.25	......	......	......	......	.35
	3.65	21.90	61.50	58.75	......	......	......	......	.25
" 19	4.50	27.00	70.75	68.75	......	......	......	......	.30
	3.70	22.20	63.75	61.50	......	......	......	......	.20
" 26	4.50	27.00	71.00	69.00	......	......	......	......	.30
	3.60	21.60	63.00	61.25	......	......	......	......	.20
Average for rich milk	4.57	164.70	425.00	412.50	8.47	8.72	2.58	2.50	.35
Average for poor milk	3.57	128.70	373.25	360.00	9.64	10.00	2.90	2.79	.21
November 2	4.60	27.60	69.00	66.75	......	......	......	......	.40
	3.60	21.60	61.75	59.75	......	......	......	......	.30
" 14	5.30	31.80	74.50	72.25	......	......	......	......	.30
	3.50	21.00	61.50	59.50	......	......	......	......	.20
Average for rich milk	4.95	59.40	143.50	139.00	8.36	8.63	2.41	2.34	.35
Average for poor milk	3.55	42.60	123.25	119.25	9.73	10.06	2.89	2.79	.25

Butter Fat Lost in Whey.

It has been claimed by some that there is no more loss of fat in handling rich milk than in making up medium or poor milk. The results of three years' experiments point conclusively to the fact that the whey from milk rich in butter-fat contains a higher percentage of fat than does the whey from medium or poor milk. Not only is the *percentage* of fat in the whey higher, but the loss of fat originally in the milk is greater per one 100 lbs. of cured cheese when made from the rich milk.

The tables give the loss of fat by months, the total fat lost in the whey and the loss per 100 lbs. of cured cheese.

The loss of fat in the "drippings" (from dipping to salting) and also in the pressings (drippings, plus whey expelled by salt and pressing) was determined from time to time during the year. All the fat determinations were made with the Babcock tester. The loss by months was as follows:

Month.	No. tests made.	Drippings. Average percentage of fat	
		H.	L.
May	4	.60	.22
June	3	.66	.56
July	1	.30	.20
August	7	.43	.50
September	6	.35	.45
October	6	.67	.71
November	2	.30	.30

In October, three tests were made by mixing the pressings with drippings, and then testing it. The whole was weighed from each lot before testing. The H (rich) drippings and pressings in October tested 1.13 percentage fat and the L (medium) tested .71 percentage fat, or a total loss of .89 and .48 lbs. fat respectively. In November, two tests were made, in which the percentage of fat was 1.15 and .6, and the total loss of fat .47 and .26 lbs. respectively. It will be noticed that the drippings alone, in October and November, did not show much difference in their fat content, but pressing caused an increased loss in the curds made from rich milk. We expect to do more work along this line next year.

Loss of Fat in Whey by Months.

	Fat in whole milk.		Fat in whey from	
	Rich milk.	Poor milk.	Rich milk.	Poor milk.
April	4.13	3.22	.250	.190
May	3.95	2.98	.256	.183
June	4.15	3.00	.285	.175
July	3.93	3.21	.225	.216
August	3.87	3.23	.261	.205
September	4.35	4.42	.286	.206
October	4.57	3.58	.350	.216
November	4.95	3.55	.350	.250
Average for season	4.23	3.27	.284	.205

Total Fat Lost in Whey and the Loss Per 100 lbs. of 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 lbs. cured cheese.
		lbs.	lbs.
3,600	2.91	5.72	1.74
22,800	3.22	41.44	1.99
19,800	3.81	41.97	2.08
9,600	4.29	24.28	2.31
3,600	4.72	15.07	3.65
1,200	5.17	3.69	2.53

The Experiments Grouped According to the per cent. of Fat.

In the following table, some of the results are grouped according to the percentage of fat in the milk. The main points to note are, (1) the *increased* yield of cheese per 100 lbs. of milk as the fat increases, except as in Group II. ; (2) the *decreased* yield of cheese *per lb. of fat in the milk* as the percentage of fat increases; (3) the increased percentage of fat in the whey as the fat in the milk increases. These results agree with those formerly obtained. But note exception in the yield of cheese in Group II., which we are unable to explain fully.

Group.	Percentage of fat in milk.		Milk required to make 1 lb of cheese.	Cheese produced per 100 lbs. of milk.	Cheese produced from 1 lb. of fat in milk.	Per cent. of fat in whey.
	Range.	Average.				
			Lbs.	Lbs.	Lbs.	
I.	Below 3.	2.91	10.950	9.131	3.13	0.175
II.	3.00 to 3.50	3.22	10.968	9.117	2.83	0.200
III.	3.55 to 4.00	3.81	9.879	10.172	2.66	0.236
IV.	4.05 to 4.50	4.29	9.162	10.914	2.53	0.284
V.	4.55 to 5.00	4.72	8.737	11.444	2.41	0.473
VI.	5.05 to 5.30	5.17	8.247	12.125	2.34	0.350
Average.... ..	....	....	10.054	9.944	2.69	

Loss in Weight while Curing.

The results of this year correspond with those for the previous two years, viz. : the cheese made from the medium and poor milk lost a higher per cent. in curing than did those made from richer milk. As explained previously, the only reason we can assign is that in the cheese made from the poorer milk there is a greater surface exposed for evaporation per 100 lbs. of green cheese.

Loss in Weight of Cheese During one Month in Curing Room.

Month.	Cheese made from	
	Rich milk.	Poor milk.
	Per cent.	Per cent.
April	3.5	3.9
May	3.3	3.8
June	3.2	3.7
July	3.3	3.8
August	3.1	3.5
September	3.1	3.2
October	2.9	3.5
November	3.1	3.2
Average	3.2	3.6

The Quality of the Cheese.

The tables show the scoring of the cheese by months. It will be noticed that the cheese made from H. (rich) milk scored ahead in the months of August, September, and October. In the other months, the cheese made from L. (medium) milk scored higher. Some months the score was very even in the two lots of cheese. In cases where cheese were kept for several months and were scored two or three times during the period, the average of these scores is given in the tables. There is nothing to warrant the conclusion that cheese made from rich milk possesses better "keeping qualities." An example will illustrate the point: On June 10th two cheese were made out of milk testing respectively 4.1 and 3.1 per cent. fat. These cheese were kept until Nov. 18th, and were scored three times during the intervening period. The scorings were as follows:

Cheese made from milk.—% fat.	Date of scoring.	Scored by	Flavor.	Closeness.	Even color.	Texture.	Finish.	Total.
4.10	Aug. 11	G. Brill	32	18	13	18	10	91
	Sept. 18	A. T. Bell.	31	19	15	17	10	92
	Nov. 18	Bell & Steinhoff.	29	19	14	16	10	88
3.10	Aug. 11	G. Brill.	31	19	14	19	10	93
	Sept. 18	A. T. Bell.	32	19	15	18	10	94
	Nov. 18	Bell & Steinhoff.	28	19	14	18	10	89

APRIL.—Five experiments.

—	Possible score.	Cheese made from milk averaging: 4.13% fat. Points scored.	3.22% fat. Points scored.
Flavor	175	155.0	159.5
Closeness	100	85.0	86.5
Even color	75	68 0	68.0
Texture	100	85.5	83.5
Finish	50	50.0	50.0
Totals	500	443.5	447 5

MAY.—Nine experiments.

—	Possible score.	Cheese made from milk averaging: 3.95% fat.	2.98% fat.
Flavor	315	281	287.5
Closeness	180	154	162.0
Even color	135	119	125.0
Texture	180	151	159.5
Finish	90	90	90.0
Totals	900	795	824.0

JUNE.—Seven experiments.

—	Possible score.	Cheese made from milk averaging:	
		4.15% fat.	3.00% fat.
Flavor	245	208.0	213.5
Closeness	140	126.5	130.0
Even color	105	94.5	95.5
Texture	140	117.0	115.0
Finish	70	70.0	70.0
Totals	700	616.0	624.0

JULY.—Six experiments.

—	Possible score.	Cheese made from milk averaging:	
		3.93% fat.	3.21% fat.
Flavor	210	186.5	186.0
Closeness	120	114.0	113.0
Even color	90	89.5	89.5
Texture	120	109.0	111.0
Finish	60	60.0	60.0
Totals	600	559.0	559.5

AUGUST.—Nine experiments.

—	Possible score.	Cheese made from milk averaging:	
		3.87% fat.	3.23% fat.
Flavor	315	287.5	282.5
Closeness	180	166.5	164.0
Even color	135	129.0	128.5
Texture	180	167.5	162.5
Finish	90	90.0	90.0
Totals	900	840.5	827.5

SEPTEMBER.—Seven experiments.

—	Possible score.	Cheese made from milk averaging:	
		4.35% fat.	3.42% fat.
Flavor	245	215	190
Closeness	140	136	135
Even color	105	102	100
Texture	140	124	127
Finish	70	70	70
Totals	700	647	622

OCTOBER.—Six experiments.

—	Possible score.	Cheese made from milk averaging:	
		4.57% fat.	3.57% fat.
Flavor	210	195.0	192.0
Closeness	120	113.0	111.0
Even color	90	85.5	83.0
Texture	120	110.0	108.5
Finish	60	60.0	60.0
Totals	600	563.5	554.5

NOVEMBER.—Two experiments.

—	Possible score.	Cheese made from milk averaging:	
		4.95% fat.	3.55% fat.
Flavor	70	62	64
Closeness	40	38	37
Even color	30	28	28
Texture	40	37	37
Finish	20	20	20
Totals	200	185	186

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%	32.50	18.50	14.00	17.83	82.83
3.00 to 3.50%	30.46	18.35	14.15	17.65	80.61
3.55 to 4.00%	31.31	18.28	14.00	18.06	81.71
4.05 to 4.50%	31.50	18.34	13.96	17.59	81.39
4.55 to 5.00%	30.66	18.22	13.75	16.66	79.29
5.00 to 5.30%	31.00	19.00	14.00	17.25	81.25

APPLICATION TO FACTORY WORK.

When the system of adding two to the fat readings and dividing on this basis was first proposed from this department, it was met with a storm of disapproval. To-day there are few who will not admit the justice of the plan. The addend two fairly represents the casein of the milk which is incorporated in the cheese—at least the excess of casein over two per cent. is counterbalanced by the loss of fat and casein in the whey. When we add two to the fat readings and use this as a basis for distributing money among patrons of cheese factories, we divide according to the fat and casein of the milk, which are the two substances in it that determine its cheese-producing power.

The following tables show the three systems applied to our year's work, together with the amounts of money that patrons would receive by each plan, compared with the actual value of cheese produced, on the supposition that it net eight cents per pound :

Lbs. milk.	Average per cent. fat.	Lbs. cheese made.	Amounts of money (cheese 8c.) credited by three systems and according to weight of cheese.			
			Weight milk.	Per cent. fat.	Per cent. fat + 2.	Weight cheese.
			$ c.	$ c.	$ c.	$ c.
3,600	2.91	328.75	28 64	22.59	24.72	26.30
22,800	3.22	2,078.75	181 41	158.30	166.42	166.30
19,800	3.81	2,014.25	157 54	162 66	160.86	161.14
9,600	4.29	1,447.75	76 38	88.8[illegible]	84.43	83.82
3,600	4.72	412.00	28 64	36.64	33.83	32.96
1,200	5.17	145.50	9 55	13.16	11.89	11.64

Differences in the three systems compared with the actual value of the cheese produced.

Value of cheese made.	Weight of milk.	Per cent. of fat.	Per cent. fat +2.	Per cent. fat in milk.
$ c.	$ c.	$ c.	$ c.	
26 30	+ 2 34	−3 71	−1.58	2.91
166 30	+15 11	−8 00	+ .12	3.22
161 14	− 3 60	+1 52	− .28	3.81
83 82	− 7 44	+4 98	+ .61	4.29
32 96	− 4 32	+3 68	+ .87	4.72
11 64	− 2 09	+1 52	+ .25	5.17

General Conclusions.

1. An increased percentage of fat in the milk increases the quantity of cheese which may be made per 100 lbs. of milk in most cases.

2. The increase of cheese is not in exact proportion to the fat. One pound of fat in three per cent. milk will make more cheese than a pound of fat in four per cent. milk. The yield of cheese per pound of fat gradually decreases as the percentage of fat in the milk increases.

3. The yield of cheese is fairly uniform in proportion to the fat and casein in the milk. The casein may be represented by the addend two.

4. The quality of the cheese is not determined by the percentage of fat in the milk, The fat is but one factor in the problem. Our experiments indicate that an excess of fat is of no advantage to the cheese. To make cheese from milk containing over four per cent. of fat, we advise cooking to about 100° and salting from quarter to half pound extra, to improve body and texture.

5. The loss of fat in the whey was greater from the richer milk.

6. As a fair basis for distributing proceeds among patrons of cheese factories, we recommend the percentage of fat + 2, or fat and casein system.

Ripening of Milk before adding Rennet.

During July, August and September, thirteen experiments were made to see the effect of ripening milk before renneting. The test used was the 8 oz. with 1 drachm of rennet. The test varied from 12½ seconds to 31 seconds. So far as getting the cheese made more quickly, there does not seem to be any gain in time by ripening the milk more or less. If the milk is ripened a good deal, it should be dipped in that much less time. If set "sweet," it remains in the whey the longer. The main thing seems to be to ripen the milk to such a point that it will dip in from 2 to 3 hours, which will allow the curd to become properly cooked. In the spring curds should dip in from 2 to 2½ hours, and in a longer time as the season advances, or if we wish to make longer keeping cheese. It is a question whether it is ever advisable to leave curds in the whey for over three hours. On Sept. 8th, when the milk was set sweet without any starter, it remained in the whey 5½ hours. This was a very poor cheese. The following table shows the main points of the experiments :

Effect of varying the rennet test, or of different degrees of ripeness at setting.

Date.	Per cent. fat in milk.	Rennet test. Seconds.	Minutes coagulating.	Time from setting to dipping.	Time from dipping to salting.	Lbs. cheese.		Per cent. fat in whey.	Score.
						Green.	Cured.		Max. 100.
				H. M.	H. M.				
July 25	3.40	12½	18	1.32	2.45	28.25	26.50	.20	93
	3.40	21	33	2.42	2.43	28.00	26 50	.20	93
" 27	3.60	15	20	1.44	2.54	29.00	27.50	.20	93
	3.60	21	31	2.50	2.55	29.00	27.75	.20	94
Aug. 8	3.40	15	19	1.57	2.50	27.00	25.50	.20	92
	3.40	24	33	2.59	2.50	26.50	25.00	.20	90
" 5	3.30	16	21	2.10	3.00	27.50	25.75	.20	89
	3.30	24	34	3.07	3.03	27.50	25.75	.20	89
" 12	3.30	17	18	2.02	2.51	26.50	25.00	.20	92
	3.30	24	33	2.43	2.48	27.00	25.50	.20	91
" 22	3.50	18	23	1.59	3.06	29.25	27.75	.20	91
	3.50	24	34	2.41	3.06	29 00	27.50	.20	94
" 26	3.40	18	22	2.05	3.02	29.50	28.00	.25	90
	3.40	24	35	2.55	3.02	29.00	27.50	.25	94
" 28	3 40	19	23	1.56	2.59	30.50	29.00	.20	96
	3.40	24	33	2.50	4.02	30.00	28.50	.20	93
" 11	3.30	20	24	2.02	3.04	27.00	25.50	.20	91
	3 30	24	33	2.40	3.05	26.00	25.00	.20	92
Sept. 8	3.50	27	38	3.07	3.23	30.25	28.75	.20	88
	3.50	23	31	2.40	3.23	30.25	28.75	.20	87
" 14	3.70	29	40	3.38	3.11	30.00	28 50	.20	94
	3.70	25	33	3.04	3.11	30.25	28.75	.30	90
" 5	3.50	30	42	3.57	3.02	30.50	29.00	.20	90
	3.50	24	32	2.32	3.00	30.50	29.00	.20	87
" 3	3.50	31	44	5.30	3.21	29.50	28 25	.20	87
	3.50	26	34	3.34	3.22	30.00	28.50	.30	88

Temperature for Renneting Milk

This, too, is a continuation of last year's experiments. During September, October and November, fourteen trials were made by setting a vat of milk at temperatures varying from 72° to 96°. Another vat of similar milk was set at 86° each day. On November 5th, three vats were set at 79°, 86° and 93° respectively. Below 80°, the time from setting to dipping and from dipping to salting was longer than in the vats set at normal temperature. The loss of fat in the whey was greater, the yield of cheese was less, and the quality of the cheese was poorer when the rennet was added below 80°. Between 80° and 90°, the effect in these points was not marked. Above 90°, the quality of the cheese does not appear to be quite so good; otherwise there is not much difference, except in the less time required for coagulation. These results correspond with those obtained in 1895, which were reported in Bulletin 102. In that Bulletin we said "above 86° up to 95°, each increase of one degree in temperature of the milk will decrease the time required for coagulation by one minute." The trials of this year confirm this rule. Below 86° and down to 80° each decrease of one degree in temperature *increases* the time required for coagulation from one to two minutes but the rule does not seem to be so regular as it is above 86°. From 70° to 80° it is more irregular still. A temperature of 86° for the milk is recommended when the rennet is added, though no particular harm will result if it is added between 80° and 90°.

Effect of setting milk at different temperatures.

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.
				H. M.	H. M.			
Sept. 26	3.50	72°	90	3.05	3.00	.40	28.00	94
	3.50	86°	31	2.24	2.49	.25	29.00	98
" 25	3.50	75°	73	3.05	3.18	.40	28.25	91
	3.50	86°	31	2.53	2.57	.20	29.00	93
" 28	3.70	77°	56	2.31	3.15	.40	27.75	93
	3.70	86°	31	2.36	2.53	.20	28.50	96
" 10	3.40	79°	40	2.22	2.58	.30	28.25	86
	3.40	86°	30	2.20	3.00	.20	28.50	90
Nov. 5	4.00	79°	43	3.05	3.07	.40	30.75	92
	4.00	86°	32	3.03	3.07	.30	30.50	95
	4.00	93°	25	3.00	3.10	.30	31.00	95
Sept. 23	3.50	80°	46	3.02	3.21	.40	29.50	93
	3.50	86°	31	3.08	3.21	.25	29.50	94
Oct. 1	3.80	83°	38	2.30	3.00	.30	30.75	95
	3.80	86°	31	2.28	3.00	.20	31.00	90
" 14	3.80	88°	31	2.35	3.02	.20	30.50	90
	3.80	86°	33	2.37	3.00	.20	30.50	91
Sept. 2	3.50	90°	27	2.09	3.00	.20	28.75	84
	3.50	86°	32	2.12	3.00	.20	29.25	85
Oct. 7	3.70	91°	26	2.27	3.03	.20	29.75	95
	3.70	86°	33	2.25	3.05	.20	29.75	97
" 6	3.50	92°	26	2.35	2.55	.20	29.50	90
	3.50	86°	33	2.37	2.55	.20	29.50	89
" 10	4.00	94°	24	2.33	2.55	.20	31.25	92
	4.00	86°	34	2.41	2.55	.20	31.25	94
" 9	3.85	96°	22	2.52	3.00	.25	30.75	94
	3.85	86°	35	3.00	3.00	.25	31.00	95
" 13	4.00	96°	22	2.59	2.53	.20	31.00	90
	4.00	86°	35	2.49	3.01	.20	31.00	94

Effect of Different Quantities of Rennet.

The results of experiments made in 1895 on this question were reported in Bulletin 102. Sixteen experiments were made during the months of April, May and June. The quantity of rennet varied from one ounce to nine ounces per 1,000 lbs. of milk. The extra quantity of rennet caused the cheese to "break down" more quickly—or in other words ripened the curd sooner. Below three ounces the time required from setting to dipping was a little longer than with quantities above three ounces. From dipping to salting there was very little difference in the time required to mellow the curds, whether a large or a small quantity of rennet was used, indicating that at this stage of the ripening the work is done by other agencies than the rennet. Later on, the rennet plays an important part—bacteriologists to the contrary.

It will also be noticed that the loss of fat in the whey increased when an ounce of rennet was used and the yield of cheese was less. Makers should use sufficient rennet to cause coagulation in not more than 35 to 40 minutes. Longer time means loss.

The two cheese made May 26th by using seven and one-half and three and one-third ounces of rennet respectively were scored on July 15th by Messrs. Bell & Steinhoff, when they scored 9[illegible] points each. On Sept. 18th, Mr. Bell again scored these cheese (they having been kept in a cellar in the meantime), when the cheese made by using seven and a-half ounces of rennet scored 86 and the other 92 points. The cheese made with a large quantity of rennet had decreased from 32 points to 25 points in flavor and from 20 to 18 points in texture. The other held its flavor (being 31 both times), though it decreased two points in texture.

The cheese made on June 1st from three and a-third and one ounce of rennet scored 89 and 86 points respectively on July 15th. On Sept. 18th, they scored 93 and 94 points, the improvement being in closeness, color and texture. The cheese made with one ounce of rennet was kept in a cool place until Nov. 18th when it scored 90 points, having decreased two points in flavor, one in texture and one in color. It would seem that if a small quantity of rennet is used, the cheese require a longer time before attaining their maximum quality. When a cheese attains this point, then it begins to decrease in quality, and should be eaten as soon as possible. If it were possible to control all the conditions, we should be able to make cheese ready for eating in a given definite time by varying the quantity of rennet in the milk. One of the conditions that we think essential in preparing cheese for market in summer is a cool room in which the cheese may be placed in order that the curing may go on more slowly after the first ten days or two weeks. Such a method insures "closeness" and improved flavor.

The effect of rennet on the time required for coagulation is seen to be as follows in the experiments of 1895 and 1896.

Rate of rennet per 1000 lbs. milk.	Minutes coagulating. 1895.	1896.	Average
1 ounce	65	65.5	65.25
1½ "	....	53	53
2 "	42	37	39.5
2½ "	40	36	38
3 "	33	....	33
3½ "	27	....	27
4 "	26	28	27
4½ "	25.5	23	24 25
5 "	20	26	23
5½ "	....	20	20
6 "	18	18.5	18.25
6½ "	....	17.5	17.50
7 "	16	17	16.50
7½ "	....	15	15
8 "	17.5	14	15.7
8½ "	....	14	14
9 "	13	13	13

The decrease in time required for coagulation is very marked as the quantity of rennet increases from one ounce to four ounces. After this, the lessened time is not so marked. Increasing the quantity fourfold from one ounce decreases the time for coagulation over one-half. Doubling the quantity from four ounces has about the same effect on time required for coagulation—decreases it one-half.

Table showing the effect of different quantities of rennet used in milk.

Date.	Rate of rennet per 1,000 lbs. milk.	Rennet test. Seconds.	Minutes coagulating.	Time from setting to dipping.	Time from dipping to salting.	Lbs. cured cheese from 300 lbs. milk	Per cent. fat in Whole milk.	Per cent. fat in Whey.	Score Max. 100.
	oz.			h. m.	h. m.				
May 12	$3\frac{1}{3}$	19	30	2 53	4 35	55.50	3.10	.20	92
	1		67	3 01	4 22	54.00		.35	90
June 1	$3\frac{1}{3}$	22	31	2 39	2 49	59.57	3.40	.20	89
	1		64	2 47	2 40	58 50		.35	86
May 19	$3\frac{1}{3}$	21	35	2 30	3 07	58.50	3 30	.15	92
	$1\frac{1}{2}$		53	2 38	2 47	57.00		.25	89
April 1	$3\frac{1}{3}$	$16\frac{1}{2}$	27	2 20	3 56	59.00	3.50	.20	90
	2		37	2 38	3 35	57.50		.20	92
" 4	$3\frac{1}{3}$	18	31	2 45	3 23	61.75	3.50	.20	94
	$2\frac{1}{2}$		36	2 56	3 04	60.25		.20	94
" 6	$3\frac{1}{3}$	18	32	2 41	3 25	60 25	3.60	.15	92
	4		28	2 34	3 40	60.00		.15	92
" 13	$3\frac{1}{3}$	18	30	3 05	3 38	58.75	3.60	.20	87
	$4\frac{1}{2}$		23	3 09	3 35	58.50	3.60	.20	82
" 21	$3\frac{1}{3}$	19	34	3 00	3 03	54.00	3.40	.18	86
	5		26	3 04	2 53	53.50		.18	88
" 25	$3\frac{1}{3}$	19	31	3 03	2 33	57.00	3.50	.20	88
	$5\frac{1}{2}$		20	3 05	2 31	56.75		.20	86
" 28	$3\frac{1}{3}$	18	30	2 13	3 25	54.25	3.20	.20	85
	6		$18\frac{1}{2}$	2 15	3 00	54.75		.20	84
May 2	$3\frac{1}{3}$	19	30	2 37	2 38	55.75	3.35	.20	86
	$6\frac{1}{2}$		$17\frac{1}{2}$	2 40	2 17	56.00		.20	86
" 9	$3\frac{1}{3}$	20	32	3 05	2 51	55.50	3.30	.15	86
	7		17	2 57	2 45	55.25		.15	84
" 26	$3\frac{1}{3}$	$22\frac{1}{2}$	31	2 58	2 51	56.50	3. 0	.20	94
	$7\frac{1}{2}$		15	2 44	2 53	56.00		.20	94
" 27	$3\frac{1}{3}$	22	31	2 55	3 17	58.25	3.30	.20	94
	8		14	2 43	3 18	58.00		.20	87
" 18	$3\frac{1}{3}$	$19\frac{1}{2}$	34	2 30	3 00	58.75	3.40	.20	89
	$8\frac{1}{2}$		14	2 32	2 49	59.00		.20	79
June 2	$3\frac{1}{3}$	22	29	2 21	2 58	57.75	3.30	.15	87
	9		13	2 14	3 00	58.00		.15	90

Acid on Curd at Dipping.

These experiments are a continuation of last year's work. Ten trials were made in June, in which the hot iron test varied from "no acid" to $1\frac{1}{4}$ inches at dipping. The whey from a curd which tested "sweet" with the hot iron on June 8th, indicated .12 per cent. acid when tested with Farrington's alkaline tablets The other curd dipped at $\frac{1}{8}$ inch of acid indicated .15 per cent. acid with the tablets. (As stated in Bulletin 102 the hot iron indicates a *condition* of the curd which may or may not be accompanied by corresponding degrees of acidity.) On June 24th, the "iron" showed no acid on either curd at dipping. When tested with the tablets, one showed .13 and the other .11 per cent. of acid. One hour after milling, the dippings tested .43 and .45

per cent. of acid. (The iron still showed no acid at milling.) The hot iron test as used in cheesemaking is not understood at present, and we hope to secure something more accurate and just as simple for this work.

There is not much effect on time required for making the cheese whether dipped sweet or with 1¼ inches of acid. A certain amount of time is required for the curd to "mellow down," and if the conditions are right, the curd will ripen *out of the whey* as well as *in* it, hence we advise dipping with ⅛ to ¼ inch of acid, in order to secure the best results. The following table shows details.

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. at in		Score.
				Green.	Cured.	Milk.	Whey.	Max. 100.
		h. m.	h. m.					
June 17	Sweet.	2 49	3 14	58.25	56.00	3.20	.20	94
	⅛	3 39	2 27	57.75	55.25	3.20	.20	89
" 8	Perceptible	2 35	4 15	57.75	54.75	3.40	.20	88
	⅛	3 42	3 10	58.25	55.25	3.40	.20	91
" 9	1/16	2 22	3 34	56.75	53.75	3.20	.20	92
	⅛	2 44	3 12	56.50	53.50	3.20	.20	92
" 23	¼	4 52	3 27	56.75	54.50	3.20	.20	91
	⅛	3 52	4 21	57.75	55.50	3.20	.20	89
" 6	¼	3 16	2 39	58.00	55.25	3.50	.20	91
	⅛	2 42	3 05	57.50	54.75	3.50	.20	90
" 15	½	3 18	2 09	60.50	57.50	3.50	.20	88
	⅛	2 30	2 56	60.25	57.25	3.50	.20	90
" 20	½	4 24	2 35	57.00	55.00	3.20	.20	90
	⅛	3 30	3 33	57.00	55.25	3.20	.20	91
" 16	¾	3 13	2 26	57.25	54.50	3.20	.20	88
	¼	2 29	3 11	57.00	55.00	3.20	.20	92
" 22	1¼	3 52	2 28	56.50	52.75	3.10	.20	89
	⅛	3 00	3 14	56.00	52.75	3.10	.20	93
" 24	No acid.	4 19	3.00	58.00	56.25	3.30	.20	89
	No acid.	3 16	4.03	58.00	56.25	3.30	.20	91

Milling the Curd.

There is some difference of opinion among makers as to the best time at which to mill or grind. Some practice milling half way between dipping and salting. Others do not mill until the curds have mellowed and are nearly ready for salting. This latter plan no doubt causes much loss of butter fat. The column in table (p. c. fat in drippings and pressings) clearly shows that where curds are left from two to three hours after dipping and are then milled, the loss of fat is much greater than when milled in from one to one-and-a-half hours after dipping. There is apparently not so very much difference in the quality of the cheese, except in the two cases (Oct. 27 and 28), where a portion of each curd was left about three hours before milling. The score of these cheese was 91 and 92 as compared with 95 for cheese made from the same kind of curd milled one and three-quarter hours after dipping.

We recommend milling in from 45 minutes to 1½ hours after dipping.

Effect of milling at different stages of acid.

Date.	Lbs. milk.	Per cent. fat	Hours from dipping to milling	Acid on hot iron at milling.	Hours from dipping to salting.	Per cent. fat in Whey.	Per cent. fat in Drippings and pressings.	Lbs. cured cheese.	Score. Max. 100.
			h. m.		h. m.				
Oct. 3	600	3.6	1 00	1 inch	3 03	.20	.90	29.75	94
			1 45	1 "	3 05	.20	.90	29.75	94
" 15.........	600	3.6	1 15	1 "	2 57	.20	1.70	29.25	95
			1 45	1 "	2 59	.20	2.60	29.25	95
" 16.........	600	3.5	1 30	1 "	3 02	.30	3.00	29.50	91
			1 45	1 "	3 04	.30	3.90	29.25	92
" 20.........	600	3.7	2 00	1¼ "	3 02	.20	1.80	31.25	94
			1 45	1¼ "	3 00	.20	1.50	31.00	92
" 21.........	600	3.9	2 15	1¼ "	3 12	.15	1.00	31.75	96
			1 45	1¼ "	3 10	.15	.80	31.50	95
" 22.........	600	3.7	2 30	¾ "	3 13	.20	1.20	31.75	93
			1 45	1 "	3 11	.20	1.00	31.50	92
" 23.........	600	3 8	2 45	1⅛ "	3 09	.20	1.20	31.75	94
			1 45	1¼ "	3 07	.20	1.20	31.25	94
" 27.........	600	3.80	3 00	1⅛ "	3 07	.20	2.20	32.00	91
			1 45	1¼ "	3 05	.20	1 30	31.25	95
" 28.........	600	3.80	3 07	¾ "	3 11	.20	1.70	31.50	92
			1 45	1⅛ "	3 05	.20	1.20	30.75	95

Effect of Salt on Curds.

From May to November ten experiments were made by using quantities of salt at the rate of from 1 lb. to 4 lbs. salt per 100 lbs. of curd. The results on spring cheese agree with those reported last year, when we recommended "about 2½ lbs. of salt per 100 lbs. of curd." When less than 2 lbs. of salt per 100 lbs of curd is used, the cheese lack flavor, body and texture, and do not keep so well. Two cheese made May 30th, which were salted at the rate of 2 and 2½ lbs., scored 91 and 95 points respectively on July 15th. These cheese were kept until Sept. 18th, when they scored 94 and 95.

Two cheese, made October 30th and November 14th, salted 3¾ and 4 lbs., and scored December 26th, were found to be good in body and texture. Last year, the cheese salted 4 lbs. was harsh in texture and never mellowed down. This year, the cheese salted 4 lbs. mellowed nicely between November 14th and December 26th. The only reason we can give for this differenee in result is, that in 1895 the curd was made from milk testing 3.5 per cent. of fat, and this year the milk tested 4 per cent. This agrees with all our experiments along this line—*curd made from milk rich in fat (4 per cent and over) may be salted much heavier than curds from average milk.*

Salting Curds One Hour Sooner than Usual.

It is customary among cheesemakers to allow the curd to become "velvety" in feel and to ripen, so that when pressed in the hand the fat will be forced out freely, before applying the salt. The curds are then put to press in about twenty minutes. This practice allows a good deal of the butter fat to be pressed out and lost in the drippings and whey. The object of the experiments here noted was to see if adding the salt sooner than usual (in about one hour) and allowing the curds to mature *in the salt*, would not prevent some of this loss. It will be noticed that in nearly every case the yield of cheese per 100 lbs. of milk was greater when the curds were salted earlier. In those trials in which the "drippings" and "pressings" were weighed and tested, there was more loss by leaving the curds to mature before salting. The score shows that the quality was not injured. Five lots were kept in a cellar for a month or two and scored again. The last column in the table shows that the keeping was not injured by this method. Makers troubled with "greasy" curds are advised to try the plan of salting earlier, and allow the curds to mature *after salting*.

Effect of salting curd at different periods.

Date.	Lbs. milk.	Per cent. fat in milk.	Time from dipping to salting.	Lbs. cheese.		Lbs. cured cheese per 100 lbs. milk.	Lbs. drippings and pressings.	Per cent. fat in drippings and pressings.	Score.						Total second score.
				Green.	Cured.				Flavor.	Closeness.	Even color.	Texture.	Finish.	Total.	
			h. m.				Lbs.								
June 27	1,200	3.40	1 58	60.00	58.00	9.66	.....	......	31	18	13	18	10	90	95
			2 58	59.50	57.50	9.58	.....	......	32	18	13	19	10	92	94
" 29	1,200	3.30	2 07	59.75	57.50	9.58	......	......	33	19	14	19	10	95	92
			3 02	59.00	57.00	9.50	......	......	30	17	14	18	10	89	93
" 30	1,200	3.40	2 30	59.00	57.00	9.50	......	......	32	19	14	19	10	94	94
			3 00	59.25	57.25	9.54	....	......	31	18	13	18	10	90	94
July 1	1,200	3.30	2 15	58.00	56.00	9.33	.....	.....	30	17	14	17	10	88	....
			3 25	57.50	55.50	9.25	.....	.....	30	17	14	18	10	89	....
Aug. 13	600	3.40	2 00	27.50	26.00	8.66	.....	.....	34	19	15	19	10	97	94
			2 50	27.50	26.00	8.66	......	......	31	18	15	18	10	92	94
" 18	600	3.60	2 10	30.25	28.75	9.58	......	......	33	18	14	17	10	92	....
			2 45	29.50	28.00	9.33	....	......	33	18	14	17	10	92	....
" 19	600	3.50	1 51	30.50	29.00	9.66	1.4	3.00	32	17	13	16	10	88	....
			2 41	30.25	28.50	9.50	2.1	4.60	32	17	13	17	10	89	....
" 20	600	3.40	2 08	30.25	28.50	9.50	3	1.40	32	18	14	16	10	90	95
			3 08	30.00	28.50	9.50	3.6	1.80	33	19	14	17	10	93	93
Nov. 3	600	4.10	2 08	33.50	31.75	10.58	3.2	1.00	33	18	14	19	10	94	....
			3 00	32.50	31.00	10.33	4	1.60	33	18	14	19	10	94	....
" 4	600	3.90	2 00	33.00	31.50	10.50	3.2	.80	33	18	14	19	10	94	....
			3 00	32.75	31.50	10.50	3.5	.90	33	18	14	19	10	94	....

Temperature of Curds at Time of Putting to Press.

This is also a continuation of last year's experiments, as reported in Bulletin 102. In each experiment the curd was equally divided and the two lots put to press at the temperatures given in the table. The temperature ranged from 60° to 96° in half of the curds, the other half being put to press between 80° and 85°. The scoring shows that there is not much difference in the quality of the cheese made in each trial, except in three cases where the temperature at time of putting to press was 92°, 93° and 96°. These cheese were more open and not so good in texture.

The table gives the details.

Table showing effect of temperature of curd when put to press.

Date.	Lbs. milk.	Per cent fat in milk.	Lbs. cheese. Green.	Lbs. cheese. Cured.	Temperature when put in press.	Scoring of cheese. Flavor.	Closeness.	Even color.	Texture.	Finish.	Total.
					Degs.						
April 8	1,200	3.65	61.75	59.50	60	30	17	14	16	10	87
			63.25	61.25	78	28	17	14	17	10	86
" 22	1,200	3.40	57.50	55.25	66	31	17	14	16	10	88
			58.50	56 25	81	30	17	14	16	10	87
" 20............	1,200	3.65	60.00	58.00	68	30	15	14	14	10	83
			58.50	56 75	81	30	16	14	14	10	84
" 15	1,200	3.70	59.50	57.25	70	31	18	13	15	10	87
			59.00	56.75	81	30	18	13	15	10	86
" 29	1,200	3.30	57.00	55.00	70	31	17	13	16	10	87
			57.00	55.00	80	31	17	13	16	10	87
" 27............	1,200	3.30	56.00	54.25	72	30	14	14	14	10	82
			56.00	54.00	79	28	13	14	15	10	80
May 4.............	1,200	3.40	58.25	56.50	76	30	16	14	16	10	86
			58 50	56.75	83	30	16	14	17	10	87
" 18......	1,200	3.50	57.25	55.25	90	32	19	15	18	10	94
			57.50	55 50	83	32	19	15	18	10	94
July 20............	1,200	3.00	55.00	53.25	90	31	19	15	18	10	93
			56.25	54.50	82	31	19	15	18	10	93
" 14...........	1,200	8 20	55.25	53.25	91	30	19	15	19	10	93
			56.00	54 00	83	30	19	15	19	10	93
" 22............	1,200	3.30	54 75	52.50	91	31	19	15	18	10	93
			55 00	52.75	83	30	19	15	18	10	92
May 11.	1,200	3.50	59.50	57.50	92	32	18	14	18	10	92
			60.00	58.00	83	33	19	15	19	10	96
Aug 1.......... ..	600	3.30	27.75	26.50	93	32	17	15	18	10	92
			28 25	27.00	82	32	19	15	19	10	95
July 28............	600	3.50	27.25	26 00	96	32	17	15	17	10	91
			27 75	25.50	84	32	19	15	18	10	94

Separating Cream from Milk Containing High and Low Percentages of Fat.

This is a continuation of last year's work. Altogether 21 trials were made with milk averaging 4 03 per cent. fat in one lot and 3.29 in the other. To produce one pound of cream from the rich milk, required 7.19 lbs. milk; and for a pound of cream it required 7.28 lbs. of medium or poor milk. The per cent. of fat in the cream from rich milk was 28.15 and from the other 23.99. These results agree with those of last year, in reference to which we stated that "the richer milk does not produce a greater *volume* of cream, but it is richer in butter fat than the cream produced from the poorer milk. The *machine* governs the volume of cream." In all cases feed, speed and outflows were kept as nearly alike as possible in both lots of milk.

Separating Milk at Different Temperatures.

Last year we reported that "the higher temperature of the milk at separating showed (1) less loss of fat in the skim-milk; (2) a higher percentage of fat in the cream; (3) in the case of the Alexandra separators the cream was smoother." In 1895 the highest average temperature was 118 2°; but this year we tried 130° with several lots, and 160° with other lots. The conclusions of last year are confirmed in the experiments of 1896. In addition we have this year churned the cream separately that was obtained by creaming at the high, medium and low temperatures.

In trials made during October and November, the average score for flavor and grain of the butter made from cream separated at 96° was 39.8 and 23 4 respectively. The butter made from cream separated at an average temperature of 159° scored 40.4 and 23.7 in flavor and grain. The drawback to the plan of separating at 158° to 160° is the expense of heating the milk and of cooling the cream afterwards. We are inclined to favor the plan of heating the milk to a higher temperature before separating than is commonly practised in winter, as it has the following advantages: (1) Increases the capacity of the separator; (2) enables it to skim more closely; (3) gives smoother cream; (4) cream is of better flavor, as the heating drives off stable, turnip, and other undesirable flavors. We need a convenient heater and cooler for winter creamery use, by which the temperature of the milk or cream may be easily regulated.

The following table shows the effect on quality of butter by separating at different temperatures. The flavor, grain, and total average scores only are given:

Butter.		Average flavor. Max. 45.	Average grain. Max 25.	Average total. Max. 100.	Temperature of milk when separated.
Made.	Scored.				
Oct. & Nov.	Nov. 14......	39.8	23.4	96 4	96°
"	Jan. 2, 1897.....	41.4	22.8	93.1	96°
Nov..................	"	40 8	22 8	92 2	98°
Oct. & Nov........	Nov. 14.........	43.0	24.0	97.	130°
"	Jan. 2..........	41.5	23 0	93.5	130°
"	Nov. 14.........	40 1	23.6	93.5	160°
"	Jan. 2..........	41.5	23.	93.	160°
Nov..................	"	40.7	23.	92.7	160°

The average of all scores was 40.6 for flavor and 23 for grain, where the milk was separated at 96° to 98°; at 130° the score was 42.2 and 23.5; at 160°, the average flavor and grain scored 40.7 and 23.2. From this it is apparent that the "grain" of the butter was not injured by separating at the higher temperatures and the flavor was slightly improved. These trials indicate 130° F., as giving best results in flavor of butter.

Jersey Cows' Butter.

The question has been frequently asked, "Is the butter made from Jersey cows' milk any different, or any better than that made from any other cows' milk?" During September and October eighteen trials were made of setting the milk from our pure-bred Jerseys by itself. The milk from the remainder of the herd was mixed together and then set in ice water for the cream to rise. In two trials, October 22nd and 23rd, the milk was run through the cream separator, and the skim milk tested one-tenth of one per cent. of fat. Altogether there were 2,221 lbs. of herd milk set and separated. The average temperature of the milk set was 41.5° at skimming, when set from 15 to 24 hours—average 21 6 hours. The percentage of fat lost in the skim milk by setting varied from 0.25 to 0.60, an average of 0.39. The total lbs. of fat lost in the skim milk was 7.52.

Of the Jersey milk set and separated (1,593 lbs.), the loss of fat in skim milk was 3.75 lbs. or 0 23 lbs. per 100 lbs. of whole milk; while in the rest of the herd the loss was 0.33 lbs. of fat lost per 100 lbs. of whole milk set. The average percentage of fat in the whole milk from the herd, without the pure-bred Jerseys, was 3 69 during these experiments. The Jerseys cows' milk averaged 5.03. The pounds of milk required to make one pound of butter were 23.64 and 16.9 respectively. With both lots of cream at the *same temperature*, the cream from the Jersey cows took a longer time to churn and the butter was firmer. Some of the Jersey cream was churned at two to four degrees higher temperature and yet the butter was firm in body and texture.

We hope to continue this investigation in reference to the characteristics of the milk from ordinary grade cows, and also that from cows representing the different breeds. This will be done with a view to studying the peculiarities of the milk and not to add anything by way of ammunition for the "Battle of the Breeds."

The following table shows the quality of the butter in flavor and grain, and the total average scoring:

Kind.	Made.	Scored.	Average flavor. Max. 45.	Average grain. Max. 25.	Average total. Max. 100.
Jersey	Sept.	Sept. 30	41.9	23.8	95.3
Grade	"	"	42.2	28.5	95.1
Jersey	Sept. and Oct.	Nov. 14	39.0	24 5	93.5
"	" "	Jan. 2nd	38.7	22.7	90 7
Grade	" "	" 14	39.6	24.3	94.0
"	" "	" 2nd	40 2	22.5	92.1
Jersey	Oct	" 2nd	41.0	22.5	92.0
Grade	"	" 2nd	42.0	22.5	93.5

The results show that in "grain" the Jersey butter scored slightly ahead in the average of all scores (23 4, as compared with 23.2); but in flavor the score was 40.1 for the Jersey butter, as compared with 41 for the butter made from grade cows.

EFFECT OF PERIOD OF LACTATION ON CREAMING OF MILK AND QUALITY OF BUTTER.

Will milk from cows which have been milking for 6 months or more cream so well and make so good a quality of butter as the milk from "fresh" cows? To throw some light on this question, experiments were made during September, October and December by dividing the cows in the dairy herd into three groups—those which had been milking over 6 months, those between 2 and 6 months, and those which were fresh milkers, or under two months.

There were 1,361 lbs. of milk set in deep cans in ice water for Group I. (over 6 months). The average percentage of fat in the skim-milk was 0 7, when set for 24 hours. Group II. (under 6 and over 2 months) had 0 6 p.c. fat in the skim-milk set under the same conditions. The fresh milkers averaged 0.41 per cent. fat in the skim-milk. These trials go to show that as the period of lactation increases the less readily does the cream rise when the milk is set in deep cans in ice water. With the separator the difference is not so marked.

The loss of fat in buttermilk was 0.22, 0.237 and 0.17 in Groups I., II. and III. respectively. The time required for churning increased with the period of lactation, 42 5, 29.1 and 24.3 minutes respectively for each group.

The following table shows the quality of butter:

Kind.	Made.	Scored.	Average flavor.	Average grain.	Average total score.
Cows milking under 6 months	Sept. 29th	Sept. 30	42	23	94
" " " "	Sept. and Oct.	Nov. 14	40.5	24	94
" " " "	" "	Jan. 2nd	39.0	23	90.5
" " " "	December	"	42.2	22.8	93.2
" " over "	Sept. 29th	Sept. 30	43.0	24.0	97
" " " "	Sept. and Oct.	Nov. 14	41 0	24.5	95
" " " "	" "	Jan. 2nd	41.5	23.5	94
" " " "	Dec.	"	41.5	23.0	92.8
Fresh milkers	Dec	"	41.8	22.8	93.5

The average score in flavor of the butter made from cows milking under 6 months was 40.9; for those milking over 6 months the score was 41.7, and for fresh milkers, made in December only, and scored January 2nd, the average score of flavor was 41.8. It would seem that there is not much in the theory that the butter is not so good in flavor when made from the milk of cows advanced in the period of lactation.

Loss of Fat in Skim-milk from Farmers' Dairies.

In the months of April, May, July, and September, 100 samples of skim milk were obtained from 36 farmers' dairies in the vicinity of Guelph and the College. The methods of creaming included small shallow pans, crocks (classed as shallow pans in table), deep setting (with and without ice), and cream separator (in one dairy). No ice was used in the deep setting method in most dairies. The number of cows in each herd varied from 2 to 10. The great loss of fat in the shallow pan methods was caused by setting in warm rooms, not allowing milk to set long enough time for the cream to rise, and careless skimming. The loss in deep setting was caused mainly by lack of ice to cool the milk properly. One farmer put the cans into the well. This plan left from .8 to 1.5 per cent. of fat in skim milk—equal from 1 lb. to $1\frac{3}{4}$ lbs. of butter in every 100 lbs. of skim-milk.

There is undoubtedly a great loss of butter from the ordinary methods of creaming milk on the farm. The table of losses clearly shows that the butter lost in the skim-milk would more than pay for the cost of manufacturing in creameries. How long is this waste to continue in our dairy business? This loss is true, not only for the vicinity of Guelph, but all over the Province.

Month.	Shallow pans.		Deep setting.		Separator.		—
	Per cent. fat in skim-milk	Number of samples.	Per cent fat in skim-milk	Number of samples.	Per cent. fat in skim-milk	Number of samples.	
April	1.166	12	.70	12	.19	4	
May	.725	16	.887	16	....	....	....
July	1.119	13	.98	13	....	....	....
September ...	.457	7	1.25	7	....	....	....
Average loss	.867	....	.954	....	.19	....	....
Total samples.	....	48	....	48	....	4	100

Temperature for Ripening Cream.

Considerable discussion has been given to the question of the best temperature at which to ripen separator cream. Some advocate and practise cooling to the ripening temperature (about 60°) as quickly as possible after separating, and allow the cream to stand at this temperature with or without starter, until it is properly ripened. They then warm or cool (as needed) to churning temperature and put the cream into the churn. Others advocate ripening at a higher temperature of 70° to 75°, and then cool to churning temperature the night before churning, or allow it to cool gradually during the night. Some others recommend cooling to 45° or 50° for an hour or two after separating, and then warm for ripening. They claim that this plan improves the body and texture of the butter. Then we have the Danish practice of pasteurizing the cream (heating to 158°), and then cooling for ripening. And there is yet another plan of pasteurizing the whole milk before separating, and then cooling the cream. We have tried all these methods during the past year, but shall need to make further trials before coming to definite conclusions.

During July and August, 16 lots of cream were ripened at temperatures ranging from 70° to 78°—average 74°. An equal number of lots of the same cream were cooled to 60° to ripen. The cream ripened at the higher temperature had an average of .53 per cent. of acid at churning, and the other .47 per cent. of acid. The average churning temperature of the cream ripened at 74° was 47.4; and of the cream ripened at 60° was 47.5.

The percentage of fat in the buttermilk was .185 and 0.2 respectively. The time required for churning was 26.4 and 28 minutes.

Ten lots of cream were cooled to 48° after separating, and in one hour were heated to 60° for ripening. A like number of lots of the same kind of cream were ripened at 74° and 60°. The churning results were much the same as in the lots previously spoken of. The table shows the effect on quality of butter from the three methods of ripening cream. The scale of points used was, flavor 45, grain 25, color 15, salt 10, package 5—total 100. It will be noticed that there is not much difference in the quality of the butter obtained by the three plans. There would seem to be no good reason for cooling the cream to a temperature of 48° or below and then warming it up to 60° to ripen. It is a lot of labor and expense for nothing. If the cream be cooled to churning temperature, a sufficient length of time before it is churned (say one to two hours), in order to allow the fat time to cool and harden, the body and texture of the butter will be all right. Where the mistake is often made on this point is here—the cream standing at a high temperature is quickly cooled to churning temperature and then churned. This does not allow the fat time to harden and the butter comes soft.

Ripening temperature of cream.	Flavor. (Max. 45.)	Grain. (Max. 25.)	Color. (Max. 15.)	Salt. (Max. 10.)	Package. (Max. 5.)	Total score. (Max. 100.)
75°	42.2	23.7	14.5	9.6	5	95.
60°	42.9	23.7	14.8	10.	5	96.4
48° and 60°	42 8	23.3	14.7	10.	5	95.8

Thick *vs.* Thin Cream for Churning.

There is a tendency at present to make the cream very rich in butter fat. This plan has several advantages, such as less labor in handling, quicker churning and more exhaustive churning, and it also enables the maker to churn at low temperatures, which is a decided advantage in hot weather. Our experience goes to show that it is possible to carry this too far, and have the cream so thick that it will not churn without the addition of water, which is not advisable—skim milk is a better diluent than water. Cream with over 35 per cent. of butter fat in it is difficult to churn without diluting. The general results indicate about 25 to 30 per cent. of butter fat in cream as giving the best results in easy and exhaustive churning.

The butter made from cream averaging 18 per cent. fat had higher flavor shortly after being made, but did not hold its flavor so well as butter made from cream averaging 28 per cent. fat. Cream which is low in butter-fat contains a higher proportion of skim-milk and buttermilk, and we should expect it to develop more flavor. If the butter is to be kept for some time, this higher flavor is likely to be sooner lost and rancidity will take its place.

Pasteurized Cream.

Owing to the lack of suitable appliances, most of our pasteurizing experiments have been conducted by simply heating the cream contained in an ordinary shot-gun can (set in a hot water bath) to a temperature of 160°. In about 20 minutes afterwards the cream was cooled to ripening temperature and the "starter" was added.

The quality of the butter was improved by pasteurizing, and it held the flavor more perfectly for a length of time. What we need to-day is some suitable apparatus for "scalding" either the whole milk or cream. By adopting this system and the use of "starters," made from either the pasteurized skim-milk of our dairies and creameries or from commercial "cultures"—where suitable starters cannot be obtained in the ordinary practice—we should be able to make a decided improvement on the quality of Canadian creamery butter. In our own practice we find no difficulty in securing a nice clean-flavored "starter" from our milk, and this we propagate from day to day, sometimes having the same kind of a starter for two or three months. We observe the precaution of pasteurizing the skim milk each time before adding the old starter. We also add 10 to 15 per cent. of water, in order to get it more evenly distributed through the cream. There would be more difficulty in doing this in creameries and in ordinary dairies so as to get good results by this plan.

"Pure Cultures" *vs.* "Starters" made from Pasteurized Skim-Milk.

During the months of May and June, twelve experiments were made with Hansen's Lactic Ferment, Conn's B. 41, and a "starter" made from skim-milk. A given quantity of cream was thoroughly mixed and then divided into three equal lots, and a culture added to each. The "pure cultures" were first examined at the Bacteriological department and then sent to the Dairy, and at once used according to directions.

In the month of November three other trials were made of Hansen's and B. 41. Several trials were also made by ripening cream with these cultures which had been transferred from one churning to another.

The samples made during May and June were kept in an ordinary cool room at a temperature of about 56°. The first lot was made on May 7th, and the last on June 16th. Each sample of butter was scored two or three times by Mr. Brill between May 7th and June 22nd. On June 29th all the butter, which had been put into tubs, was sent to D. Derbyshire & Co., Brockville, to be scored. This they did on July 3rd. Some prints of each lot were kept until September 30th and then scored. The acidity of the cream was determined with alkaline tablets before adding the cultures. The acid was also determined in the evening, after the cultures had been added for five or six hours, and again the following morning before churning. Other determinations were made at various intervals between these times. The table shows the acidity.

Sweet cream. Aver. % acid.	B. 41. Aver. % acid in cream.		Hansen's. Aver. % acid in cream.		Pasteurized. Skim-milk starter. Aver. % acid in cream.	
	P. M.	A. M.	P. M.	A. M.	P. M.	A. M.
0.15	0.21	0 52	0.21	0.50	0.24	0.51
Average % acid in starters when added to the cream.	0.52		0.45		0.57	

It will be noticed that the percentage of acid developed in the cream by all the "cultures" or "starters" was practically the same. In the "cultures" themselves, at the time of adding them to the cream, there was not much difference in the acid—Hansen's having a slightly lower percentage.

The Cultures Transferred.

Four lots of butter were made from both Hansen's and B. 41 cultures by propagating the original culture and adding it to cream in from two to four days after the culture had been first prepared. The table shows the quality of butter made from these transferred "starters," and also the scoring of the butter made from the cultures on Nov. 25th and two transfers to Nov. 26th and 30th.

Kind.	Made.	Scored.	Average flavor.	Average total of all scores.
Hansen's	June	June 22	42.7	92.0
"	"	July 14, Aug. 11 & Sep. 30	32.5	
" (original S.)	Nov. 25	Jan. 2	38.0	89.0
"	" 26	"	38.0	89.0
"	" 30	"	40.0	92.0
B. 41	June	June 22	42.5	92.3
"	"	July 14, Aug. 11 & Sep. 30	35.0	
" (original S.)	Nov. 25	Jan. 2	41.0	92
"	" 26	"	40.0	91
"	" 30	"	42.0	94

Quality of the Butter.

The table shows the average score in flavor of each lot as given by Mr. Brill the first and last times. Also the score of Mr. Derbyshire; and the average of all scores.

Scored by	Hansen's. Flavor (max. 45)	B. 41. Flavor (max. 45.)	P. Skim-milk. Flavor (max. 45.)
Mr. Brill — First time	42.6	42.5	43.6
Mr. Brill — Last time	38.8	38.4	38.0
Mr. Derbyshire	41.5	44	43.8
Average of all lots made from original cultures in May and June	41.8	41.8	42 8

Summary.

1. All the "cultures" and "starters" developed about the same amount of acidity in the cream.

2. In those lots where the cream was pasteurized, the butter scored higher soon after being made and held its flavor better.

3. Of the butter made from the two "cultures" in June, there was not much difference in the flavor. The butter made from a pasteurized skin-milk "starter" scored an average of about one point higher in flavor.

4. The butter made from the transferred "cultures" was much alike in flavor when first made, but the B. 41 seems to have held its flavor better—1.5 points.

5. The "cultures" used Nov. 25th gave a scoring of 38 for Hansen's and 41 for B. 41. The transfers improved the flavor in this case. Hansen's seemed to give a "yeasty" flavor to the butter.

Effect of Washing Butter.

There is considerable difference of opinion as to the amount of washing which butter should receive. The Danish practice is not to wash at all, but to dip the butter out of the buttermilk, salt slightly, work, and pack for export. On the other hand, many Canadians go to the extreme of washing too much. If we had a "quick" market, we could, no doubt, get a higher flavor in the butter by washing slightly or not at all. Cold storage may possibly aid us, that we may leave more of the fine flavors in the butter. At present, where the butter is not consumed directly after it is made, it is advisable to wash at least once. The longer the time butter is likely to be kept, the more washing it will require to free it from the caseous matter which hastens decomposition or spoiling.

The experiments of 1896 consist of 23 churnings, made from June to September, inclusive. The average pounds of cream at each churning were 129 ; the per cent. fat in cream was 22 and in the buttermilk 0.18. The churning temperature averaged 51° and the time required for churning 44 minutes. Altogether there were 665 pounds of butter made in these trials. The plan adopted was to divide each churning into three lots—unwashed, washed once and washed twice. Samples were kept and scored from time to time. The results are seen in the table :

Scoring.	Unwashed.			Washed once.			Washed twice.		
	Flavor.	Grain.	Total score.	Flavor.	Grain.	Total score.	Flavor.	Grain.	Total score.
First	42.0	23.6	95.0	42.13	23.75	95.6	42.9	23.73	95.7
Last	34.6	24.0	88.2	38.3	24.00	90.0	38.0	24.0	91.8
Average for year	38.3	23.8	91.6	40.22	23.87	92.8	40.45	23.86	93.75

On April 20th, five lots of butter (two unwashed, two washed once and one washed twice) were sent to D. Derbyshire & Co., Brockville, to be scored. The packages were marked by number only. They reported on May 4th as follows : "We think No. 3 is the finest package of butter that we have seen this year. It is really first-class at every point." Package No. 3 was unwashed butter, made April 4th ; it scored 100 points. No. 2, made March 25th, was also unwashed butter, but scored only 90 points. Nos. 1 and 4 were washed once and scored 93 and 95 points. No. 5, washed twice, scored 95 points.

Effect of Salt on Quality of Butter.

From May to October twenty-six trials were made with different quantities of salt on butter. The quantity varied from $\frac{1}{4}$ ounce to 1 ounce of salt per pound of butter. The average pounds of cream churned were 70.65 and the pounds of butter 19.34. The average churning temperature was 50.3° ; the range was from 47° to 61°. The average percentage of fat lost in buttermilk was .198. The average pounds of cream required to make one pound of butter were 3.65. The average per cent. of fat in the cream was 22.43. Each lot of butter was handled alike, except in the quantity of salt. All the experimental butter was scored from one to three times in periods of three days to three months after being made.

The table shows that the average scoring of the butter salted $\frac{7}{8}$ oz. and over was higher at the first time than the butter salted $\frac{1}{2}$ oz. This, of course, is largely a matter of taste. However, the keeping quality of light-salted butter was not nearly so good, as is clearly shown by the results :

Scoring.	Amount of salt per lb. butter.	Flavor.	Grain.	Color.	Salt.	Package	Total. (Max. 100.)
First	$\frac{7}{8}$ oz. and over	40.83	23.8	14.75	9.8	5	94.3
Last		38.9	23.8	14.7	9.8	5	92.4
Average for year		39.3	23.8	14.6	9.6	5	92.4
First	$\frac{1}{2}$ oz. and under.	39.5	23.2	14.2	9.1	5	91.0
Last		32.5	23.3	14.3	9.2	5	83.7
Average for year		37.2	23.3	14.2	9.15	5	88.8

III.—DAIRY STOCK.

The stock at the Dairy department, Jan. 1st, 1897, consists of fifteen grade cows, four grade heifers, four grade heifer calves, six Jersey cows and heifers milking, and one Jersey calf, one Ayrshire cow, three Holstein cows and one calf, making altogether thirty-five head of cattle; we also have forty pigs and one horse.

At the annual sale, three Jerseys, one Holstein and one Ayrshire calf were sold. Some of these were too young to be profitably disposed of, but to hold them until the next annual sale would mean an expense which the prices would not cover.

During the year we have bought several cows and have sold a number for beef. Those which were not in calf or which did not come up to our standard of 6,000 lbs. of milk and 250 lbs. of butter or 600 lbs. of cheese were disposed of. We have also bought a number of hogs, besides those which we have raised from two brood sows. Altogether we have sold about $600 worth of fat hogs from the dairy which have been fattened chiefly on whey, skim-milk, buttermilk, middlings and barley meal. We aim to keep a sufficient number of hogs to consume the by-products from the dairy. An accurate account was not kept of all the hogs, but the following will show our profits on one lot.

On May 12th we bought from W. F. Barber, in the city of Guelph, thirty-two store hogs which weighed 3,365 lbs. The total cost of these was $133.51. These hogs were sold to Mr. Barber on July 13th at $4.05 per 100 lbs. They weighed 4,974 lbs. and brought $201.44. They consumed $22.17 worth of middlings, peas and barley, leaving a profit of $45.17 for dairy by-products and labor in the two months.

The Dairy department is indebted to the Farm department for about 200 tons of corn silage, also for hay, roots and a limited amount of bedding—chiefly saw-dust, which makes excellent bedding. It is better than straw, unless the straw is cut. In return for this, the Farm department receives a good many tons of excellent manure. Mr. Rennie, the farm superintendent, has very kindly allowed a team to take hogs to the city when it was required. The Dairy maintains a horse and rigs for the various departments, which make free use of "the dairy horse."

All foods not furnished by the farm are bought in the city at current market prices. This year we have been able to purchase oats at 20 cents per bushel, peas at 42½ cents, barley at 28 cents, bran at $9 per ton, middlings at $12 per ton, and oil-cake at $19 per ton. At these prices we expect to feed our cows more cheaply than we have done hitherto. Our winter ration for 1896 and 1897 is costing us thirteen cents per day.

Record of Dairy Cows.

In addition to the weighing and testing of the milk from each cow, this year we have been keeping account of the food eaten by each cow. Owing to the fact that we have but one man (together with student labor) to look after thirty to forty head of cattle and as many pigs, we have not been able to weigh all the food and the refuse. Our plan has been to weigh each item of food once or twice a month and measure it as accurately as possible the remainder of the time. While the results are not to be taken as absolutely correct, they are near enough for all practical purposes.

We were very short of pasture during the summer. Outside of a part of May and the months of June and July, our cows depended nearly altogether on stable feeding. Altogether we have charged the cows with $1 per month for the season's pasture—it is more than the pasture was worth. The green corn was cut before being fed, and we estimate a saving of about one-third of the corn by running it through a cutting-box before feeding it. There is a great deal of waste corn when it is fed whole.

Another circumstance that is against a good showing for the past year is the fact that we have had three different cattlemen. So many changes are not good for the cows. They will do better in 1897.

In explanation of the tables, we may observe :

1. That each cow's milk is weighed morning and evening and the weight recorded on the milk sheet. Samples are also taken at each milking and the composite sample is tested weekly with the Babcock tester.

2. The pounds of butter are obtained for each cow by adding ten per cent. to the butter fat.

3. The pounds of cheese are got by multiplying the pounds of butter by 2¼. (For milk with less than 3 per cent. fat multiply butter by 3, and between 3 and 3.5 per cent. multiply butter by 2½.)

4. A part of the milk is sold at four cents per quart at the dairy. A part is made into butter, which has averaged us about twenty cents per pound during the year. A part of it is made into cheese, which averaged us 8.7 cents per pound during the year.

5. The first fourteen cows on the list have been in the herd the full year. The others have been bought in from time to time, and three of them are heifers with their first calf.

6. The foods not bought were charged as follows: Hay, $6 to $10 per ton; silage, $1.30 per ton; mangels, seven cents per bushel. The grinding of the grain costs five cents per bag of two bushels and is charged to the cows.

7. The table of monthly costs of milk, butter and cheese does not include cost of feeding *dry* cows. The food cost of individual cows *includes the period when dry.*

Food cost of milk, butter and cheese, from Dairy Herd, by months.

Month.	No. cows milking.	Total food cost.	Pounds of			Average food cost of		
			Milk.	Butter.	Cheese.	1 gal. milk	1 lb. butter.	1 lb. cheese.
		$ c.				c.	c.	c.
December, 1895....	16	62 00	7,767	329	740	8.0	18.8	8.4
January...........	16	43 60	7,043	317	713	6.2	14.0	6.1
February..........	15	46 00	8,029	373	839	5.7	12.3	5.5
March	17	45 53	7,224	334	722	6.3	13.6	6.1
April	18	48 40	10,487	463	1,041	4.6	10.4	4.6
May	17	33 09	11,665	490	1,102	2.8	6.7	3.0
June..............	21	23 73	11,664	568	1,278	2.0	4 2	1.8
July	22	37 65	10,245	454	1,021	3.7	8.3	3.7
August	24	58 64	11,511	464	1,045	5.1	12.6	5.6
September	21	69 31	8,939	400	900	7.7	17.3	7.7
October	22	73 65	10,205	479	1,077	7.2	15.3	6.8
November..........	20	54 38	9,237	435	979	5.9	12.5	5.6
Average.......	19.1	49 66	9,501	425	955	5.2	11.6	5.2

Record of Dairy Herd for 1896.

Name of cow.	Breed.	Total cost of food.	Total pounds of			Average food cost of			Profit in one year with		
			Milk.	Butter.	Cheese	1 gal. milk.	1 lb. butter.	1 lb. cheese.	Milk at 4c. per quart.	Butter at 20c. per lb.	Cheese at 8.7c. per lb.
		$ c.							$ c.	$ c.	$ c.
Margaret	Holstein..	39 89	7,994	312	702	5.0	12.7	5.6	87 15	22 51	21 18
Belle Temple.........	Jersey ...	37 50	6,702	424	954	5.6	8.8	3.9	69 70	47 30	45 49
Birdie	Grade....	38 85	7,787	365	821	4.9	10.6	4.7	85 63	34 15	32 57
Pansy (1)	Grade....	28 45	5,771	227	511	4.9	12.5	5.5	63 87	16 95	16 00
Annie................	Grade....	28 23	5,341	239	537	5.2	11.8	5.2	57 21	19 57	18 48
Jennie	Grade....	26 69	4,028	120	360	6.6	22.2	7.4	37 69	*2 69	4 63
Jessie................	Grade....	29 48	3,780	161	362	7.8	18.3	8.1	31 00	2 72	2 01
Filpail	Grade....	29 60	5,006	199	448	5.9	14.9	6.6	56 40	10 00	9 37
Carrie	Grade....	29 64	3,979	169	380	7.4	17.5	7.8	34 04	4 16	3 42
Minnie...............	J. Grade.	24 36	2,389	133	300	10.1	18.2	8.1	13 86	2 32	2 61
Lisgar's Rose	Jersey ...	30 94	5,865	325	731	5.2	9.5	4.2	62 98	34 06	32 65
Patience	Ayrshire .	30 06	7,473	329	740	4.0	9.0	4.0	89 46	35 74	34 32
Maud (2).............	Grade....	27 14	4,147	180	405	6.5	15.1	6.7	39 10	8 86	8 09
Mabel................	Grade . .	32 55	5,683	235	528	5.7	13.8	6.1	58 33	14 45	13 38
Wedo (3)............	Holstein..	19 90	3,434	119	293	5.8	16.7	6.8	34 98	3 90	5 59
Ontario Belle (4)......	Jersey ...	17 43	3,195	194	436	5.4	9.0	4.0	33 61	21 37	20 50
Biddy (5)............	Grade....	19 36	4,393	194	436	4.4	10.0	4.4	50 68	19 40	18 57
Maid of Oxford (6)....	Jersey ...	13 67	2,291	105	236	5.9	13.0	5.8	22 97	7 33	6 86
Bossy (7)	J. Grade.	13 23	2,078	87	196	6.3	15.2	6.7	20 05	4 17	3 82
Beauty (8)............	J. Grade.	13 23	1,582	75	169	8.2	17.6	7.8	12 05	1 77	1 47
Rena Burnette (9)	Jersey ...	18 21	4,126	231	520	4.4	7.9	3.5	47 87	27 99	27 03
Daisy Belle (10)	Jersey ...	13 45	2,083	113	254	6.4	11.9	5.2	19 83	9 15	8 64
Lily X. Y. (11)	Jersey ...	8 17	1,278	66	150	6.3	12.3	5.4	12 31	5 03	4 88
Scott (12)............	Grade....	3 90	777	35	79	5.0	11.1	5.0	8 58	3 10	2 97
Summer (13)..........	Grade....	3 90	919	49	110	4.2	8.0	3.5	10 82	5 90	5 67
Autumn (14)..........	Grade....	3 90	1,267	50	112	3.1	7.8	3.4	16 42	6 10	5 84

(1) Sold Oct. 25th. (2) Sold Oct. 25th. (3) Bought Feb. 5th. (4) Calved Apl. 1. (5) Bought April 30th. (6) Bought June 1st. (7) Bought June 1st. (8) Bought June 1st. (9) Bought May 30th. (10) Calved July 27th. (11) Calved Sept. 1. (12) Bought Oct. 25th. (13) Bought Oct. 25th. (14) Bought Oct. 25th. * Loss.

IV. MISCELLANEOUS DAIRY NOTES.

Dairy Conventions and Farmers' Institute Meetings.

During the past year I have attended meetings and given addresses on dairy topics at the following places:

Woodstock (Western Dairy Convention), Campbellford (Eastern Dairy Convention), Cornwall (Creameries' Convention), Ormstown (P.Q.), Listowel and Elmira (branch meetings of Western Dairy Association), Londesboro' and St. Anns (fall fair). The following farmers' institutes were attended by me in December: Bath, Emerald, Stella, Cataraqui, Joyceville, Lansdowne, Mallorytown, Lyn, Delta, North Augusta, Spencerville, Wales, Cornwall Centre, St. Andrews, Lancaster, Alexandria and South Finch.

The Winnipeg Industrial fair and the Markham fair were attended by me in the capacity of judge of cheese and butter. I took charge of the dairy tests at the Toronto Industrial and at the Southern fair, Brantford. I acted as arbitrator in a dispute between the Rockwood Cheese Co. and Messrs. Brill & Hallett of Guelph. Mr. Rogers, our buttermaker, judged cheese and butter at the Guelph and Campbellford fairs, and made tests of dairy cows at the farm of Gilroy & Son, Glen Buell.

A cheese and butter makers' convention held at the College near the close of the dairy course, was very successful, and we hope to repeat it in 1897.

Testing Rennet.

During the past year there have been heavy losses on cheese in some places owing to the fact that makers have used an inferior rennet—no doubt because it was cheaper. We would emphasize the importance of using none but first-class rennet. We may easily injure our hard-earned reputation by using supplies which do not give satisfactory results.

In two instances we have tested rennet sent to us—one by a maker in Manitoba, who was not sure of the quality and strength. Our trials with it showed it to be all right. The other lot came from Quebec and had caused a great deal of trouble in that Province. We found that it had a very bad smell, but the cheese made with it on Nov. 23rd was all right on Dec. 26th. This is a bad feature of this brand, as it is said to develop a rotten smell later on. British buyers have found it to be one of the worst things ever experienced in the trade with Canadian cheese.

Then again this "cheap" rennet may have been very "dear" rennet, as we found that one ounce of Hansen's extract of rennet was equal to about $2\frac{1}{2}$ ounces of the sample sent us. Makers should beware of these so-called "cheap" rennets.

Square Cheese.

We have made several square cheese during the past year. The size has varied from 40 lbs. up to $92\frac{1}{2}$ lbs. (green). There are several advantages in boxes this shape as compared with those of circular form in common use: (1) They may be packed together more closely in car or ship. (2) They will cut to better advantage and with less waste. (3) In the curing room they may be turned on six sides or ends, which will allow more even curing. (4) Our cheese will then correspond in shape with our export butter. Nearly all are now convinced that the square package is best suited for the export butter trade.

A local dealer who saw our square cheese at once ordered some for his trade. Exporters look with suspicion on a change of shape, as they are afraid the trade will not accept it. We used to think that nothing but a tub was suited for our export butter, but one day we woke up to find that another colony had found something more suitable, and now we are imitating her. History is likely to repeat itself in reference to the cheese trade. We are surely a nation of imitators, so far as a package for our export dairy goods is concerned.

Dairy Tests.

The Toronto Industrial Exhibition requested me to take charge of the dairy test on Sept. 7th and 8th. Mr. Harry Hutton, a third year student, assisted me in the work. The conditions of the test were, that all the cows should be milked out clean on the evening of Sept. 6th, and the cows producing the greatest number of *pounds of solids* in two days (food not considered) were to be winners of the prizes. Three breeds were among the entries for the test, but all withdrew except representatives of the Holsteins. Eight cows went through the whole test. They were milked three times a day—5.30 a.m., 1 p.m. and 8.30 p.m. The table shows the yield of milk, fat and total solids from each of the eight cows:

Name of cow.	Owner.	Lbs. milk 2 days.	Lbs. fat in 2 days.	Lbs. total solids in 2 days.
1. Emery Beauty	A. Hoover	124.50	3.781	14.633
2. Carmen Sylvia	C. J. Gilroy & Son	106.00	2.743	11.342
3. Lady Akkron 2nd	G. W. Clemons	88.75	2.535	11.073
4. Princess Lida 4th	Ellis Bros	98.25	2.290	10.404
5. Cornelia Tensen	G. W. Clemons	105.75	2.117	10.399
6. Worthemall 3rd	"	107.00	2.624	10.109
7. Kaatje de Boer	"	87.75	2.599	10.090
8. Aagie Gem	A. Hoover	85.25	2.515	9.518

The cow, Emery Beauty, which won first place, was dropped March 14th, 1892. Consequently she was only about four and a half years old at the time of the test. Two cows were twelve years old, and the others ranged from five to nine years of age. It will be noticed that the cow Worthemall 3rd, was second in *quality* of milk and third in quantity of fat, and her taking only sixth place is due to the fact that her solids not fat were low—running from 7.75 to 8 per cent. Her quantity of milk at one milking ranged from 13.75 lbs. to 21.75. The percentage of fat in her milk varied from 1.8 to 3.4. Evidently this cow was affected by the conditions surrounding her at the exhibition, as so wide a variation in quantity and quality of milk would not likely be found in her milk at home. The first prize cow did not seem to be at all affected by these conditions, as her quantity of milk and percentage of fat and of solids not fat were fairly uniform from one milking to another.

The Brantford Tests.

The Southern Fair at Brantford awarded prizes on the following scale:

20 points for conformation.
1 point for each pound of milk.
20 " " " fat.
4 " " " solids not fat.
1 " " 10 days in milk after first 20 days—limit 200 days.
10 " deducted for each per cent. of fat below 3.

There were only two cows competing in this test, at which I was assisted in the judging by Mr. T. B. Millar, Instructor of the Western Dairy Association. Both cows were Shorthorn grades. The first prize cow, owned by Mr. J. R. Alexander, of Cainsville, gave 41.5 lbs. of milk in 24 hours. She had been milking 37 days at the time of the test. Her tests for fat were 4.3 in the morning and 4.0 per cent. in the evening. She produced 1.726 lbs. fat in the 24 hours, which was equal to about two pounds of butter per day. She scored altogether 109.3 points. The other cow had been milking 184 days, and gave 26.5 lbs. of milk and .99 lbs. of fat. She scored 84.7 points.

Needs of Dairy Department.

1. Man to do experimental work in the stable and piggery.

2. Continuation of the Dairy School throughout the year.

3. A cold storage building for experimental purposes. We have no proper place in which to keep either butter or cheese for any length of time. The cost of compressor, condenser, piping, etc., to cool a room 10x16 to below freezing, and another room of same size (10x16) to between freezing and 50° as required, would be about $1,000 set up. The power required to run the machine would be 4 horse power (5 hours per day), which we have to spare at the dairy. The cost of a building 16x20, which would be large enough for the dairy, horticultural and other departments, ought not to exceed $800 with properly insulated walls. This is very important at the present time.

4. A proper system of ventilating curing room and dairy stables.

5. A curing room suitable for making Stilton and other fancy cheese.

All of which is respectfully submitted.

H. H. DEAN,
Professor of Dairy Husbandry.

Ontario Agricultural College,
Guelph, December 31st, 1896.

PART VII.

REPORT OF THE AGRICULTURIST.

To the President of the Ontario Agricultural College:

SIR,—I have the honor to submit herewith my fourth annual report:

TEACHING.

My work in this department has followed very closely that of previous years, except that improved facilities have enabled me to make the work more practical and effective. The division of the first year into two sections gives more opportunity for that individual instruction and drill which are so necessary in connection with judging live stock, and we are in a better position than ever before to emphasize this part of the work.

EXPERIMENTAL FEEDING.

The new piggery, the plan of which appeared in last year's report, is proving in every way satisfactory. The experimental cattle stable, when completed, will also be fairly convenient and comfortable.

As the piggery was not finished until June, the work accomplished this year in experimental feeding is necessarily not very extensive. A report of what has been done is given below.

COMPARISON OF BREEDS OF HOGS UNDER DIFFERENT METHODS OF TREATMENT.

Though the general characteristics of the different breeds of swine are fairly well known, there is a great lack of definite information regarding them; and the experiment here recorded was undertaken as the first of a series of experiments in which it is proposed to study carefully the leading breeds of hogs under different conditions, in the hope of being able, in the course of time, to give the public something definite and reliable regarding their relative merits. It cannot be too strongly emphasized, however, that a single experiment comes very far short of settling this question. There are many things which tend to make the results of such experiments very uncertain, chief among which is the individuality of the animals used; for it is a well-known fact that two animals of the same breed, and even of the same litter, will sometimes be found to evince a wider difference in characteristics than the average difference between two distinct breeds. It therefore follows that to obtain reliable information regarding the breeds requires years of patient and careful work; and I would ask those who read the results given below to bear in mind that next year's work may very materially alter the standing of the different breeds. This experiment is merely a first step; subsequent experiments will add new light, and I trust that no one will mar the usefulness of this work by drawing hasty conclusions.

PLAN OF EXPERIMENT.

In the beginning of June thirty-six pure-bred hogs were brought to the farm. They were purchased from reputable breeders and comprised the following breeds: Six Berkshires, six Poland-Chinas, six Yorkshires, six Chester-Whites, six Tamworths, and six Duroc-Jerseys. They were divided as follows:

Group I. comprised two hogs of each breed. These were kept in the pens from the beginning to the end of the experiment. Each pair belonging to the same breed was kept in a separate pen, and the food consumed was carefully weighed. In feeding no attempt was made to force them. They were simply kept in fair growing condition.

Group II. comprised two hogs of each breed. These were turned into a clover pasture of one-third of an acre, and given just half the meal ration received by Group I.

Group III. comprised two hogs of each breed. These were given clover pasture the same as Group II., and were fed one-quarter the meal ration received by Group I.

Owing to lack of conveniences it was impossible to turn the hogs upon the clover until June 18th, at which time the clover was very much too far advanced to give good results as hog pasture; but, as all the breeds would fare alike, it was decided to let them take chances under the unfavorable conditions. This treatment, however, was not fair to the younger animals, and the Yorkshires, being the youngest, suffered very severely, as will be seen by referring to Table I., Period I. This treatment was continued until July 18th and constitutes Period I.

On July 18th Group III. was brought into the piggery and put upon full feed, while Group II. was given the run of the two plots and also put upon full feed. This was continued until October 20th and constitutes Period II.

Below is given Table I., which shows the gains made by each breed in the different groups during both periods, as well as averages for both periods and for all groups.

TABLE I.

Breed.	Average gain (live weight) per hog. Period I. June 18 to July 18			Average gain (live weight) per hog. Period II. July 18 to Oct. 20.			Total gain (live weight) per hog during both periods.			Average gain (live weight) per hog per day during both periods.			Average gain per hog for all groups during both periods.	Average gain per hog per day for all groups during both periods.
	Group I.	Group II.	Group III.	Group I.	Group II.	Group III.	Group I.	Group II.	Group III.	Group I.	Group II.	Group III.		
	lbs.	lbs.	lbs.	lbs	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Berkshire.....	16.50	1.25	1.5	87.25	110.00	113.25	103.75	111.25	114.75	.85	.89	.92	109.91	88
Poland-China.	21.25	7.25	6.0	84.00	120.00	99.25	105.25	127.25	105.25	.85	1.02	.85	112.58	.90
Yorkshire	15.00	.25	0.0	90.25	88.75	90.25	105.25	89.00	90.25	.85	.72	.72	94.83	.76
Chester-White	18.25	3.5	0.0	95.75	97.75	111.00	114.00	101.25	111.00	.92	.81	.89	108.75	.87
Tamworth....	14.75	9.75	1.0	66.25	124.25	66.75	81.00	134.00	67.75	.65	1.08	.52	94.25	.76
Duroc-Jersey.	19.50	12.75	6.25	104.25	116.00	112.50	123.25	128.75	118.75	.99	1.03	.75	123.58	.99
Average for all breeds	17.54	5.94	2.47	87.96	109.46	98.83	105.50	115.25	101.30	.85	.93	.80	107.35	.86

Table I. is necessarily somewhat complicated, and in order to compare the different groups during both periods, Table II. has been prepared from Table I. and is appended below.

TABLE II. Showing gains live weight) of different groups.

No. of Group.	Average gain (live weight) per hog. *Period I.* June 18th to July 18th.	Average gain (live weight) per hog. *Period II.* July 18th to October 20th.	Total gain (live weight) per hog during both periods.	Average gain (live weight) per hog per day during both periods.
	lbs.	lbs.	lbs.	lbs.
Group I. (In pens during both periods)........................	17.54	87.96	105.50	.85
Group II. (On pasture during both periods)........................	5.79	109.46	115.25	.93
Group III. (On pasture during Period I., in pens during Period II....	2.47	98.83	101.30	.80

It is of interest to compare the gains made by Groups II. and III. during the second period, as it is a comparison of the results of exercise *vs.* non-exercise. Both groups received the same kind of meal, and they were fed as much as they would eat up clean three times a day. It will be noticed that Group II., receiving exercise, made a much more rapid gain than Group III., and that they also made a greater total gain during both periods than Group I. It will also be noted that Group III., when compared with Group I., nearly made up for the ground they had lost during the first period.

The cost of producing 100 pounds gain is shown in Table III. below. There was considerable variety in the kinds of meal used, but the average cost of the meal during the experiment was nearly $14 per ton, and this value has been used in estimating the cost of 100 lbs. gain.

TABLE III.—Showing meal consumed, and cost of meal per 100 lbs. gain.

No. of Group.	Meal consumed. Period I.	Meal consumed. Period II.	Total meal consumed.	Meal consumed per 100 lbs. gain live weight. Period II.	Meal consumed per 100 lbs. gain live weight. Average of Periods I. & II.	Cost of meal per 100 lbs. gain (live weight) for Periods I. & II.
	lbs.	lbs.	bs.	lbs.	lbs.	
Group I.	740.5	4,810	5,550.5	455	438	$3 06
Group II.	366.5	5,469	5,835.5	416	429	$3 00
Group III.	185.6	4,748	4,933.6	400	406	$2 84

A reference to Table III. shows that Group III. made a much more economical gain than either of the other groups, leaving the value of the pasture out of consideration. As intimated before, this experiment gives very little idea of the value of clover for hogs, owing to the fact that the clover was much too far advanced when the hogs were turned upon it.

In order to compare the weights of the different breeds at given periods, and the amount of food consumed by each, use was made of the hogs in Group I., since the food consumed by each breed in the other two groups could not be ascertained. One of the difficulties attending this experiment lay in the fact that all the breeds were not of the same age. An effort was made to get them as nearly as possible of one age; but, when the pigs arrived, it was found that the difference in some cases was considerable. As the oldest pigs were 93 days old when the experiment commenced, this age was selected as a standard, and each pig in Group I. was weighed when it reached that age. Each was weighed again when it reached the age of 210 days, and the food consumed by each animal between those two periods of its life was carefully weighed and recorded. This information is not given in any of the previous tables, since this part of the experiment covers entirely different periods of time. Table IV. compares the weights, gains, food consumed, etc., between the ages of 93 and 210 days.

TABLE IV.

Breed.	Average weight per hog at 93 days.	Average weight per hog at 210 days.	Total gain per hog in 117 days.	Average gain per hog per day during 117 days.	Total meal consumed per hog in 117 days.	Meal consumed per 100 lbs. gain live weight.
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Berkshire	65.75	185	119.25	1.01	475	398
Poland-China	68.50	190	121.50	1.03	507	417
Yorkshire	50.	177	127.	1.08	589	468
Chester-White	61.75	185	123.25	1.05	557	452
Tamworth	54.	171	117.	1.	469	400
Duroc-Jersey	62.25	199	136.75	1.16	580	424

Table IV. requires little comment. It will be seen at a glance that for heavy weight and rapidity of gain, the Duroc-Jersey takes the lead; but for economy of gain, the Berkshire has a marked advantage.

A very important part of this experiment remains to be reported, viz., the market value of the animals. Here we met another difficulty arising from the difference of age; for, while we were waiting for the youngest to "come of age," the older ones were growing too heavy, and some allowance for this drawback must be made in reading Mr. Flavelle's report. The Chester-White's, Duroc-Jerseys, Berkshires, and, to some extent, the Poland-Chinas, all suffered in this respect. A remarkably fine Tamworth was also much too heavy. However, as soon as practicable, the hogs were consigned to the Wm. Davies Co., Ltd., Toronto, and Mr. J. W. Flavelle, managing-director of the company, very kindly prepared a report on them. The report is interesting and exceedingly valuable, and is inserted in full. The remarks regarding the general characteristics of each breed are based solely upon the characteristics of the animals used in the experiment, and do not necessarily apply to the breed as a whole. The numbers refer to the ear labels of the individual animals. Following is Mr. Flavelle's report:

Report of Hogs Shipped From the Experimental Farm, Guelph.

Chester White. General characteristics: Exceedingly fat, very little flesh, therefore quite unsuitable for export Wiltshire sides.

178. Short, blocky, fat hog; small bone; fat reasonably firm.

177. Short, blocky, fat hog; a little more evidence of flesh than in 178; fat, somewhat tender.

175. Blocky fat hog; fleshier than either 178 or 177, and might be used to make a second class Wiltshire Side which would command a moderate price if the market were bare; fat, reasonably firm.

174. Resembles 178.

Yorkshire. General characteristics: Good length between shoulder and ham; generally even thickness of fat from shoulder to ham down the back; bellies, thick and fleshy; the meat exceedingly full of flesh. The hogs seemed to have made flesh rather than fat. Bone, generally sizeable.

187. Good length; moderate head; sizeable bones; full of flesh; slight thickening of fat on the back in the shoulder, otherwise fat on the back, very even from shoulder to ham. This hog is suitable for the best English trade.

188. Same general characteristics as 187. Fat, even down the back without the thickening on the shoulder complained of in 187. This hog is suitable for the finest export side, and apart from being a little tender in the fat (doubtless owing to the feeding) could not well be improved upon.

189. Altogether different from 187 and 188; a shorter, blockier hog; quite too fat in the back, and deficient in thickness of belly; an undesirable hog for export purposes.

191. Small, but good length; even back; medium thickness of belly; a little tender, but the same general characteristics as 187 and 188.

186. Sizeable, fat, even on the back; good belly; very desirable hog for export purposes.

Duroc-Jersey. General characteristics: Very little flesh; feed seems to run to fat; fine in skin; head moderate; well developed in hams. This hog is entirely unsuitable for any fine English export trade, but is admirably adapted for L.C. bacon sides for Canadian lumber business, owing to being a good yielder; the bone being moderate and the fat very abundant.

183. A lump of fat; a profitable killer; a good yielder; small in bone; fat a little tender.

184. Same as above, only a little more evidence of flesh.

185. A very fat hog.

181. Short, thick hog, not so fat as the previous three, and on a bare market might be made into an export side of second grade quality.

180. Fat, short, blocky hog; a little tender in the fat.

182. The same as above with fat firmer.

Poland-China. General characteristics: Feed runs to fat rather than flesh; skin, coarse; head, large; jowls, particularly large; thin belly in contrast to fat back. These hogs are unsuitable for any export trade which is done from Canada. They doubtless could be made into export cuts for north country trade now supplied by American packers, but whether sold in this country or in England, the product would have to go to a cheap trade.

203. Moderate in bone; jowl very large; cuts fat down the back; belly, thin for weight of back; fat a little tender.

199. The same as above, except that the tenderness in the fat is quite pronounced.

200. Same as 199.

201. Short, blocky hog, much more fleshy than the others—on account of the greater development of flesh could be made into a second grade export side; fat tender.

202. A lengthy hog; has developed a good deal of flesh; a coarse thick shoulder; fat tender.

Berkshire. General characteristics: Moderately fleshy—shoulders a little large for the size of the ham; bone sizeable.

395. Rather short side; runs a good deal to flesh; bone moderate; fat a little tender; fat down the back too thick for best export side.

196. Lengthy side; fat even on the back and not too thick for export purposes, but belly quite too thin; shoulder too largely developed for the ham; fat, a little tender.

194. Heavy; lengthy; fat; suitable only for rough Canadian trade. The fat on this hog is very firm.

396. Lengthy; fleshy; a little thick on the back; belly, excellent; fat firm.

397. Blocky, short, fat hog, quite different in character to the others; suitable only for Canadian trade. The belly in this hog is thin considering the stoutness of the back; fat, firm.

Tamworth. General characteristics: Exceedingly fleshy; small shoulder; evenness of side from ham to shoulder; evenness of fat on the back; a long head which, however, is compensated by neck being moderate; bone, sizeable.

22. Lengthy; fleshy; even down back; good belly; long head; sizeable bones; small shoulder; well developed ham; fat, tender, apart from this fault in every way a desirable hog.

19. The same general characteristics as the above, but a little too fat down the back. If killed a few weeks earlier no fault could have been found with the hog. The fat is firmer than in 22.

18. Same general characteristics, but belly thin.

23. Same general characteristics, but fat too thick on the back; running however very even in depth from shoulder to ham; fat, a little tender.

The two varieties of hogs above, which are unquestionably in advance of all the others from the standpoint of a Canadian exporter, who wants a long lean side with a well developed belly and small shoulder and full ham, are the Yorkshire and Tamworth; next is the Berkshire; the others are generally so unsatisfactory that they do not need to be considered.

All the hogs except one or two of the Berkshire gave evidence of being tender or inclined to be soft. In the Poland-China this was particularly noticeable; while in the Berkshire there was a decided tendency to firmness absent in all the others.

From the standpoint of an exporter nearly all these hogs have developed too much fat for the amount of flesh produced.

Yours truly,

J. W. FLAVELLE.

After the above report was received, Mr. Flavelle was asked to state the market value of each animal, and in response to this request he sent the following reply:

MARKET VALUES.

We have your letter of the 4th, and will be pleased to give you the further information you desire, although we hardly see how we can give you ideas of value for each variety of hog. Perhaps it will be well for us to indicate some general lines on which we establish values from time to time, and then you can yourself apply the prices to the several varieties.

The English market for Wiltshire sides is in a general way divided first in relation to the fatness or leanness of a side, and second as to its size.

The most desirable hog is one which will make a side weighing from 42 lbs. to 55 lbs. If it be made from a hog with the fat even down the back, and not too much of it, and a good thick belly, it will grade as No. One selection. If the back be too stout, with perhaps only the extra fat bowed up on the shoulder, it may go into what we call No. Two selection. This No. Two selection is purely regulated by the fatness of the side. If it is extra stout, it goes forward as "fat." The value of a No. Two side fluctuates very greatly; sometimes when the market is in a peculiarly active condition, No. Two sides will sell almost on a parity with No. One. The general difference is from 2/— to 8/—, with perhaps an average through the year of 4/— per cwt. Heavier sides weighing say from 60 lbs. to 70 lbs., even if lean, often bear a severe reduction in price, while if they are fat we have known the difference to reach the extreme point of 12/— per cwt., although this of course is a very rare case.

The tendency in Canada during the past five years has been to gradually grow more severe in relation to selection of hogs. Occasionally, for certain local reasons, we have been compelled to lapse back into less careful distinction, but on the whole the tendency has been to more severe discrimination against undesirable types of hogs, or hogs which were too fat or too large for best sides.

We have not found it possible to make the discrimination average as severe as the average difference between No. One and Two sides in England would seem to warrant. There are all kinds of elements entering into a matter of this kind which make it prudent to adopt methods which will give general average results, although at the same time believing that the correct theory would be to pay for each kind absolutely on its merits.

The value of hogs like your Chester White, Duroc-Jersey, and Poland-China is largely determined by the season of the year in which they are marketed. The sections from which these come the most freely (Essex and Kent) have always catered to the dressed-hog trade, and have been in the habit, prior to eighteen months ago, of marketing their hogs almost exclusively during the winter months. These hogs were marketed at a time when the export business was the worst—the winter trade always recording lower prices in England than the summer, hence these hogs have sold for dressed-hog purposes fairly well up to desirable Wiltshire stock. We are, however, as exporters, gradually pulling away from them even in winter time, and to-day we are paying for prime lean hogs up to 200 lbs., 4 cts., while for fat hogs and hogs over 200 lbs., we are only paying 3½ cts. Your Chester Whites, Duroc-Jersey, and Poland-China, would all come in the 3½ cts. class; unless possibly hog 181 Duroc-Jersey, 210 Poland-China, 175 Chester White. These on account of being sizeable, and showing some evidence of flesh, might pass with a lot of other hogs and command the first value, although applying the theory of selection severely they would be thrown out.

Again, 189 of the Yorkshires would probably be thrown out into the $3\frac{1}{2}$-cent class.

The Berkshires would probably run about as follows: 395 would class as a best hog when alive, notwithstanding the fact that after dressed it developed a thin belly. These nicer distinctions of the fatness or thinness of the belly cannot be passed on in buying hogs in a lot. The value of criticism upon such a distinctive feature in this particular hog is to call the attention of breeders to the necessity for improvement in this respect, and not because the packer would discriminate against a hog of this particular type on account of such a defect, although theoretically he ought to. The same general remarks will apply to 196. 194 would be classed among the $3\frac{1}{2}$-cent group. 396 would pass for best unless its extra length would mean it was too heavy. 397 would belong to the $3\frac{1}{2}$-cent type.

Coming to the Tamworths, I have not before me the individual weights of these hogs, but my memory is that the hog complained of for being too fat was also a little too heavy. The same thing, however, which would have corrected the complaint of being too thick in the back would have kept them in more moderate size, viz, killing them some weeks earlier.

I am persuaded that what we want to cultivate in Canada is a hog which will develop well in flesh, have a deep side, well proportioned ham and shoulder, and which will be put upon the market when weighing between 165 and 190 lbs. Care should be exercised in breeding to develop a hog with a good thick belly, and special attention should be given to producing a type which will back down even with fat and carry a side as nearly as possible even throughout.

I have noticed frequently when in England going into one of the large dry houses (smoke houses) in which were hung Canadian, Irish and Danish sides, that a marked feature of the Canadian was the way it ran off in the loin and ham. The shoulder end of the side in the Canadian showed quite too much development in contrast to the ham. This is a defect which deserves the earnest consideration of all those interested in the development of this business. This much, however, must be said in defence of the Canadian, that his best market having been in sides running from forty-two to fifty pounds, there has been a tendency to pay full values for their little hogs which would make sides as small as the above even if the shoulder were a little unduly developed.

When the long, lengthy hog is bred, particularly in the Yorkshire crosses, it sometimes seems almost impossible to put the hog on the market, owing to his biggish frame, until he has developed so much weight that although making a grand, long, lean side, it is too heavy for the market upon which the Canadian side is placed. The Dane and the Irishman, on the other hand, having as their large consuming centre the city of London, can sell at top values sides weighing several pounds more than the above weights, and hence their well developed, long, lean hogs are marketed on favorable terms.

I am sorry to say that as yet the Canadian curer has almost no place on the London market proper for consumption in London. The really fine trade of that most critical city has never commenced to use Canadian bacon. We hope before five years go by to see a change in this respect; efforts are now being made in that direction for the first time in a thoroughly intelligent manner.

I have thought it prudent to write at this length so that you might understand why I did not feel like arbitrarily setting the value of these several varieties of hogs.

I know it is quite possible when one is familiar with a subject to make explanations which seem to him perfectly lucid, but which coming to an outsider for the first time only lend greater confusion to his mind. It will give me very great pleasure indeed to answer any questions which you may put to me specifically touching anything I have said in this letter, if by so doing I can be of any service in giving you a clearer insight into this most important question of raising the proper class of hog for best English export trade.

You must not view our attention to this matter as an evidence of our unselfishness. We are deeply interested in the feeding operations conducted on your farm, as well as those at Ottawa, and feel that our interests are thoroughly in common.

Yours truly,

J. W. FLAVELLE.

Mr. Flavelle's report is so clear that it requires no explanation. The tenderness of fat noted in so many cases is difficult to understand, and experiments have been commenced for the purpose of investigating the cause.

As a summary of the whole matter Table V. has been prepared, in which the breeds are arranged in order of merit as regards the several purposes noted at the head of the columns. This order of merit is true only so far as *this single experiment indicates*, and no further.

Table V.

Arranged in order of rapidity of gain in pens.	Arranged in order of economy of gain in pens.	Arranged in order of adaptability to pasture.	Arranged in order of suitability for export trade.	Arranged in order of percentage of dressed carcase.	
					Per-cent.
1. Duroc-Jersey.	1. Berkshire.	1. Duroc-Jersey.	1. { Yorkshire.	Duroc-Jersey	77.21
2. Yorkshire.	2. Tamworth.	2. Poland-China.	Tamworth.	Berkshire	77.19
3. Chester White.	3. Poland-China.	3 Tamworth.	2. Berkshire.	Poland-China	77.18
4. Poland-China.	4. Duroc-Jersey.	4. Chester White.	{ Poland-China.	Chester-White....	77.10
5. Berkshire.	5. Chester White.	5. Berkshire.	3. { Chester White.	Tamworth........	75.79
6. Tamworth.	5. Yorkshire.	6 Yorkshire.	Duroc-Jersey.	Yorkshire........	74.45

With regard to the percentage of dressed carcase, it is only fair to state that the Tamworths and Yorkshires were, on the whole, younger, smaller and leaner hogs than the others, and hence the lower percentage.

I shall conclude the report of this experiment as I began, by appealing to breeders, feeders, and others, not, as yet, to commend or condemn, but to wait patiently for further developments.

Comparison of the Value of Sweet and Sour whey for fattening Hogs.

This work was undertaken at the request of the Western Dairymen's Association; and at the present date, two experiments have been completed. Though the results of the two experiments agree very closely, it is the intention to carry on the work still further next season, commencing as soon as sour whey is available.

The experiments were conducted as follows: On August 15th, nine uniform hogs were purchased from the Dairy department, and divided into three groups, each group containing three hogs. During the first seven days, all the groups were fed the same ration, and their gain in weight during this period was carefully ascertained. By referring to the fourth column of Table I. it will be seen that the average daily gains during this preparatory period were very uniform. At the end of this period, August 22nd, the rations were changed: Group I. was given a ration of meal and water; Group II. meal and sweet whey; and Group III. meal and sour whey. These rations were continued from August 22nd to October 16th, a period of 55 days. In Group I. the meal was moistened with water; and the hogs were given water to drink, in addition. In Groups II. and III. the meal was moistened with whey; about two pounds of whey being used to one of meal. They were given water to drink during the first two weeks, at the end of which time whey was substituted for the water; but, in a short time, one hog in each group became somewhat stiffened, and it became necessary to reduce the amount of whey. The hog in Group III. made a rather slower recovery than that in Group II. and this accounts for the smaller amount of whey consumed by Group III.

On October 15th, nine more hogs, all of one litter, were purchased, and a second experiment commenced. The preparatory period extended from October 15th to October 22nd, and the experiment proper from October 22nd to December 3rd, or 42 days. At the end of the preparatory period, two hogs were rejected as unsuitable, and the experiment was conducted with two hogs in each of Groups I. and II. and three hogs in Group III. The fourth column of Table III. shows that during the preparatory period, the hogs which were retained made very uniform daily gains. The second experiment was conducted on the same plan as the first, except that the hogs were given no whey besides what was used to wet their meal.

The following tables explain themselves:

Whey Experiment No. 1.

Table I., showing weights and gains (live weight) of hogs used.

No. of group.	Weight of hogs at beginning of preparatory period (Aug. 15.)	Weight of hogs at end of preparatory period, (Aug. 22, 7 days).	Total gain during preparatory period.	Average gain per hog per day during preparatory period.	Weight at end of experiment (Oct. 16).	Total gain during experiment proper (Aug. 22 to Oct. 16, 55 days).	Average gain per hog per day during experiment proper.
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Group I. (Water)	336	361.5	25.5	1.21	564	202.5	1.23
Group II. (Sweet whey)	339	365.	26.	1.23	635	270.	1.64
Group III. (Sour whey)	357	381.5	24.5	1.16	648	266.5	1.61

Table II., showing food consumed during experiment proper (55 days).

of group.	Total amount of meal.	Total amount of whey.	Food consumed per 100 lbs. gain live weight.	
			Meal.	Whey.
	lbs.	lbs.	bs.	bs.
Group I. (Water)	1,007.	....	497.	....
Group II. (Sweet whey)	1,005.75	2,543.	372.	941.
Group III. (Sour whey)	1,012.75	2,315.	380.	868.

Whey Experiment No. 2.

Table III., showing weights and gains (live weight) of hogs used.

No. of group.	Weight of hogs at beginning of preparatory period (Oct. 15).	Weight at end of preparatory period (Oct. 22, 7 days).	Total gain during preparatory period.	Average gain per hog per day during preparatory period.	Weight at end of experiment, Dec. 3.	Total gain during experiment proper (Oct. 22 to Dec. 3, 42 days).	Average gain per hog per day during experiment proper.
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	
Group I. (2 hogs—water)	295	320.0	25.0	1.78	457.5	137.5	1.63
Group II. (2 hogs—sweet whey)	317	341.5	24.5	1.75	500.0	158 5	1.88
Group III. (3 hogs—sour whey)	439	476 0	37.0	1.76	722.0	246.0	1.95

Table IV., showing food consumed during experiment proper (42 days).

No. of group.	Total amount of meal.	Total amount of whey.	Food consumed per 100 pounds gain live weight.	
			Meal.	Whey.
	lbs.	lbs.	lbs.	lbs.
Group I. (2 hogs—water)	674.	....	490	....
Group II. (2 hogs—sweet whey)	623.5	1,235	390	779
Group III. (3 hogs—sour whey)	949.	1,894	385	769

Table V., showing average results of two experiments.

No. of group.	Average gain (live weight) per hog per day.	Average amount of food consumed to produce 100 lb. gain live weight.	
		Meal.	Whey.
	lbs.	lbs.	lbs.
Group I. (Water)	1.43	493.5	....
Group II. (Sweet whey)	1.76	381.0	860.0
Group III. (Sour whey)	1.78	382.5	818.5

The results of these two experiments will no doubt be a surprise to many, since sour whey is commonly regarded as having little or no feeding value. It is too soon, however, to draw conclusions, though the results of the two experiments correspond very closely indeed, and indicate that sour whey is practically equal to sweet whey in feeding value. As stated before, this work will be continued next season, and it is intended to have analyses made of the sweet and sour wheys.

The meal mixture fed during the first experiment consisted of wheat and barley, equal parts by measure, mixed with an equal weight of shorts. For the second experiment, peas were used in the place of wheat.

By reference to tables II. and IV. it will be seen that group I. in the first experiment required more meal to produce 100 pounds of gain than group I. in the second experiment, which would indicate the superior feeding value of peas, as compared with wheat. But it will be further seen that in the first experiment, groups II. and III. required *less* meal to produce 100 pounds gain, than groups II. and III. of the second experiment. This apparent inconsistency may be accounted for on the grounds that *more* whey was fed during the first, than during the second experiment.

The average of the two experiments shows 100 pounds of whey (sweet and sour) to be equal to 13.31 pounds of the meal used. At the prices paid for the grain and shorts, 13.31 pounds of meal cost, approximately, 8 cents.

EXPERIMENTS IN PROGRESS.

At the present time, nine steers are being used in an experiment intended to test the relative merits of light and heavy meal rations; and twenty-one hogs have just been purchased, for the purpose of testing different rations, both as regards economy of production, and quality of pork. In addition to these, it is intended to commence experiments in feeding milch cows, if suitable arrangements can be made.

EXPERIMENTAL UNION.

As director of the Live Stock Committee of the Ontario Agricultural and Experimental Union, I have devoted considerable time and labor to gathering information regarding rations used by Ontario dairymen, dehorning, remedies used for the horn fly, etc. This information, together with remarks on the principles of feeding, on the composition of fodders, on formulating rations, etc., has been published by the Department of Agriculture as bulletin 104 of this College, and therefore no further description is necessary.

FARMERS' INSTITUTES AND CORRESPONDENCE.

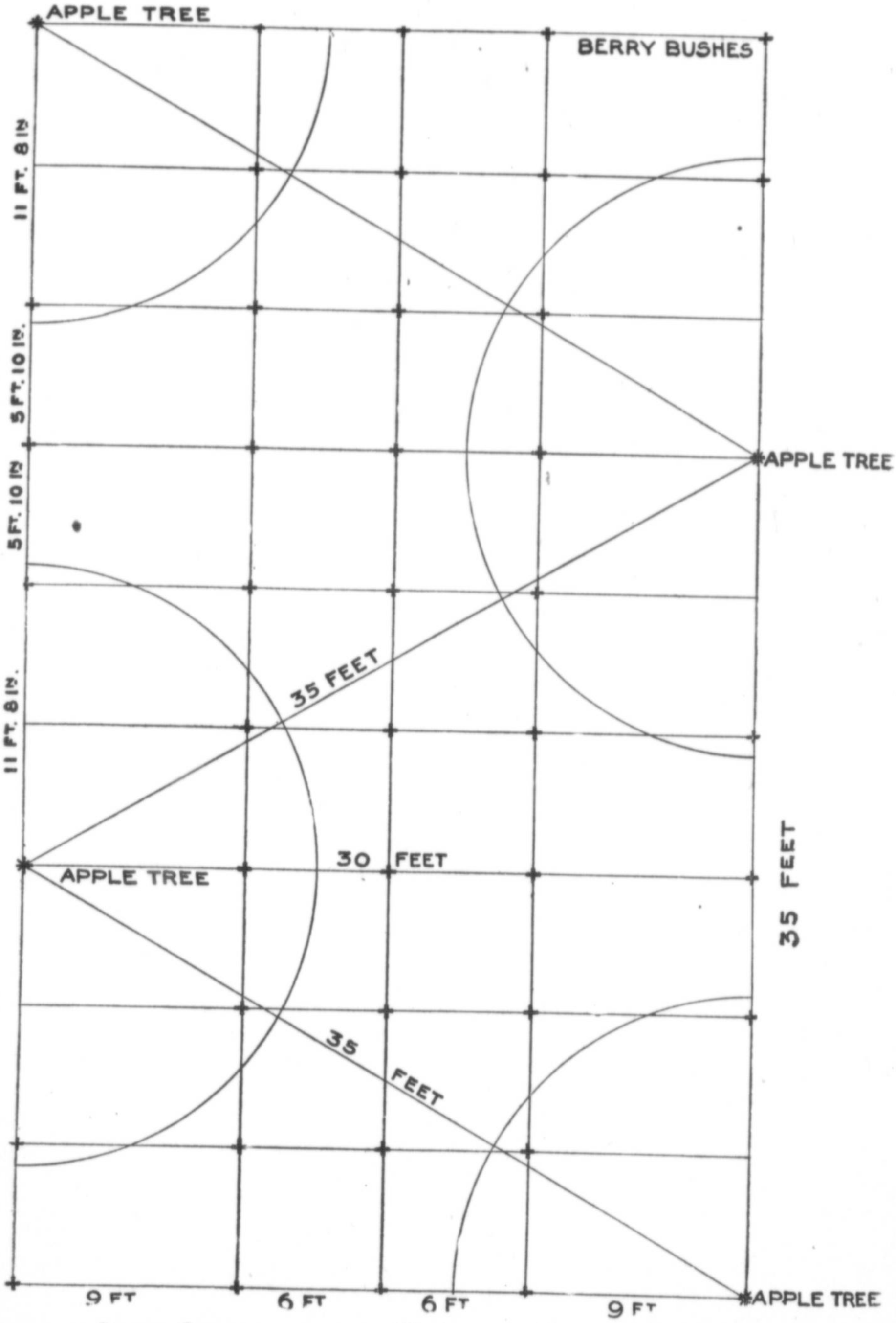
Attending Farmers' Institutes and answering questions by correspondents, relating to a wide variety of subjects, continue to form an important part of my work, though the time devoted to Farmers' Institutes was considerably shortened this year.

In conclusion, I beg to gratefully acknowledge the co-operation and assistance of other departments, especially the farm department, in carrying on experimental work. I trust that during the coming year we shall be able to furnish something towards the solution of some of the problems which confront the feeder.

Respectfully submitted,

G. E. DAY,
Agriculturist.

ONTARIO AGRICULTURAL COLLEGE,
December 31st, 1896.



APPLE ORCHARD ON THE HEXAGONAL PLAN. (See page 84.)

PART VIII.

REPORT OF THE HORTICULTURIST.

To the President of the Ontario Agricultural College:

SIR,—I have the honor of presenting herewith the report of the Horticultural Department for the year 1896.

I.—TEACHING.

1. LECTURES.

A full course of lectures, as outlined in the College circular, has been given to all the students of the second year, and a similar course is being given to those students taking Horticulture as their special work in the third year. The course covers as fully as is thought practicable the subjects of Fruit Growing, Vegetable Gardening, Floriculture and Landscape Gardening. An effort has been made to make the course as practicable as possible. Each subject treated of in the class has been illustrated by means of specimens of trees, vines, plants, fruits, flowers, vegetables, etc.; and we have endeavored by systematic questioning to induce students to observe and reason for themselves.

2. PRACTICAL WORK.

I have given personal attention to the practical instruction of all the students of the second year in such work as planting berry bushes; pruning apples, pears, raspberries, currants, and gooseberries; pruning, training, and trellising grapes; practising the different methods of grafting hard and soft wooded plants; preparing spraying mixtures and handling spraying pumps; originating new varieties of fruits, flowers, and vegetables by hand pollination; germinating and testing seeds; transplanting seedlings; growing forcing crops, and potting and handling house plants.

During the year students have shown much interest in the work, both in the class-room and in the outside branches of the department, and this interest has made the task of teaching a pleasant one.

II.—MANAGEMENT OF THE HORTICULTURAL DEPARTMENT.

The regluar work of this department, apart from teaching, is of a varied character. It includes the care and management of: 1. The orchards and fruit plantations; 2. Vegetable garden; 3. Lawn and grounds; 4. Arboretum and tree plantations; 5. Conservatories and greenhouses.

1. ORCHARDS.

The apple crop this year has been unusually large in nearly all parts of the country, and the crop here was no exception to the rule. The few old trees we have in bearing produced about 150 barrels of good fruit, enough for the first time in many years to meet the requirements of the College.

The young orchard planted in 1891 has been well cultivated, carefully pruned, and thoroughly sprayed. The trees have made a good growth and a number of them bore fruit this year for the first time. The regular spraying followed up in this orchard for the past two or three years, before the trees were of a bearing age, has brought about good results in promoting a vigorous growth. The application used was a combination of the Bordeaux mixture and Paris green. The Paris green has proved quite effective in ridding the trees of a number of leaf-eating insects, such as the tent caterpillar, red-humped caterpillar, and fall web-worm, with which they were badly infested a few years ago. And the Bordeaux mixture has prevented the attack of the apple-scab fungus (*Fusicladium dendriticum*), which attacks the foliage as well as the fruit. The spaces between the trees in this young orchard were planted this year with such small fruits as raspberries, currants and gooseberries, which will give some return from the land until the orchard comes into full bearing. They have been planted so as to admit of thorough cultivation, and so that they do not encroach upon the space occupied by the trees. After a few years they will be gradually taken out as the trees require more room.

2. Small-fruit Plantation.

The small-fruit plantation set out in 1891 is made up of a few of the leading varieties of raspberries, currants, and gooseberries, and is now in full bearing. The raspberry canes were seriously winter-killed last winter, owing no doubt to their weakened, immature growth after the severe late frosts in the spring of 1895. The crop on this account this year was a light one. The currants and gooseberries, however, yielded an abundant crop.

This plantation being too small for our requirements a new one was set out this spring between the rows of trees in the young apple orchard. The bushes were arranged so that cultivation may be given both ways with a minimum amount of hand hoeing. The accompanying plan (see page 82) shows the arrangement of the trees and bushes, and is made on a scale of 8 feet to the inch. The trees are planted on the hexagonal plan, the rows being 30 feet apart and the trees 35 feet apart in the rows, the trees in one row alternating with those in the next. By this method of arrangement 15 per cent. more trees can be planted to the acre than by the ordinary method, and yet not be any more crowded. The bushes are 6 feet apart one way by 5 feet 10 inches the other. At present no trees are nearer than 9 feet to the apple trees. As the trees increase in size, those bushes within the circles, as shown on the plan, will be the first to be removed. This plan of arrangement, we think, is well worthy of consideration by any one who intends to plant an orchard or small-fruit plantation.

In the new collection of small fruits we have planted all the varieties we could obtain from Canadian nurserymen of red, white, purple, and black raspberries; red, white, and black currants; English and American gooseberries, and blackberries. From this collection we hope to derive some valuable information as to the adaptability of these different fruits to this section of the country.

On account of the extremely dry weather for a month or six weeks after planting, there have been a number of failures, but all such blanks will be refilled next spring.

3. Test of Varieties of Strawberries.

Early in the spring of 1895, a plot of strawberries was planted in the vegetable garden, the intention being to include strawberries in the regular rotation of garden crops. This plot is 100 yards long by 28 yards wide, being a little over an acre in extent. The yield from it this year was a little over 2,250 boxes—more than enough to supply the demands of the College.

A portion of the plot was devoted to the testing of varieties, 121 of which are reported on in the tabular statement following.

Test of Varieties of Strawberries.

Rank.	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	Weight of 50 average berries.	Firmness.
						May.	June.		Ounces.	Ounces.	
1	Warfield	P	11	10	6	11	8	July 4	294.00	9.25	V F
2	Afton	P	12	10	5	7	8	June 29	264.00	7.75	V F
3	Edgar Queen	P	12	10	5	15	15	July 9	244.50	9.00	M
4	Bisel	P	12	10	8	12	13	" 6	243.50	13.25	F
5	Prize	P	12	10	5	12	8	" 2	236.50	9.00	F
6	Standard	P	11	10	8	12	8	" 6	228.75	11.00	M
7	Barton's Eclipse	P	12	8	9	12	8	" 4	214.00	16.50	M
8	Saunders	B	12	10	7	17	15	" 6	207.00	14.50	F
9	Mrs. Cleveland	P	12	10	5	12	10	" 9	206.25	9.00	M
10	Haverland	P	10	10	10	2	8	" 2	205.00	13.00	M
11	Greenville	P	12	9	7	12	13	" 4	202.50	15.00	S
12	Chairs	P	9	8	7	12	8	" 2	201.50	8.00	M
13	Stone's Early	B	12	10	7	12	13	" 2	201 25	9.75	M
14	Boynton	P	12	8	8	9	8	" 4	197.75	5.75	F
15	Seedling A	P	11	10	5	12	8	" 9	192.75	9.75	F
16	Lovett's Early	B	11	10	7	12	8	" 13	191.75	15.00	V F
17	No Name	B	12	9	7	12	10	" 2	188.25	15.00	V F
18	Bubach	P	12	8	9	12	10	" 2	185.25	20.25	F
19	Gandy	B	12	9	7	7	8	" 2	183.25	19.50	F
20	Oberholtzer No. 1	B	12	10	9	7	8	" 2	181.25	14.50	M
21	Eureka	P	11	10	6	13	10	" 6	181.25	13.50	S
22	Belle (Crawford's 51)	B	10	8	9	11	13	9	180.50	18.00	F
23	Gertrude	B	12	10	6	9	8	June 29	179.50	6.00	F
24	Swindle	P	11	7	4	12	10	July 21	178.25	12.25	V F
25	Unknown	B	12	10	5	10	13	" 6	174.75	20.00	F
26	Jocunda Improved	B	12	8	5	15	15	" 6	173.00	7.00	V F
27	Phillips	B	12	10	8	12	10	" 6	172.00	20.50	F
28	Crescent	P	11	10	8	11	8	" 2	167.00	6.50	F
29	Martha	P	12	10	5	14	15	" 6	164.75	10.75	V F
30	Robinson	B	11	8	5	12	8	" 6	164.25	11.00	S
31	Williams	B	12	9	6	17	15	" 6	164.00	17.50	V F
32	Dr. Arp	P	12	8	5	12	8	" 9	163.75	12.50	M
33	Tennessee Prolific	B	12	10	9	12	13	" 6	163.75	15.50	M
34	Splendid	B	12	10	8	14	15	" 6	163.25	17.00	F
35	Prince of Berries	B	11	8	6	12	10	" 9	163.25	16.00	
36	Southard	B	11	10	10	7	8	" 9	162.00	11.00	M
37	Northern	B	12	10	6	12	13	July 6	159.25	12.00	F
38	Enhance	B	11	8	7	12	13	" 4	158.50	14.50	V F
39	Leader	B	12	8	10	9	8	" 6	157.75	14.50	F
40	Isabella	B	12	7	5	12	7	" 6	156.75	12.50	F
41	Smith's Seedling	B	10	10	6	9	8	June 26	156.50	11.50	S
42	Howard's No. 41	P	12	10	9	12	10	July 4	156.00	11.25	V F
43	Rio	B	12	10	6	7	8	June 29	153.50	9.00	F
44	Charlie	P	11	9	6	11	8	July 4	152.75	9.00	V F
45	Shuster's Gem	P	11	8	9	11	8	June 29	152.25	8.50	F
46	Effie May	B	12	8	9	9	10	July 2	145.00	13.50	S
47	Van Deman	B	10	9	7	5	8	June 29	141.75	10.50	F
48	Michel's Early	B	12	10	5	9	8	" 26	140.50	5 00	S
49	Cyclone	B	11	10	10	9	8	July 4	139.25	7.00	F
50	Equinox	B	12	9	5	13	17	" 9	138.00	12.50	M
51	Bessie	B	12	8	8	9	9	" 2	137.00	8.25	F
52	Woolverton	B	11	9	7	12	15	" 4	131.50	13.00	F
53	Snowball	B	12	9	7	7	8	June 29	131.50	8.50	M
54	Ohio Centenial	B	11	7	7	12	8	July 21	126.25	17.50	F
55	Dayton	B	12	8	7	12	8	" 2	124.25	13.75	M
56	Lady Rusk	F	13	7	5	12	10	" 2	124.00	5.50	V F
57	Mary	P	12	9	6	13	13	" 9	122.75	21.50	V F
58	Princeton Chief	P	12	8	7	14	17	" 13	122.75	10.00	F
59	Hunt's No. 3	B	7	7	6	13	10	June 29	121.50	13.25	F
60	Sunnyside	P	10	9	6	14	13	July 6	120.75	13.75	M
61	Timbrell	P	11	9	7	12	17	" 9	117.00	14.00	F

TEST OF VARIETIES OF STRAWBERRIES.—*Continued.*

Rank.	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.	Weight of 50 average berries.	Firmness.
						May.	June.		Ounces.	Ounces.	
62	Aroma	B	12	8	10	12	15	" 4	114.50	17.00	F
63	Beverly	B	12	8	9	9	8	" 9	113.75	9.50	F
64	Kossuth	B	9	8	5	7	8	June 26	113.25	8.50	S
65	Muskingum	B	12	8	7	12	13	July 13	109.50	13.50	F
66	Jessie	B	7	7	9	7	8	June 29	106.50	13.00	S
67	Marshall	B	12	9	7	13	10	July 4	105.25	18.00	F
68	Caughell's No. 2	B	12	10	6	14	17	" 6	102.50	11.50	S
69	Alabama	B	11	9	6	12	13	" 4	100.75	11.75	F
70	Nehring's Gem	P	12	10	8	17	15	" 9	98.75	12:00	V F
71	Beauty	B	11	9	10	11	8	June 29	98.50	12.50	M
72	Hatch Expt. Stn. No. 24	B	10	7	5	17	17	July 9	97.25	8.50	F
73	Governor Hoard	B	11	8	5	12	10	" 2	96.00	12.00	M
74	Klickita	P	12	8	6	11	13	" 4	93.25	9.25	V S
75	Farnsworth	B	11	7	6	9	8	" 2	92.50	9.00	F
76	Epping	P	6	6	8	13	8	" 6	92.25	12.75	S
77	Fremont	B	12	8	5	17	15	" 4	91.50	10.50	F
78	Ivanhoe	B	10	8	6	12	10	" 4	89.75	11.75	F
79	Judsonia	B	11	7	8	12	13	" 6	89.25	13.25	S
80	Scarlet Ball	P	12	8	7	14	19	" 13	87.00	12.00	S
81	Howard's No. 25	B	9	9	7	11	8	June 26	86.00	11.50	M
82	Glenfield	B	10	8	6	2	8	" 26	83.75	8.50	F
83	Oberholtzer No. 4	P	12	10	5	15	9	July 9	71.75	11.50	F
84	Stone's No. 7	B	12	10	4	12	13	" 2	70.75	7.75	M
85	Alpha	P	12	7	10	9	10	June 29	69 50	15.50	V F
86	Be ler Wood	B	10	8	7	7	8	" 29	67.00	9.00	F
87	Ona	P	10	6	9	12	8	" 29	62.75	9.00	S
88	Watson	P	12	6	7	12	10	" 29	62.75	7.50	F
89	Oberholtzer No. 2	P	12	10	5	17	19	July 13	61.25	9.00	F
90	Jersey Queen	P	12	6	6	17	19	" 6	57.25	8.50	F
91	Parker Earle	B	11	7	7	9	8	June 29	56.25	11.50	F
92	Belle of Lacrosse	B	7	8	5	12	10	" 29	39.75	......	F
93	Wicomico	P	10	6	9	12	10	" 26	39.50	7.75	F
94	Auburn	P	12	9	9	15	15	" 29	37.50	......	F
95	Crimson Cluster	P	8	4	6	12	8	" 29	35.25	12 25	F
96	Arrow	P	4	8	10	7	8	" 26	33.50	7.50	M
97	Steven's Early	B	9	6	8	9	8	" 24	30.50	2.00	......
98	E. P. Roe	B	9	4	9	9	15	July 2	29.50	......	M
99	General Putnam	P	10	5	8	5	8	June 24	26.75	......	......
100	Gandy Belle	B	8	4	9	12	10	" 24	25.25	......	......
101	Cruse's No. 9	B	7	4	8	7	8	" 24	24.25	......	......
102	Clyde (Fall planted)	B	12	10	10	11	8	" 24	22.75	......	......
103	Accomack	B	11	7	7	9	10	" 26	20.00	7.50	S
104	Price	B	12	7	8	9	10	" 26	19.75	3.00	S
105	Beebe	B	7	4	10	12	10	" 29	19.50	......	......
106	Anna Forest	P	12	9	10	15	15	" 29	18.00	......	F
107	Westlawn	P	2	8	10	12	10	" 22	16.25	7.25	......
108	Gillespie	B	9	4	9	9	8	" 24	15.00	......	......
109	Regina	P	12	9	8	17	22	July 2	12.75	......	F
110	Little's No. 30 (Fall planted)	P	9	8	10	15	22	" 13	11.75	......	F
111	Dew	B	11	4	9	7	15	June 24	8.00	......	......
112	Edwards' Favorite	B	9	3	8	11	10	" 24	8.00	......	......
113	Princess	P	5	6	10	21	15	" 22	7.00	......	......
114	Wentzel	B	12	5	10	12	10	" 19	5.25	......	......
115	Early Idaho	B	9	4	7	13	13	" 22	5.00	......	......
116	Brandywine (Fall planted)	B	12	8	9	13	13	" 22	4.75	......	......
117	Clark's Early	B	12	3	8	12	10	" 17	4.00	......	......
118	Meek's Early	B	2	7	10	12	15	" 17	.50	......	......
119	Leviathan	B	1	7	10	22	......	......	......	......	......
120	Westbrook	P	4	6	10	12	......	......	......	......	......
121	Alpine ("Everbearing")	B	5	4	10	2	8	Oct. 8	Not weighed		S

The treatment given may be briefly outlined as follows: Previous to planting the ground was plowed, subsoiled and thoroughly cultivated. The plants were set in rows four feet apart and fifteen inches apart in the row. Twelve plants of each variety were planted and all runners allowed to set, forming a matted row fifteen feet long. Thorough cultivation was given thoroughout the season and each variety was confined to its fifteen feet of row. All blossoms were picked off the first year. After the ground had frozen hard in the fall it was lightly mulched with short stable manure. Long strawy manure would have been preferred had it been obtainable. When growth commenced in the spring the thickest of this mulch was swept off the plants into the spaces between the rows. This not being heavy enough to keep down the weeds, the cultivator was started and the mulch worked into the soil. The soil being a rather heavy clay loam, cultivation had to be given after every heavy shower to prevent a crust forming. Before the berries began to ripen a heavy mulch of coarse grass was put into all the spaces between the rows. This kept the berries clean and retained the soil moisture while the crop was ripening.

In the tabular statement the varieties under test are ranked in the order of their yield. In many cases the twelve plants planted did not live, but with some of the free running varieties this would not materially affect their yield, as their runners filled up the fifteen feet of row alloted to them. The number which lived of each variety is given so that allowances may be made for some good varieties which stand low on the list.

Points Worthy of Note.

These are the results of but one year's trial; more extended trials and less favorable seasons may considerably alter the relative positions of many varities here reported upon.

The yields are given in ounces, this having been found to be the most accurate method of recording results. The yields in boxes may be approximately ascertained by reckoning 16 ounces to a full box.

The largest yield at any one picking was from Bisel, which gave 68.75 ounces, or 4.25 boxes, from 15 feet of row.

By the term "Vigor of growth" is meant the ability of the plant to send out runners and make a full matted row. This is recorded on a scale of 10. The most vigorous growers, such as Haverland and Saunders, are graded 10. On ordinary soils, such varieties may well be planted 2 feet apart in the row, and yet make a full matted row.

The value of a berry for shipping depends upon its firmness. This, in the different varieties here reported upon, is indicated in the last column by means of letters. V.F. means very firm, F. firm, M. medium, S. soft, and V.S. very soft.

Fertilization of Blossoms.

In looking down the list it will be noticed that most of those varieties near the top are pistillate. When selecting such varieties to plant, it must not be forgotten that the productiveness of these is due to the fertilizing influence of the bisexual varieties growing near them. We grow the pistillate and bisexual varieties as nearly as possible in alternate rows. When early blooming pistillate varieties are grown, it is important to have growing near them early blooming bisexual varieties, so that the first blossoms on the former may be fertilized and set fruit. The date of first bloom as recorded in the eighth column will be a guide in selecting such varieties. Haverland, for instance, a pistillate variety, began to bloom on May 2nd, while the earliest blooming bisexual variety of any value was Van Deman, which began to bloom on May 5.

Early and Late Varieties.

The first two or three pickings from a good early variety often prove more profitable than the whole crop from a later variety. In the following list, the best early varieties are ranked in the order of their yield for the three pickings previous to June 15.

Rank.	Early varieties.	Sex.	Date of first picking.	Yield before June 15th.	Total yield.	Rank for total yield
				ounces.	ounces.	
1	Van Deman	B	June 8	80.00	141.75	47
2	Rio	B	"	70.75	153.50	43
3	Michel's Early	B	"	68.25	140.50	48
4	Warfield	P	"	67.75	294.00	1
5	Afton	P	"	59.75	264.00	2
6	Kossuth	B	"	55.50	113.25	64
7	Bessie	B	"	53.25	137.00	51
8	Gertrude	B	"	51.00	179.50	23

The late varieties are not as a rule so profitable as the early ones; yet a few of them are very desirable in every collection, to extend the fruiting season. Some varieties gave light pickings as late as July 21st. The Alpine was still fruiting when frost came; yet these very late pickings were hardly large enough to be taken into account. In the following table are given a few of those varieties that gave the largest late yields, ranked in the order of their yield after July 1st.

Rank.	Late varieties.	Sex.	Date of last picking.	Yield after July 1st.	Total yield.	Rank for total yield.
1	Edgar Queen	P	July 9	54.50	244.50	3
2	Equinox	B	"	53.25	138.00	50
3	Mrs. Cleveland	P	"	46.25	206.25	9
4	Dr. Arp	P	"	29.75	163.75	32
5	Belle (Crawford's 51)	B	"	28.50	180.50	22
6	Hatch Experiment Station 24	B	"	27.00	97.25	72

Large Berries.

The comparative size of the berries of the different varities is recorded by giving the weight of 50 average sized berries. In the following table those varieties bearing the largest berries are ranked according to the size of berries.

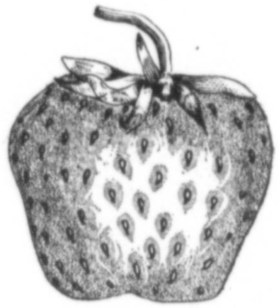
Rank.	Varieties.	Weight of 50 average berries.	Rank for total yield.	Firmness.
		ounces.		
1	Mary	21.50	57	V.F
2	{ Bubach	20.50	18	F
	{ Phillips	20.50	27	F
	Gandy	19.50	19	S
	{ Belle	18.00	22	F
	{ Marshall	18.00	67	F
7	{ Ohio Centennial	17.50	54	F
	{ Williams	17.50	31	V.F
9	Aroma	17.00	62	F

Notes on Varieties.

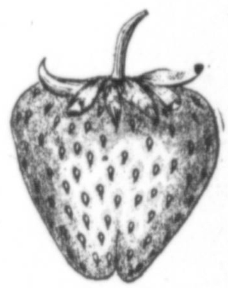
In the following pages are described forty of the more prominent new and old varieties, as they appeared here during the past season. The drawings are natural size, from average specimens.

Afton (P).—This variety is very similar to, if not identical with, Warfield, both plant and berry.

Afton.



Aroma.

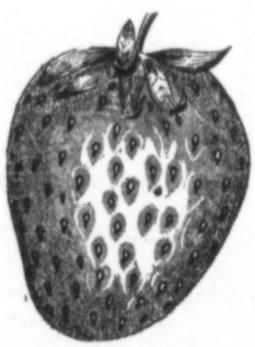


Barton's Eclipse.

Aroma (B).—Plants are vigorous, very free from rust, and make runners well. Berry large, shapely, and light scarlet color; firm and of good quality. Although this variety has not yielded so well as some others, it is valuable as a pollenizer for late pistillates, and is well worthy of further trial.

Barton's Eclipse (P).—Vigorous grower; fairly free from rust; good plant maker; berry large, dark crimson with varnished appearance; only medium for firmness; very productive, ranked seventh here for productiveness in 1896; ranked first at Geneva Experiment Station, N. Y., in 1895.

Beauty (B).—Good healthy grower; free from rust; sets plenty of plants; first berries very large; color, bright, scarlet; moderately firm. A good early variety, worthy of further trial.

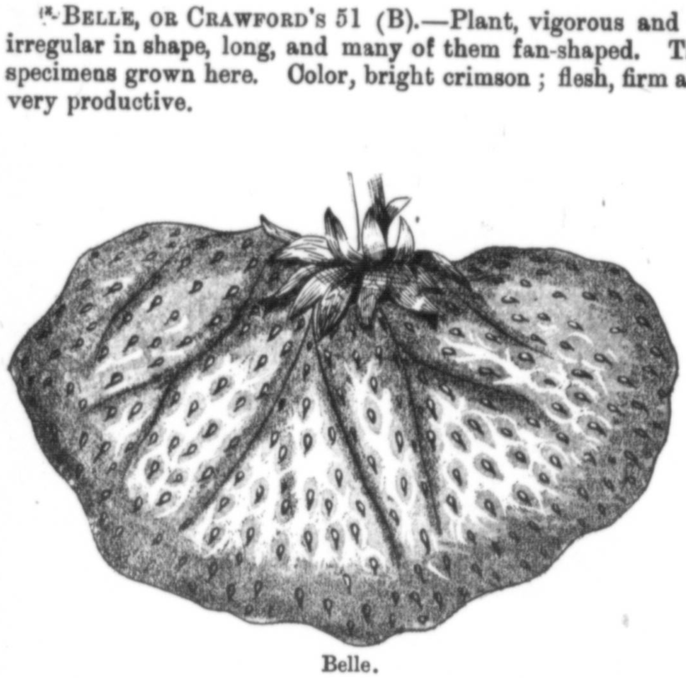


Beauty.

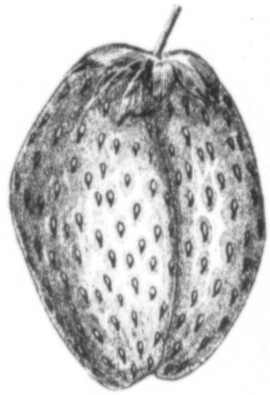
Beder Wood.

Beder Wood (B).—A free grower, but somewhat subject to rust. Very medium in size, quality and firmness; color, dark red; not showy; early, and generally reported as very productive, although it was not so here this year.

BELLE, OR CRAWFORD'S 51 (B).—Plant, vigorous and healthy; berries, very large, irregular in shape, long, and many of them fan-shaped. The cuts are the exact size of specimens grown here. Color, bright crimson; flesh, firm and of good quality. Late and very productive.

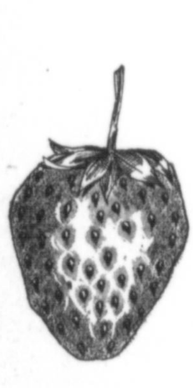


Belle.

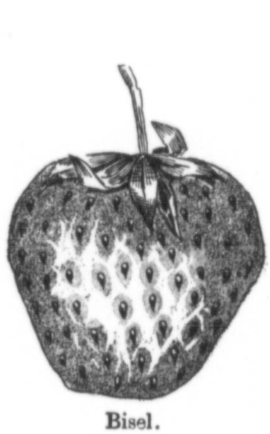


Belle.

BESSIE (B).—Plants are fairly vigorous, although affected some with rust. Berry is medium in size, of a light red color; firm. Ranks seventh among the early varieties here this year. Worthy of further trial.



Bessie.



Bisel.

Boynton.

BISEL (P).—A vigorous grower, making a wide matted row; rusts some. Season of fruit, medium to late. Very productive; gave the largest average picking of any variety grown this year, and ranks fourth for total yield. Berries, large, bright crimson, with a varnished appearance; showy, firm and of good quality. A valuable market variety.

BOYNTON (P).—Very similar to, if not identical with, Crescent.

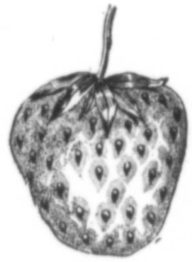
BUBACH (P).—Plant, large and vigorous; beautiful foliage; free from rust; does not throw out many runners, but enough for a narrow matted row. Berry, very large and of bright showy color; firm for so large a berry and of good quality; one of the best for home use or near market.

Chairs (P).—Plant is fairly vigorous, but somewhat liable to rust. Berry, small, dark red, moderately firm. This variety has been placed in the discarded list by some good growers. It ranked twelfth for total yield here this year, surpassing many of the "old stand bys."

Crescent (P).—This variety is almost too well known to need a description, as it and its usual companion, the Wilson, are more generally grown than any other variety.

Bubach.

Chairs.



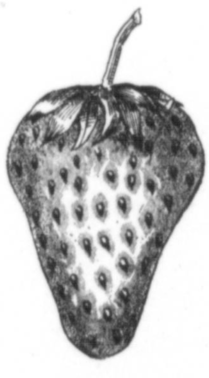
Crescent.

This is no doubt due to its vigor of growth, fair productiveness and firmness of berry for shipping. It is very sour, however, and will be less generally planted as growers realize that there are many newer varieties now surpassing it.

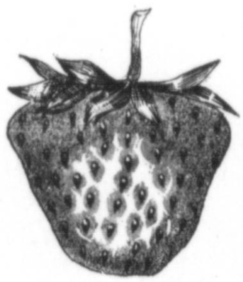
Cyclone (B).—Plant, a very vigorous grower and free from rust. Fruit, somewhat resembles Haverland, but is firmer, a good variety to plant with Haverland as a pollenizer.

Edgar Queen (P).—A new variety of great promise. Plant, very vigorous, but rusts considerably. Fruit, large, rather light in color and moderately firm, valuable on account of its large late yield; ranked first as a late variety, and second for total yield.

Edgar Queen.



Cyclone.



Enhance.

Equinox.

Enhance (B).—Plant, fairly vigorous and healthy. Berry, large, dark red and very firm, would make a splendid shipper.

Equinox (B).—Plant, a free grower, but very liable to rust. Berry, large, dull scarlet; seeds, few and deeply pitted; rather unattractive; ranked second as a late yielder; the calyx separates very readily from the berry when picking; might well be called shockless.

Gandy (B).—Plant, vigorous and healthy. Berry, very large and handsome; bright red, but hardly firm enough for a good shipper; is said to require high culture to make it productive; yielded well here.

Gertrude (B).—Plant, a strong grower, but somewhat subject to rust. Fruit, rather small, but firm and of good color; early.

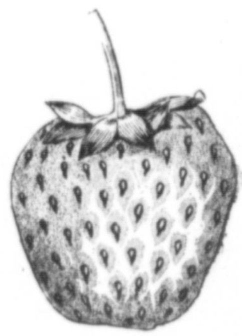
Glenfield (B).—Plant, vigorous, but rusted badly. Berry, of medium size; dark crimson and firm; early, but not productive enough.

Greenville (P).—A vigorous grower, with healthy foliage; very productive. Fruit, large, dark red, but lacking in firmness. A valuable variety; ranking next to Haverland for yield.


Gandy


Gertrude.

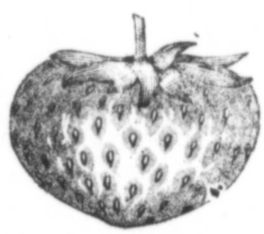

Glenfield.

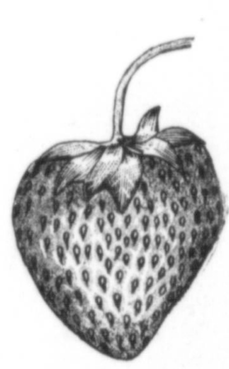

Greenville.

Haverland (P).—This may well be looked upon as one of the standards. It is one of the most healthy and vigorous growers. The plants might well be planted 2 ft. apart in the row and yet form a wide matted row. It is very productive, the fruit being borne in large clusters. The berry is large and long, of a bright scarlet color, moderately firm. The fruit begins to ripen early and holds out well to the end of the season. Valuable for home use or near market.

Hatch Expt. Station, No. 24 (B).—This is a new variety, worthy of further trial. The plant is a fair grower, but quite subject to rust. Season of fruiting very late. It ranks sixth among late yielders. The berry is of good size, broad (like cut); color, beautiful dark crimson; very firm and of good quality.


Haverland.


Hatch Expt. Sta. No. 24.


Howard's 41.

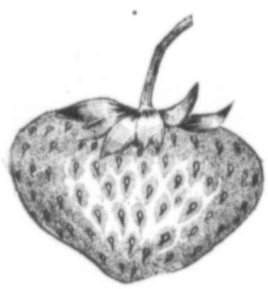
Howard's No. 41 (P).—Plants are vigorous and healthy. Fruit ripens mid-season. The berry is large and conical; color, dark crimson; seeds very numerous and prominent; very firm fleshed and would make an excellent shipper.

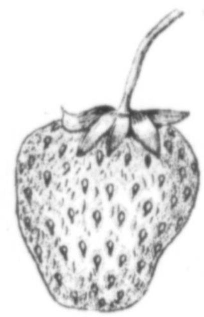
Jersey Queen (P).—Plant is only moderately vigorous and somewhat liable to rust. Berry of fair size, broad and flattened; color, light scarlet; firm fleshed and of good quality. Valuable more particularly on account of its lateness.

Kossuth (B).—Plant fairly vigorous but quite subject to rust. Fruit-stalks short and stout. Ranks sixth as an early yielder. Fruit of medium size, dark crimson, but lacking in firmness.

LEADER (B).—The plants here were fairly vigorous and very healthy, although it is reported to be a failure in light soils. Begins fruiting early and holds on well to the end of the season. Some of the new plants bore fruit late in August. Berry is large, dark crimson, firm and of excellent quality.

LOVETT (B).—A very vigorous grower, making a wide matted row: very little rust. Very productive, ripening the bulk of its crop mid-season. Berry large, dark crimson and firm. A good market variety and a good pollenizer to fertilize late pistillate varieties.


Jersey Queen.

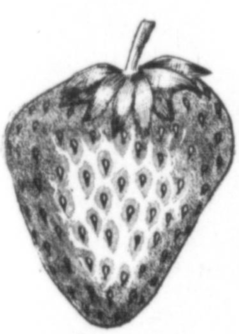

Kossuth.

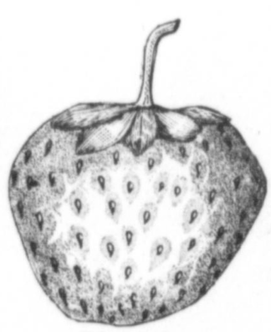

Leader.

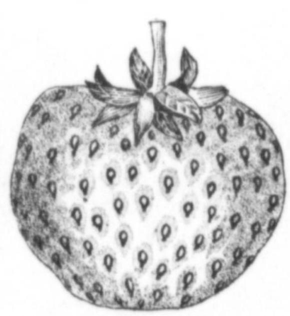
MARSHALL (B).—The plants of this variety are very large, make plenty of runners, and are but lightly affected with rust. The berry is very large, dark crimson and attractive; firm for so large a berry; only moderately productive, but worthy of further trial.

MARY (P).—A new variety of great promise. Plants are strong and vigorous. Berry larger than any other we have ever seen; well shaped; of good dark crimson color, and quite firm. Well worthy of trial.

MICHEL'S EARLY (B).—A rampant grower, but rusts badly. Ranks third as an early yielder. The fruit is small, of poor color, and lacks in firmness. Very generally grown but cannot equal Van Deman as an early variety.


Lovett.


Marshall.


Mary.


Michel's Early.

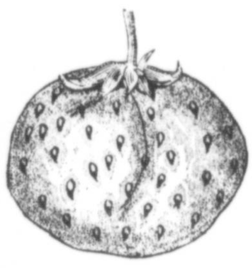
MRS. CLEVELAND (P.)—This variety has received adverse criticism elsewhere, but has done remarkably well here. Plants are very vigorous, but rust badly; ranks ninth for total yield, and third among the late yielders. Berry is of medium size, rather light in color and only moderately firm.

MUSKINGUM (B).—Plants are fairly vigorous and healthy, but late and only moderately productive. Berry large, well shaped, of dark crimson color, and with a beautiful varnished appearance; firm and of good quality; worthy of further trial.

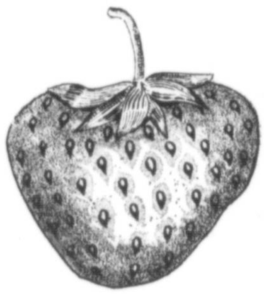
OHIO CENTENIAL (B).—Plant only moderately vigorous and somewhat liable to rust; not productive enough; fruit is very large, bright crimson, and firm.

PARKER EARLE (B).—Notwithstanding the glowing reports on this variety from different parts, our experience with it has been rather unsatisfactory. Plants made a weakly growth and rusted badly. Fruit was of fair size and firm; but plants were not vigorous enough to yield a good crop.

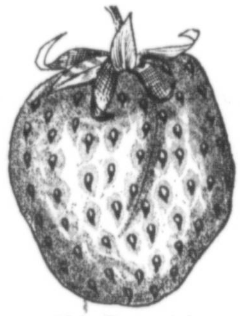
PHILLIPS (B).—The plants of this variety are vigorous and healthy, rich in pollen and productive. The fruit is very large, ranking with Bubach for size; round-conical in shape, with a series of ridges from base to point; color, dark crimson, and flesh firm; worthy of trial.



Mrs. Cleveland.



Muskingum.

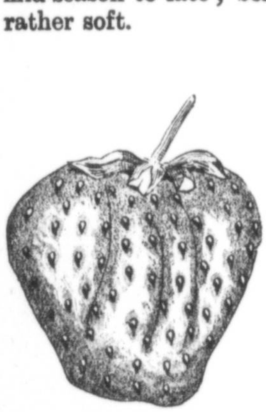


Ohio Centenial.

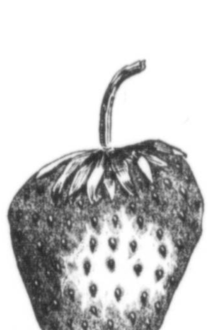
Parker Earle.

PRIZE (P).—Plant a strong grower, but rusts considerably; very productive, and ranks fifth for total yield among varieties tested this year; ripens the bulk of its crop mid-season; berry of medium size, dark red, and firm.

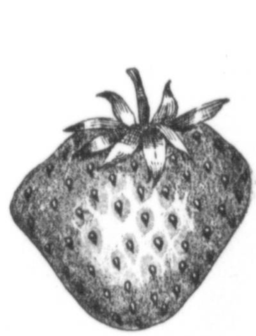
PRINCE OF BERRIES (B)—Plants fairly vigorous and healthy; quite productive; mid-season to late; berry large and rather light in color; seeds few and deeply pitted; rather soft.



Phillips.



Prize.



Prince of Berries.

RIO (B).—A promising new variety; plants fairly vigorous, but somewhat liable to rust; ranks second as an early yielder; berry of medium size; long; of light crimson color; medium in firmness; valuable on account of its earliness.

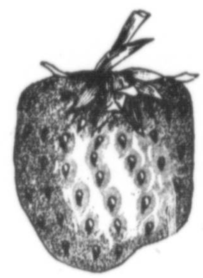
ROBINSON (B).—Plants fairly vigorous, but rust badly; productive, ripening the bulk of its fruit mid-season; the berry is of good size and of rather peculiar appearance; the color is light crimson; seeds few and very deeply pitted; lacking in firmness.

SAUNDERS (B).—A variety of great value, originated by John Little, Granton, Ont. Plants are strong growers and quite healthy; very productive, gave the largest yield of any perfect flowered variety; a good pollenizer for late pistillates; ripens evenly about mid-season; the berry is large, well shaped, and of good dark color and quite firm; a valuable market variety.

SPLENDID (B).—A new variety of great promise. Plants are remarkably vigorous and healthy. It has the most beautiful glossy green foliage of any variety under test; fairly productive; late. The berry is large, round and uniform, of bright color and attractive appearance; firm, well worthy of trial.

TENNESSEE PROLIFIC (B).—A vigorous grower with healthy foliage; fairly productive. Berry large; ripens about mid season; of light crimson color; moderately firm.

Rio.

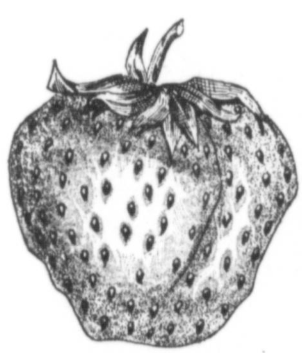


Robinson.

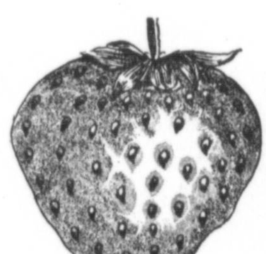
Saunders.

TIMBRELL (P).—Plant quite strong and fairly free from rust; ripens its fruit very late; hardly so productive as we would like. Berry large and well shaped; color red and white mottled; of good quality and firm.

VAN DEMAN (B).—A good grower and fairly free from rust. An early, perfect bloomer, one of the best to fertilize early pistillates; season of fruiting extra early; ranks first for early yield. The fruit is uniformly of good size and very handsome, of a rich dark crimson color and varnished appearance; firm and of good quality; should be in every collection.

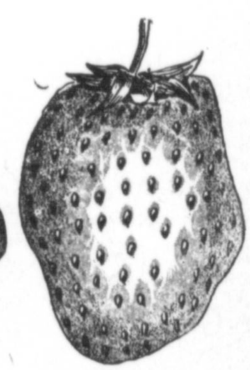


Timbrell.



Splendid.

Van Deman.

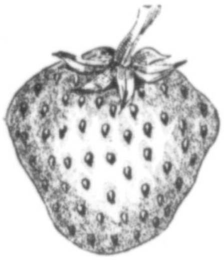


Tennessee Prolific.

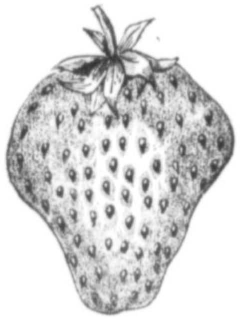
WARFIELD (P.)—A rampant grower, making too many plants; rusts some; heads the list this year for productiveness, and ranks fourth as an early yielder. The fruit is not large, but of medium size and very dark crimson color; firm; a good market variety and one of the best for canning. On light soils and in dry seasons, it often dries up and gives very poor yields; but for heavy moist soils, it is one of the best.

WILLIAMS (B).—Plants are vigorous but somewhat liable to rust; fairly productive; ripens mid season. Berry large, very seedy; and dark crimson, and firm. A good market variety.

WOOLVERTON (B).—We have been somewhat disappointed in this variety, but hope it will prove better on further trial. The plants are very large, strong, and deep rooted; comparatively free from rust; ripens late, but is not productive enough. The berry is large, of a dull red color, and firm for so large a berry. Not nearly so productive or attractive as Bubach.



* Warfield.



Williams.

Woolverton.

4. VEGETABLE GARDEN.

The plot enclosed for vegetable garden is five and three quarter acres in extent. Formerly, nearly the whole of this was required to produce a supply sufficient for the requirements of the College; but we are now finding that since the ground has been underdrained and subsoiled, and a regular rotation of crops adopted, about one-third of it can be given up to the growing of strawberries, and the remaining two-thirds produces an abundant supply of all of the vegetable garden products required by the College.

The plan of rotation adopted is as follows:

1. Strawberries, a new plantation of which is put out every spring and is plowed under after the second crop.

2. Potatoes, tomatoes, and sweet corn, all of which are gross feeders that can readily make use of the decaying vegetable matter in the old strawberry bed.

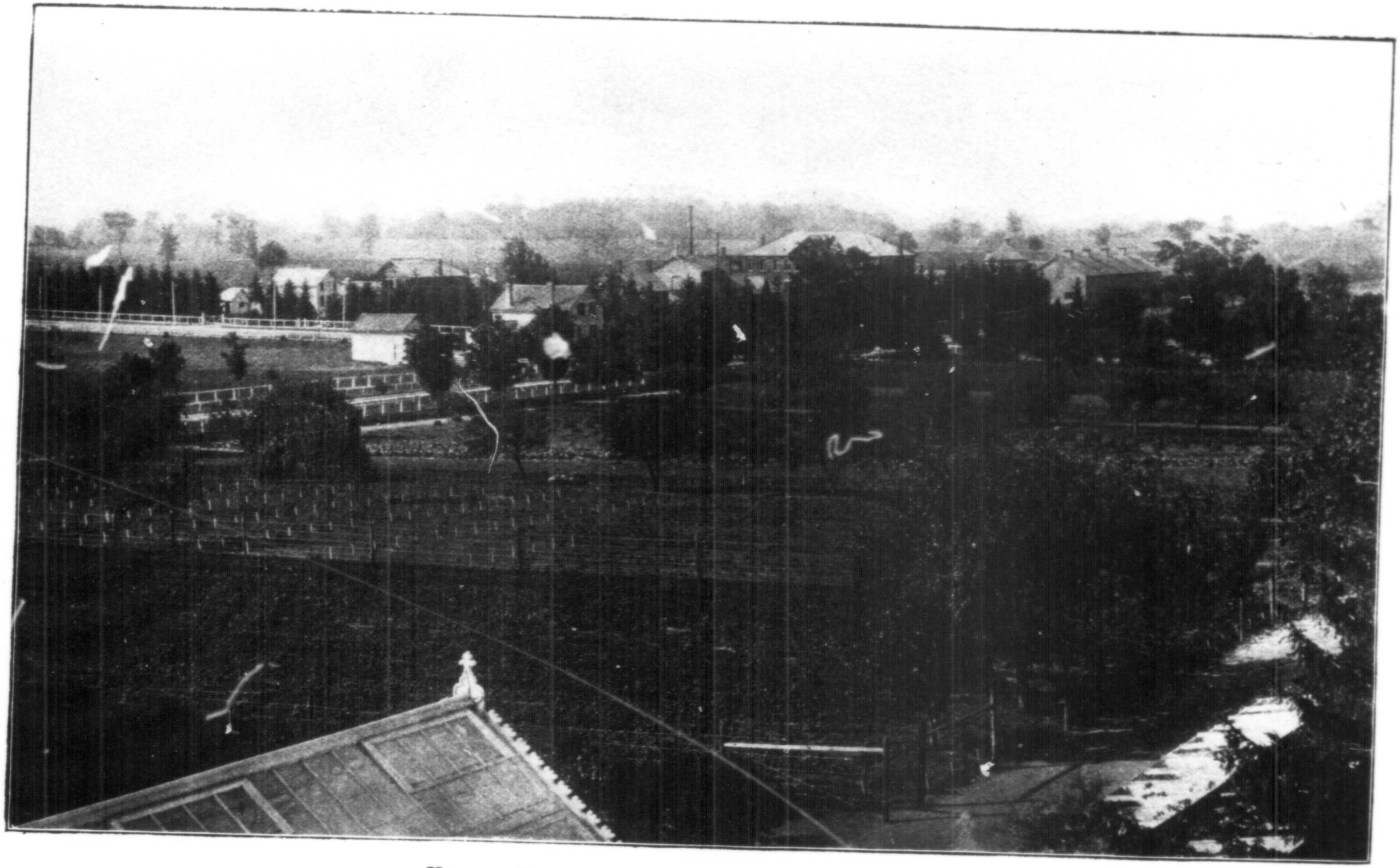
3. The various garden crops grown for their roots and bulbs, such as beets, carrots, parsnips, salsify, turnips, and onions.

4. The legumes and cucurbits, such as garden peas and beans, cucumbers, citrons, melons, pumpkins, and squashes.

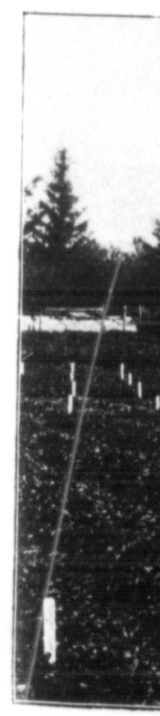
5. Cabbage, cauliflower, and celery; these and the three preceding crops afford an excellent opportunity for cleaning the land before planting again with strawberries.

5. THE LAWN AND GROUNDS.

An effort has been made to keep the lawn and grounds in their usual neat and trim condition. This requires no small amount of labor, but we believe it is labor well spent, for the influence on our students and on our many visitors, of tastefully arranged and well kept grounds, can hardly be over estimated. Apart from the usual amount of labor bestowed upon the lawn and grounds, much extra work has been done this year in levelling, grading, sodding, and seeding down the grounds around the new buildings. Along the edges bordering the walks and drives, sods had to be laid; but, wherever possible, seeding was done in preference to sodding to get a good green sward cheaply. The grass seed used is a mixture of equal parts by weight of white clover, red top, and Kentucky blue grass. This we have found much more satisfactory than many of the so-called lawn grass mixtures.

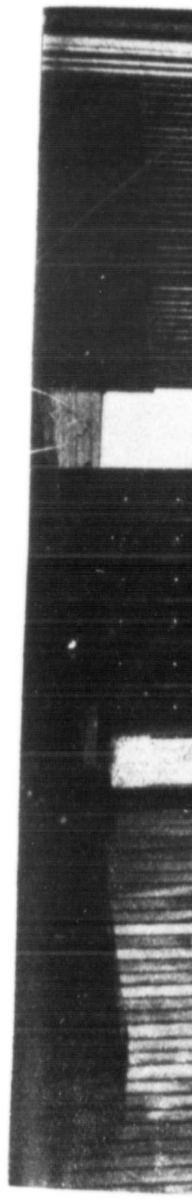


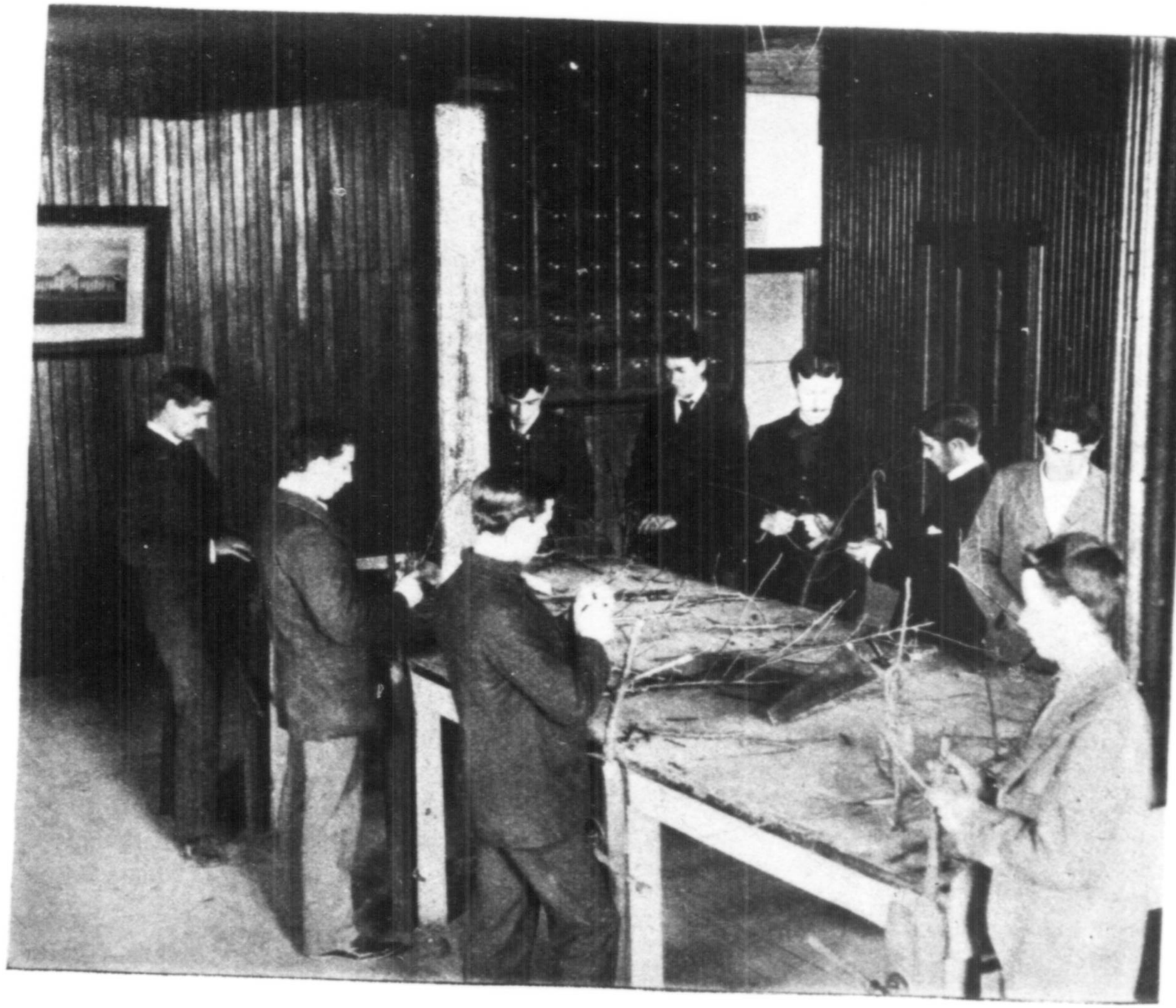
View of Vegetable Garden and Strawberry Plots, O.A.C.



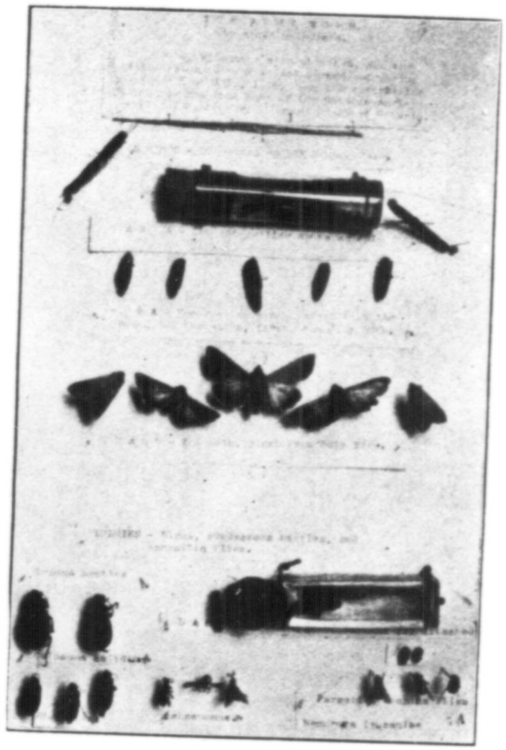
Strawberry Plots, O.A.C., 1896—155 Varieties Under Test.

Strawberry Plots, O.A.C., 1895—120 Varieties Under Test.

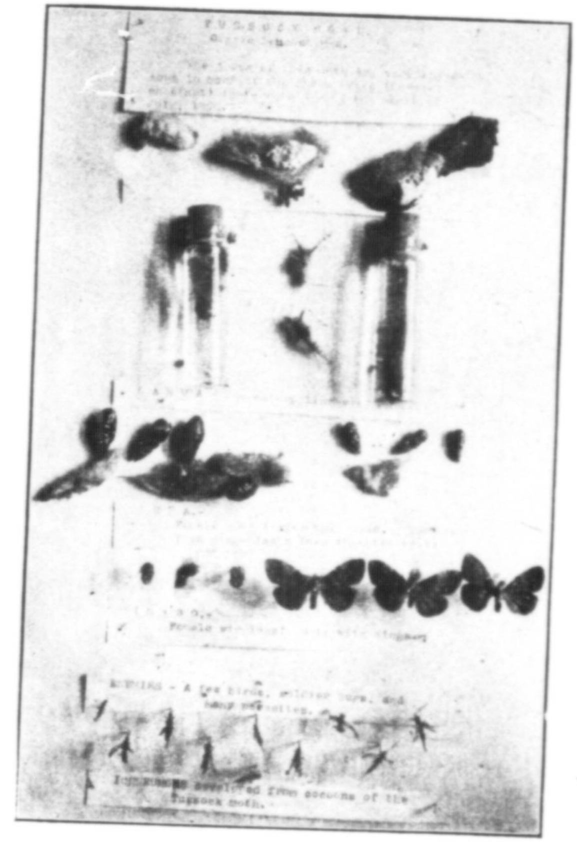




A Lesson in Grafting.



A case illustrating the Life History of the Army Worm.



A case illustrating the Life History of the Tussock Moth.

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Acer Pseudopla
Acer saccharinu
Acer tartaricum
Æsculus Hippo
Alnus glutinosa
Alnus glutinosa
Amelanchier B
Amygdalus nar
Ampelopsis qui
Ampelopsis Ve
Aralia spinosa

Berberis vulgar
Berberis vulgar
Betula alba ..
Betula alba laci
Betula alba pen
Betula lutea ...
Betula Papyrife
Betula poplifoli
Bignonia radica

A number of new drives have been laid out and gravelled on the grounds surrounding the new Experimental Building, and all of the drives on that part of the grounds have been improved by an addition of screened gravel.

On account of the pressure of other work, and the limited appropriation for hired help, we were unable this year to continue the work of paving the water courses along the sides of the drives as commenced last year. It is very important that this work should be completed, so as to avoid the repeated expenditure of repairing the drives and filling up the gullies washed out by every heavy rain. We hope that a liberal grant will be made for completing this work next year.

The heavy ice storm last winter did considerable damage to the trees and shrubs on the grounds. A number of new trees and shrubs were planted on the lawn last spring, in place of others that had died or had to be removed.

There was a great profusion of bloom last summer on a number of varieties of shrubs, and particularly so on the Viburnums, Spiraeas, and Loniceras. These were greatly admired by visitors.

During the summer, nearly all varieties of trees and shrubs on the lawn were labelled with white enamelled labels which we procured from England. On each label is neatly and clearly printed the botanical and the common name and the name of the family to which the species belongs. These labels add to the value and interest of our collection for students and visitors.

6. List of Trees and Shrubs.

While identifying and labelling the trees and shrubs in our collection, we had an excellent opportunity of noting their hardiness in this locality. For the benefit of students here and elsewhere, we have prepared an alphabetical list, giving the botanical and common name of each variety and a note as to its hardiness in this section.

Alphabetical List of Trees and Shrubs on the Lawn at the O. A. C.

Botanical Name	*Common Name.*	*Hardiness.*
Abies balsamea	Balsam fir	Hardy.
Acer campestre	European cork maple	"
Acer dasycarpum	Silver maple	"
Acer dasycarpum Weirii	Weir's cut-leaved maple	"
Acer macrophyllum	Oregon maple	"
Acer plantanoides	Norway maple	"
Acer plantanoides dissectum	Cut-leaved Norway maple	"
Acer plantanoides laciniatum	Eagle's-claw " "	"
Acer plantanoides Reitenbachi	Reitenbach's " "	"
Acer Pseudoplatanus	Sycamore maple	"
Acer saccharinum	Sugar maple	"
Acer tartaricum	Tartarian maple	"
Æsculus Hippocastanum	Horse chestnut	"
Alnus glutinosa	Sticky alder	"
Alnus glutinosa laciniata	Cut-leaved alder	"
Amelanchier Botryapium	June berry	"
Amygdalus nana	Flowering almond	Tender.
Ampelopsis quinquefolia	Virginia creeper	Hardy.
Ampelopsis Veitchii	Boston Ivy	Tender.
Aralia spinosa	Hercules' club	"
Berberis vulgaris	Common barberry	Hardy.
Berberis vulgaris purpurea	Purple barberry	"
Betula alba	European white birch	"
Betula alba laciniata	Cut-leaved birch	"
Betula alba pendula	Weeping birch	"
Betula lutea	Yellow birch	"
Betula Papyrifera	Paper birch	"
Betula poplifolia	White birch	"
Bignonia radicans	Trumpet vine	Half-hardy.

Botanical Name.	*Common Name.*	*Hardiness.*
Calycanthus floridus	Sweet shrub	"
Caragana arborescens	Siberian pea-tree	Hardy.
Caragana Chamlaga	Siberian pea-tree	"
Caragana frutescens	Siberian pea-tree	"
Caragana pygmæa	Dwarf Siberian pea-tree	"
Carpinus Betulus	European hornbeam	"
Catalpa bignonioides	Catalpa	Tender.
Catalpa bignonioides nana	Dwarf Catalpa	"
Catalpa Kæmpferi	Japan Catalpa	Half-hardy.
Catalpa speciosa	Western Catalpa	Hardy.
Celtis occidentalis	Nettle tree	"
Cerasus Padus	European bird cherry	"
Cerasus pumila pendula	Dwarf weeping cherry	"
Cercis canadensis	American Judas tree	Tender.
Cercis japonica	Japan Judas tree	Half-hardy.
Chionanthus virginicus	Fringe tree	"
Cladrastis tinctoria	Yellow wood	"
Colutea arborescens	Bladder senna	Hardy.
Cornus mascula	Cornelian cherry	"
Cornus alternifolia	Blue dogwood	"
Cornus paniculata	White fruited dogwood	"
Cornus sanguinea	Blood-colored dogwood	"
Cornus sericea	Silky dogwood	"
Cornus stricta	Stiff dogwood	"
Cratægus cordata	Washington hawthorn	Half-hardy.
Cratægus Crus-galli	Cockspur hawthorn	Hardy.
Cratægus oxyacantha	English hawthorn	"
Cratægus oxyacantha apiifolia	Parsley-leaved hawthorn	"
Cratægus oxyacantha rubra splendens	Red-flowering hawthorn	"
Cratægus oxyacantha variegata	Variegated-leaved hawthorn	"
Deutzia crenata	Crenate deutzia	"
Deutzia gracilis	Slender-branched deutzia	"
Deutzia scabra	Rough-leaved deutzia	Half-hardy.
Diervilla Desboisi	Rose-colored Weigelia	"
Diervilla hortensis nivea	White-flowered Weigelia	"
Diervilla isolene	Weigelia	"
Diervilla rosea	Rose-colored Weigelia	"
Diervilla rosea amabilis	Rose-colored Weigelia	"
Diervilla rosea Groenewegenii	Rose-colored Weigelia	"
Euonymus americanus	Burning bush	Hardy.
Euonymus europæus	Burning bush	"
Euonymus europæus variegata	Variegated burning bush	Tender
Fagus sylvatica purpurea	Purple-leaved beach	Half-hardy
Forsythia suspensa	Drooping forsythia	"
Forsythia viridissima	Golden bell	"
Fraxinus americana	White ash	Hardy.
Fraxinus excelsior	European ash	"
Fraxinus excelsior atrovirens	European ash	"
Fraxinus platycarpa	Water ash	"
Fraxinus pubescens	Red ash	"
Fraxinus quadrangulata	Blue ash	"
Fraxinus sambucifolia	Black ash	"
Gleditschia sinensis	Chinese honey locust	Half-hardy
Gleditschia triacanthos	Honey locust	"
Gymnocladus canadensis	Kentucky coffee tree	Hardy.
Hydrangea paniculata grandiflora	Large flowered hydrangea	"
Juglans nigra	Black walnut	"
Juniperus chinensis	Chinese juniper	"
Juniperus communis	Common juniper	"
Juniperus occidentalis	Rocky mountain juniper	"
Juniperus prostrata	Trailing juniper	"
Juniperus suecica	Swedish juniper	"
Juniperus virginiana	Red cedar	"
Kerria japonica	Japan Kerria	Tender.

Botanical Name.	*Common Name.*	*Hardiness.*
Larix europæa	European larch	Hardy.
Ligustrum buxifolium	Box-leaved privet	Half-hardy.
Ligustrum japonicum	Japan privet	"
Ligustrum vulgare	Common privet	"
Liquidamber styraciflua	Sweet gum	Tender.
Liriodendron tulipifera	Tulip tree	Newly planted
Lonicera flava	Yellow trumpet honeysuckle	Hardy.
Lonicera orientalis	Bush honeysuckle	"
Lonicera sibirica	Siberian honeysuckle	"
Lonicera tartarica	Tartarian honeysuckle	"
Lonicera tartarica grandiflora	Bush honeysuckle	"
Lonicera Xylosteum	Fly honeysuckle	"
Magnolia acuminata	Cucumber tree	Half-hardy.
Mahonia aquifolia	Holly-leaved mahonia	Tender.
Morus rubra	Red mulberry	Hardy.
Negundo fraxinifolium	Ash-leaved maple	"
Philadelphus coronarius	Garland syringa	"
Philadelphus Gordonianus	Gordon's syringa	"
Philadelphus grandiflorus	Large flowering syringa	"
Phlox decussata	Perennial phlox	"
Picea alba	White spruce	"
Picea nigra	Black spruce	"
Picea pungens	Colorado blue spruce	"
Picea excelsa	Norway spruce	"
Pinus austriaca	Austrian pine	"
Pinus mughus	Mountain pine	"
Pinus mughus pumila	Dwarf mountain pine	"
Pinus rigida	Pitch pine	"
Pinus strobus	White pine	"
Pinus sylvestris	Scotch pine	"
Platanus orientalis	Oriental plane tree	"
Platanus occidentalis	Button wood	"
Populus abla	White poplar	"
Populus angustifolia	Narrow-leaved poplar	"
Populus balsamifera	Balsam poplar	"
Populus monilifera	Carolina poplar	"
Populus nigra pyramidalis	Lombardy poplar	"
Prunus americana	Wild plum	"
Prunus chicasa	Chickasaw wild plum	"
Prunus Pissardii	Purple-leaved plum	Newly planted
Prunus virginiana	Choke cherry	Hardy.
Pseudotsuga Douglasii	Douglas spruce	"
Ptelea trifoliata	Hop tree	"
Pyrus americana	American mountain ash	"
Pyrus Aucuparia	European mountain ash	"
Pyrus Aucuparia laciniata	Cut-leaved mountain ash	"
Pyrus Aucuparia macrocarpa	Large fruited mountain ash	"
Pyrus Aucuparia nana	Dwarf mountain ash	"
Pyrus hybrida	Hybrid mountain ash	"
Pyrus japonica	Japan quince	Half-hardy.
Pyrus Malus communis	Double flowering crab.	Newly planted
Pyrus Malus coronaria	Sweet scented crab	Hardy.
Quercus lyrata	Over-cup oak	Hardy.
Quercus macrocarpa	Burr oak	"
Quercus Pedunculata	Peduncled oak	"
Quercus Robur	English oak	"
Quercus Robur pedunculata	Peduncled English oak	"
Retinospora ericoides	Heath-like retinospora	Half-hardy
Retinospora plumosa	Plumosa retinospora	"
Rhamnus carolinianus	Carolina buckthorn	Hardy.
Rhamnus catharticus	Cathartic buckthorn	"
Rhamnus frangulus	Breaking buckthorn	"
Rhus aromatica	Fragrant sumach	"
Rhus copallina	Copal sumach	Tender.
Rhus Cotinus	Mist shrub	Hardy.
Ribes aureum	Yellow flowering currant	"
Ribes floridum	Wild black currant	"
Ribes Gordonianum	Gordon's currant	"
Ribes sanguineum	Crimson flowering currant	Tender.

Botanical Name.	*Common Name.*	*Hardiness.*
Rosa rubiginosa	Sweet briar	Hardy.
Rosa rugosa	Japan rose	"
Salisburia adiantifolia	Maiden-hair tree	"
Salix alba	White willow	"
Salix annularis	Ringed willow	Tender.
Salix Caprea	Goat willow	Hardy.
Salix purpurea	Basket willow	Half-hardy.
Salix rosamarinifolia	Rosemary-leaved willow	Hardy.
Salix Russelliana	Russell's willow	"
Salix Villarsiana	Villars' willow	"
Sambucus racemosa	Red-berried elder	"
Sambucus variegata	Variegated elder	"
Shepherdia canadensis	Shepherdia	"
Spiræa Billardi	Billard's spiræa	Half-hardy.
Spiræa callosa	Callous-leaved spiræa	"
Spiræa callosa alba	White Japan spiræa	"
Spiræa carpinifolia	Hornbeam-leaved spiræa	Tender.
Spiræa chamædrifolia	Germander-leaved spiræa	Hardy.
Spiræa crenata	Crenate-leaved spiræa	"
Spiræa Douglasii	Douglas spiræa	Newly planted
Spiræa media rotundifolia	Round-leaved spiræa	Hardy.
Spiræa opulifolia	Guelder-rose-leaved spiræa	"
Spiræa opulifolia aurea	Golden-leaved spiræa	"
Spiræa paniculata	Panicled spiræa	Half-hardy.
Spiræa Reevesi	Reeves' spiræa	Newly planted
Spiræa salicifolia	Willow-leaved spiræa	Half-hardy.
Spiræa sorbifolia	Sorbus-leaved spiræa	"
Spiræa Thunbergii	Thunberg's spiræa	"
Spiræa ulmifolia	Elm-leaved spiræa	Hardy.
Spiræa Van Houttei	Van Houtte's spiræa	"
Symphoricarpus racemosus	Snow berry	"
Symphoricarpus vulgaris	Coral berry	"
Symphoricarpus vulgaris variegatis	Variegated-leaved snow berry	"
Syringa Josikæa	Josika's lilac	"
Syringa oblata	Purple lilac	"
Syringa persica	Persian lilac	"
Syringa purpurea florepleno	Purple lilac	"
Syringa vulgaris	Purple lilac	"
Syringa vulgaris alba	White lilac	"
Syringa vulgaris Dr. Stockhardt	Dr. Stockhardt's lilac	"
Syringa vulgaris Gloire de moulins	Lilac	"
Syringa vulgaris Princess Maria	Purple lilac	"
Syringa vulgaris rubra insignis	Purple lilac	"
Syringa vulgaris vallettiana	Purple lilac	"
Syringa vulgaris Chas. X	Charles X. lilac	"
Syringa vulgaris Verschaffeltii	Verschaffelt's lilac	"
Taxus canadensis	American yew	"
Thuya gigantea	Pacific Coast arbor-vitæ	"
Thuya occidentalis	American arbor-vitæ	"
Thuya occidentalis aurea	Golden arbor-vitæ	"
Thuya occidentalis globosa	Globose arbor-vitæ	"
Thuya occidentalis pyramidalis	Pyramidal arbor-vitæ	"
Thuya occidentalis Tom Thumb	Dwarf arbor-vitæ	"
Tilia americana	American linden	"
Tilia europæa	European linden	"
Tilia europæa laciniata	Cut-leaved linden	"
Tsuga canadensis	Hemlock spruce	"
Ulmus americana	American white elm	"
Ulmus campestris	English elm	"
Viburnum acerifolium	Maple-leaved viburnum	"
Viburnum lantana	Way-faring tree	"
Viburnum lantanoides	Hobble bush	"
Viburnum nudum	Snowball	"
Viburnum Opulus	Common snowball	"
Viburnum Oxycoccus	Cranberry bush	"
Viburnum prunifolium	Sheep berry	"
Wistaria frutescens	Shrubby wistaria	Tender.
Xanthoxylum fraxineum	Prickly ash	Hardy.

7. Forest Tree Plantations.

The various forest tree plantations set out at different times during the past twenty years have now become well established.

Three acres of trees, consisting of several varieties of maple, ash, elm, oak, hickory, butternut, walnut, basswood, mountain ash, pine, spruce and larch, which were put out 19 years ago, have now become so large that cultivation is no longer needed.

A similar plantation of four acres, put out six years ago, has been kept well cultivated, and pruned when necessary. This plantation was put on a hill side on new land and the trees have, with few exceptions, made a remarkably fine growth.

A plantation of black walnuts was also put out 15 years ago. Many of the trees are now from 6 to 8 inches in diameter, and they bore this year a very fair crop of nuts. These are the only trees of the kind I have seen in the section, although they may be found growing wild in abundance along the mountain near Dundas, about 20 miles south-east of us. This is a tree that should be more extensively planted on account of its value, not only for its timber but for its nuts. From the fact that it is hardy here at Guelph, it may well be supposed that it would thrive in most parts of the Province.

About six years ago 240 elms were planted along the sides of the farm lane. On account of the ravages of borers in the trunks, and a fungus on the leaves, these trees have in the past made a very unsatisfactory growth. Last spring 100 of them had to be replaced. For the past two years we have been making an effort to remedy these evils; the trees have been sprayed regularly with the Bordeaux mixture for the fungus, the trunks have been examined for the borers, and have been washed with a solution of soft soap and carbolic acid, to prevent the beetles depositing their eggs. Some progress, we think, has been made but we will wait for the trees to proclaim the success of our treatment.

8. Greenhouses and Conservatories.

The greenhouses and conservatories, viewed from a practical and instructive standpoint, from a very important part of the equipment of the Horticultural department. Each of the six houses is used to the full extent of its capacity throughout the year. A brief running comment on each as it now appears may be of interest.

In the forcing house may be seen in the early stages of their growth, crops of radish, lettuce, and tomatoes. A portion of the house is devoted to the forcing of roses, carnations, and violets, while under the benches are some newly spawned mushroom beds.

In the propagating house are being started several thousand geraniums, coleuses, and other bedding plants which will be used in planting out the beds on the grounds next summer. A propagating oven is also in use for starting the more slowly rooting greenhouse plants.

The horticultural laboratory is now being put in readiness for the students' work next term. The soil benches are ready for sowing with seeds; tomatoes, petunias, and other plants are being grown, on which hand pollination may be practised, and a variety of plants are being made ready, upon which students may practise the various methods of grafting.

The intermediate house contains a varied collection of greenhouse plants, such as pelargoniums, azaleas, hydrangea, abutilons, primulas, cinerarias, calceolarias, etc., which are made use of to keep up the sucession of bloom in the conservatory. A portion of the centre beds in this house will be used for forcing cauliflowers during the winter.

The fine collection of tropical plants in the tropical house has been considerably improved this year by the addition of a number of choice tropical plants, orchids, palms, dracoenas, caladiums, etc. In this collection we have a large number of plants from which various articles of commerce are derived. Such a collection is useful as a subject for study, and gives students some idea of the vegetation of other climes.

In the conservatory, the great attraction during the past month has been the display of chrysanthemums. We had this year 120 varieties of these in bloom, among which were some of the newest and choicest kinds. Photographs have been taken of a number of choice typical plants, and others will be taken from time to time throughout the year of plants in various stages of development, with a view to preparing an illustrated article on this now most popular flower.

II.—THE ONTARIO FRUIT EXPERIMENT STATIONS.

1. Inspection of Stations.

During the month of September the most of my time was taken up inspecting the ten Fruit Experiment Stations now established in as many different parts of the Province. A full report of my visits to these stations is given in the Experiment Station Report.

I might mention here, however, that this work gives me an excellent opportunity of ecoming familiar with the varied fruit interests of the Province, and has brought more clearly to my notice three of the important needs of Canadian fruit growers:

1. Reliable information as to the most profitable varieties of fruits to plant in the different sections of the country.

2. More attention to the subject of spraying and cultivation.

3. Better and cheaper facilities for placing fruit in the home and foreign markets in good condition.

The first mentioned need is being met by the reports from the Fruit Experiment Stations; and these reports will become more and more valuable as the work progresses, and the many varieties now under test come into bearing.

The necessity for better cultivation and systematic spraying is one which every grower must realize and act upon for himself. The most successful fruit growers cultivate thoroughly, spray regularly, and succeed as a result of their labors. But the great majority of those who have orchards leave them in sod, a prey to insects and fungous diseases. And nature provides them with a crop of fruit just often enough to restrain them from tearing out the trees and putting the land to more profitable use. The effort being made by the Provincial Government to help fruit growers along these lines, by giving them practical instruction in spraying, will no doubt be productive of much good. Under the management of the Board of Control for the Fruit Experiment Stations, spraying experiments have been conducted, during the past two years, in nearly every county in the Province, thus affording every grower the opportunity of seeing for himself how spraying should be done, and also what it will accomplish.

The question of better and cheaper facilities for placing fruit in the home and foreign markets is one with which the fruit grower can do but little, and we hope it will receive the due consideration of the Dominion Government. The proposed system of refrigerator cars and steamers to the large markets, and cold storage buildings at these markets, would be a mutual benefit to the producer and consumer. And a reduction in freight rates, particularly to the great North-west, would open up to fruit growers many markets which are now virtually closed to them.

2. Trial of Spray Pumps.

Since the introduction of spraying as a means of destroying insects and checking fungous diseases, one of the perplexing questions with those beginning this practice has been, "Which is the best pump for the purpose?" This was the question which confronted Mr. A. H. Pettit, director of spraying experiments, when making arrangements last spring for the summer's work throughout the Province. These experiments were undertaken to give the people practical instruction, hence it was important that the most suitable pump should be selected. A practical test of the various spray pumps offered for sale was accordingly arranged for, under the auspices of the Board of Control for the fruit experiment stations, and was made in the large orchard of Mr. E. J. Woolverton, Grimsby. Eight Canadian and three American pumps were entered in the test. Upon Mr. M. Pettit, President of the Ontario Fruit Growers' Association, and myself, rested the task of judging. Each pump was thoroughly tried and examined, and each was scored by point on its merits. A full report of the trial was made at the time, and appears in a condensed form as Appendix B. to the Fruit Growers' Report for 1895. In this, the pumps are described in their order of merit as found by the judges.

One of the immediate benefits of this test was that two of the best Canadian pumps were selected with which to do the experimental spraying throughout the Province; and fruit growers generally have been given to understand that these pumps may be depended upon to do the work satisfactorily.

IV.—CO-OPERATIVE FRUIT TESTING.

In connection with the Experimental Union, we have been sending out, during the past three years, a number of the leading varieties of small fruits for co-operative testing. The following is a list of the tests undertaken this year:

1. Strawberries.—Haverland, Bubach, Woolverton and Van Deman,—twelve plants of each.

2. Raspberries.—Marlboro, Cuthbert, Shaffer, and Golden Queen,—six plants of each.

3. Black raspberries.—Souhegan, Gregg, Palmer and Hilborn,—six plants of each.

4. Blackberries.—Kittatinny, Sydner, Taylor and Gainor,—six plants of each.

5. Currants.—Fay's Prolific, Victoria, Raby Castle, and White Grape,—three plants of each.

6. Gooseberries.—Houghton, Downing, Whitesmith, and Industry,—three plants of each.

Twenty lots of plants for each of the six experiments were distributed. The reports as yet received do not warrant us in drawing any conclusions. One of the most important features of the work, so far, is that many who receive these plants get a start in growing small fruits for their own use, which they probably never would have done if they had to purchase the plants for themselves A further account of this work will be found in the Experimental Union Report.

V.—CORRESPONDENCE.

One of the ever increasing duties devolving upon the heads of the various departments here is the attention required in answering the questions of correspondents. The increased number of letters received during the past year, bearing upon all the different branches of horticultural work, may be taken as an evidence of the increased interest in this work throughout the country. The answering of such questions requires considerable time, and often careful thought and research; yet we hope this means of obtaining information will be more and more made use of. We accordingly invite correspondence upon all lines relating to horticulture, and we will gladly answer as fully as possible all questions sent to us.

VI.—MEETINGS ATTENDED.

During the month of January I attended Farmers' Institute meetings and gave addresses on horticultural topics at St. George, Burford, Brantford, Caledonia, Cayuga, and Attercliffe Station. One of these addresses on "The Farmer's Fruit Garden" appears in the Farmers' Institute Report for 1895-6.

I attended also the annual meeting of the Ontario Fruit Growers' Association, held at Kingston, Dec. 2-4, and reported the results of our experiments with strawberries during the past year.

ACKNOWLEDGMENTS,

I beg to acknowledge with thanks the following donations to the Horticultural department:

Morril & Morley, Benton Harbor, Mich.: Eclipse spray pump.

John Little, Granton, Ont.: Strawberry plants.

Prof. Wm. Saunders, Ottawa, Ont.: Thirteen varieties of chrysanthemums.

Geo. Fisher, Burlington, Ont.: Lucas' Improved black raspberry plants.

C. W. Stewart & Co., Newark, N.Y.: Seedling raspberry plants.

A. W. Burpee, Philadelphia, Penn.: Collection of garden and flower seeds.

H. H. Groff, Simcoe, Ont.: Seedling canna.

C. H. Shinn, Berkley, Cal.: Orange, lemon, olive and fig scions.

Jas. M. Waters, Fernhill, Ont.: Seedling black raspberry plants.

Wm. Sunley, Guelph, Ont.: "Royal City" strawberry plants.

W. L. Dixon, Bunessan, Ont.: "Liddle" strawberry plants.

Prof. Wm. Saunders, Ottawa, Ont.: Twelve varieties of geraniums.

Roderick Cameron, Niagara Falls, Ont.: Collection of begonias, etc.

A. Kirk, Hubrey, Ont.: Rhubarb roots.

S. T. Pettit, Belmont, Ont.: Iowa Beauty strawberry plants.

In closing this report I wish, also, to make mention of the efficient services rendered to this department by William Squirrel, gardener and foreman of the outside work; and by Arthur James, florist and foreman of greenhouse work.

All of which is respectfully submitted.

H. L. HUTT,
Horticulturist

Ontario Agricultural College, December 31st, 1896.

PART IX.

REPORT OF THE BACTERIOLOGIST.

To the President of the Ontario Agricultural College:

SIR,—I have the honor to submit herewith my report for 1896.

1.—TEACHING AND WORK FOR OTHER DEPARTMENTS.

The earlier part of the year, from January to May, was entirely taken up with class work and laboratory demonstration to the students in the special dairy course and those in the regular College courses. Instruction was given in Dairy Bacteriology to the dairy students by lectures and demonstrations, and an extensive laboratory course in this subject was also given to the Agricultural and Dairy Specialists of the third year. The specialists in Biology covered a large portion of the subjects of Vegetable Pathology and Cryptogamic Botany.

Early in June, Mr. R. F. Holtermann approached me with a view of my undertaking certain bacteriological work in connection with Foul Brood of Bees. As this work was done under the auspices of the Experimental Union, this part of my report will be found in the report of the Union.

During the month of June and the early part of July, I did the bacteriological work in connection with the testing of Hansen's lactic ferment and Conn's B 41 in the Dairy department. The report on this portion of my work will be found with Prof. Dean's in Part VI. of this volume. I spent my summer holidays at the University of Wisconsin, studying the methods of Dr. Russell, who is one of the best dairy bacteriologists on this continent. Whilst there, I started work on the bacterial flora of Canadian cheese—work which is, I think, of considerable importance, having as its object the determination of the different kinds of germs in cheese, their distribution in the different cheese factories, and the uniformity with which they occur in the different factories throughout the Province. The necessary data on these points having been obtained, a good foundation for future investigation has been laid. On my return to the College in the fall, lectures and class demonstrations occupied most of my time, but I managed to make some experiments on the bacterial contamination of milk—a sufficient number, I think, to justify the publication of the following paper:

2.—BACTERIAL CONTAMINATION OF MILK.

Milk in the udder of a perfectly healthy cow is sterile, *i.e.*, free from germs. It has been obtained in this state by Schultz and other German investigators; but unless special precautions are taken, such as the use of a sterile milking tube, it is very difficult to secure a sample that is entirely free from germs. Of course animals suffering from diseases of the udder are very liable to have germs in their milk; for instance, in tuberculosis of the udder, there will in all probability be present the germs of this disease, derived from the unhealthy glandular tissue. In fact Ernst has demonstrated that, in some cases at least, the milk of tuberculous cows, *free from affection of the udder*, contains tubercle bacilli.

Milk as sold in cities, towns and villages contains a varying number of germs, according to its age and the temperature at which it is kept. American quantitative determinations of the number of germs in milk are lower than European results; for instance, Cnopf in Munich milk supply found from 200,000 to 6,000,000 per c. c. (cubic centimetre—about a teaspoonful); Bujwid, in Warsaw milk supply, an average of 4,000,000 per c. c.; Renk, in Halle milk supply, 6-30,000,000 germs per c. c.; Sedgwick and Batchelder in Boston, U. S. A., milk supply, 30,000 to 4,220,000 germs per c. c.; and Russell, in Madison, Wis., supply from 15,000 to 2,000.000 per c. c. In a number of samples obtained in the neighborhood of Guelph, I have found from 8,750 to 1,197,000 per c. c.

The following table gives the number of germs found in each of the samples examined. I isolated different species, and in explanation of the terms, "lactic acid curd;" and "digestor," I may state that the first of these terms refers to the behaviour of a germ in sterile milk when the casein is coagulated and a solid curd is formed, which remains in this state; the second term, "digestor," refers to the behaviour of a germ in sterile milk when the casein is coagulated, and the digesting, or peptonising action of the germ causes the curd to digest and form a whey-like, transparent liquid.

TABLE A.—Germ content of milk.

Source.	Month.	Age of milk.	Number of germs per c. c. (About a medium sized teaspoonful.)	No. of species.	Description of species.
College.	November..	4 hours........	12,850	3	2 digestors and 1 producing lactic acid.
"	" ..	15 minutes	18,960	4	2 digestors, 1 producing lactic acid and 1 no effect.
Dairy ..	December ..	30 "	12,320	4	2 digestors, 1 producing lactic acid and 1 no effect.
" ..	" ..	30 "	9,000	4	2 digestors, 1 producing lactic acid and 1 no effect.
" ..	....	30 "	15,320	3	2 digestors and 1 producing lactic acid.
" ..	....	15 "	8,900	4	2 digestors and 2 producing lactic acid.
" ..	....	15 "	12,450	5	2 digestors, 1 producing lactic acid and 2 no effect.
" ..	....	15 "	8,750	5	3 digestors, 1 producing lactic acid and 1 no effect
" ..	....	15 "	10,800	4	2 digestors and 2 producing lactic acid.
Guelph.	November ..	Morning's milk.	1,197,000	4	2 digestors and 2 producing lactic acid.
" ..	....	Unknown.	1,150,000	5	2 digestors, 2 producing lactic acid and 1 no effect.
" ..	December ..	"	345,000	5	2 digestors, 2 producing lactic acid and 1 no effect.
" ..	" ..	"	480,320	6	3 digestors, 2 producing lactic acid and 1 no effect.
" ..	" ..	"	1,115,120	5	2 digestors, 1 producing lactic acid and 2 no effect.
" ..	" ..	"	149,360	6	2 digestors, 2 producing lactic acid and 2 no effect.
" ..	" ..	"	173,260	5	2 digestors, 2 producing lactic acid and 1 no effect.
" ..	" .	"	121,500	4	2 digestors and 2 producing lactic acid.
" ..	" ..	"	313,200	4	2 digestors and 2 producing lactic acid.

Notice is especially directed to the great difference between the number of germs in the mixed milk of a herd kept under cleanly conditions, immediately after milking, and the milk supplied to consumers in the city of Guelph.

No alarm need be occasioned by the large numbers of germs in milk, but the presence of very many putrefactive bacteria, such as gain admission to the milk from particles of manure, etc., have an irritating action on the digestive tracts of invalids and infants; in fact, Vaughan, of the University of Michigan, states that nearly all the cases of summer diarrhœa among infants are due to the presence of putrefactive or other decomposing bacteria in the milk fed. Whilst the great majority of the germs found in milk are not hurtful to mankind, their effect on the milk is injurious. They set up a number of fermentative changes, which always lessen the keeping quality, and diminish the value of the milk as food. Some species are of much value to the butter and cheese maker, but the difficulty is to admit these and not at the same time seed the milk with germs that are unfavorable to the best quality of butter or cheese. In fact it is almost impossible to introduce the favorable species and keep out all undesirable forms.

The effect of germs in the milk is made manifest by several physical changes. Mention of three of these has already been made, viz., those which curdle the milk into a solid mass by the production of acid from the milk-sugar; those which first curdle and then dissolve the casein into a transparent or semi-transparent whey, and those which apparently do not alter the appearance of the milk. Sometimes different colors are produced in each of these cases; and this pigment production, in every instance I have met with, is upon the surface of the milk.

Attention must be drawn to the fact that not all the germs which curdle milk are beneficial to the butter and cheese maker. Some develop bad flavor or disagreeable odour, and others split up the milk sugar into different gases, giving rise to pinhole curds, which are so well known to cheesemakers.

From what has been stated it is easy to see that the fewer germs which gain access to milk, the better it is for the buttermaker, and the cheesemaker, and the consumer, and science has given to the factory man means by which he can control the fermentation of his product, if his raw material, the milk, is kept as free as possible from bacterial life. I refer to what are known as pure cultures, that is, desirable forms of bacteria grown and kept for use by butter and cheesemakers as required for the production of desired fermentations and flavors in milk to be used for the manufacture of butter and cheese.

Contamination from the Fore Milk.

When milking is done, there remains in the teat of the cow a little milk that affords nourishment to any bacteria that may come into contact with it, through the opening at the end of the teat. The temperature of the animal and the abundant nourishment are ideal conditions for most bacteria. The teat thus becomes an incubator, and a few germs that may have gained access, multiply enormously—usually those forms which can grow without the oxygen of the air, a class which Pasteur called anaerobes. One or two species predominate, generally those that produce lactic acid. Sometimes putrefactive germs are also found which are no doubt due to the contact of the opening of the teat with particles of manure while the animal is lying in its stall. When these germs gain access the effect is very bad, because the first few streams containing many of these harmful species are milked into the pail and act as a "starter" to the rest of the milk; and in summer time the danger is enhanced by the temperature at which milk is generally kept. Fortunately, however, this infection is least liable to occur in the hot weather, as the cows are usually out in the fields at that time, but the danger may occur if cows should walk or wallow in stagnant water.

Certain forms of bacteria, under favorable conditions, are perhaps able to work their way up the teat to the milk cistern, but it is not known to what extent different forms can penetrate a healthy udder. The entrance of noxious germs may sometimes give rise to an inflammatory condition of the udder.

I have made a number of bacteriological analyses, both qualitative and quantitative, of samples of fore or first milk (the first few streams from each teat), which were passed directly from the udder into narrow-mouthed, sterilized flasks, to avoid contamination from the air or the animal. These samples were immediately taken to the labaratory and analyzed, with the following results :

TABLE B.—Bacteriological analyses of fore milk.

Source.	Month.	Number of germs per cubic centimetre.	No. of species.	Description of species.
Dairy stable..	Nov....	26,070 (night)	3	2 digestors and 1 producing lactic acid.
" ..	"	25,630 (night)	2	2 producing lactic acid.
" ..	"	38,420 (morn)	3	1 digestor, 1 producing lactic acid and 1 no effect.
" ..	"	18,110 (morn)	2	1 digestor and 1 producing lactic acid.
College stable.	"	54,800	2	1 digestor and 1 producing lactic acid.
Dairy stable..	Dec....	32,700 (night)	3	2 digestors and 1 producing lactic acid.
" ..	"	43,520 (night)	2	1 digestor and 1 producing lactic acid.
College stable.	"	27,830	2	2 producing lactic acid.
"	"	18,500	2	2 producing lactic acid.
"	"	29,400	3	1 digestor and 2 producing lactic acid.
"	"	45,630	2	2 producing lactic acid.
"	"	48,700	2	2 producing lactic acid.
"	"	29,830	2	1 digestor and 2 producing lactic acid.

In striking contrast to the above table is the following schedule which shews the number of germs found in milk after the fore milk had been drawn into a separate flask, precautionary measures having been taken to prevent contamination from the animal or the air.

The results clearly demonstrate the fact that by milking the first few streams from each teat on to the ground, or into a separate pail, contamination from the fore milk is in a large measure prevented.

Schulz, in 1892, found that the number of bacteria varied according to the stage of the milking at which the samples were taken.

In one of his experiments the fore milk contained 55,000 germs per c.c., the milk at the middle of the milking contained 2,070, and the strippings were sterile. Russell, of Wisconsin University, since found similar differences at different stages in milking, but did not find the strippings entirely sterile.

TABLE C.—Germ content of milk taken after the fore milk was removed.

Source.	Month.	Number of germs per c.c.	No. of species.	Description of species.
Dairy stable..	Nov....	1,246	2	1 digestor and 1 producing lactic acid.
"	"	1,150	2	1 digestor and 1 producing lactic acid.
"	"	1,430	3	2 digestors and 1 producing lactic acid.
College.......	"	1,463	3	2 digestors and 1 producing lactic acid.
"	Dec....	3,420	3	1 digestor, 1 producing lactic acid and 1 mould.
Dairy	"	1,560	2	1 digestor and 1 producing lactic acid.
"	"	890	3	2 digestors and 1 producing lactic acid.
"	"	2,575	3	1 digestor, 1 producing lactic acid and 1 mould.
"	"	4,820	3	1 digestor, 2 producing lactic acid and 1 mould.
College.......	"	3,270	2	1 digestor and 1 preducing latic acid.
"	"	1,285	3	1 digestor, 1 producing lactic acid and 1 no effect.
"	"	1,350	3	1 digestor, 1 producing lactic acid and 1 no effect.

CONTAMINATION OF MILK FROM ANIMAL AND MILKER.

The next prolific source of contamination is from the animal and the milker. The hairy coat of the cow affords a harbour for all kinds of dust that may be floating in the stable, and added to this are particles of manure and filth which cling to the sides, flank, udder and tail of the animal, and become dry, only awaiting the movements of the cow or milker to dislodge them (each laden with its quota of germ life) into the milk pail. The quantities of solid impurities in milk of different German cities have been determined by a number of investigators. Renk has found as much as six grains of impurities (mainly manure particles) per quart. This seems hardly credible, but when one visits an ordinary cattle stable he is prepared to believe almost anything under this head. The hair of cows, even those that are kept very clean, swarms with bacteria. I have frequently isolated many hundreds from a few particles of hair. This fact alone shows the importance of keeping cows clean, well carded and well brushed. When in this condition they are not so liable to lose hairs, nor are the hairs so easily dislodged during the movements of milking. Great care should be taken in the construction of cow stalls. If they are too long the hindquarters of the cow are apt to be plastered with manure when she lies down, and when too short the hindquarters and tail find their resting place in the gutter.

The milker, too, is not always above reproach. Clothed in dust-laden garments used for all kinds of farm and stable work, without even washing his hands or cleaning his nails, he does the milking as he would do any other job on the farm. Under such conditions, every movement of the milker adds large numbers of germs to the contents of the milk pail and greatly injures the flavor and keeping quality of the milk and its products.

Contamination from the animal and the milker can, however, to a large extent be prevented—(1) by moistening thoroughly the flanks and udder of the cow before milking; (2) by the milker putting on a clean, loose cotton or linen smock over his clothes and invariably washing his hands immediately before milking.

Germs cannot leave a moist surface, hence the importance of moistening the flanks and udder, and the reason for the smock and the washing of hands is so plain that no one can fail to understand it.

We may add that the milking smock should be kept, not in the open barn or stable but some place as far removed as possible from all kinds of dust and dirt; and the practice of moistening the hands or teats with the milk should be scrupulously avoided.

TABLE D.—Contamination of milk from animal and milker.

Number of germs falling into a milk pail 12 inches in diameter during the space of one minute under ordinary conditions.

Source.	Month	Condition of animal.	Number of germs, 12 inch milk pail.	No. of species.	Description of species.
Dairy	Nov......	Clean	8,648	3	2 digestors and 1 mould.
"	"	do	9,420	3	2 digestors and 1 mould.
"	"	do	8,295	4	3 digestors and 1 mould.
"	"	Rather dirty ..	12,420	5	2 digestors and 3 moulds.
College. ..	"	Dirty	15,780	3	2 digestors and 1 producing no effect.
" ...	"	do	8,460	3	2 digestors and 1 mould.
" ...	*Photo*. ...	Clean	16,356	4	2 digestors and 2 moulds.
" ...	Nov.....	Dirty	17,155	3	3 digestors.
" ...	Dec......	Clean	11,280	3	2 digestors and 1 producing no effect.
Dairy .... (night.)	"	Dirty	15,765	3	3 digestors.
Farm.....	"	do	9,845	4	1 digestor, 2 moulds and 1 producing no effect.
"	......	do	13,720	5	2 digestors, 1 mould, 1 producing lactic acid and 1 no effect.

In the experiments on tables D and E, dishes $3\frac{1}{3}$ inches in diameter and containing sterile nutritive gelatine were exposed for one minute by the milk pail and then covered, and in a few days the germs that fell on the surface developed into spots of varying size color and shape, which can be counted by the naked eye. These spots are called colonies, and are made up of innumerable bacteria, which developed from the germs that originally fell on the plate. By finding the ratio between this plate, $3\frac{1}{2}$ inches in diameter, and a 12-inch milk pail, the number of germs which fall into the pail during the space of one minute can be approximately reckoned, and this number multiplied by the time it takes to milk the animal will give the number falling into the pail during the whole milking period. Compare table D with table E to see the influence which moistening the udder and flanks with a wet cloth has on the number of germs.

Table E.—Contamination of milk from animal and milker.

Number of germs falling into a milk pail 12 inches in diameter during the space of one minute, the flanks and udder of the cow being moistened with a wet cloth.

Source.	Month.	Number of germs 12 inch pail.	No. of species.	Description of species.
Dairy	Nov......	1,125	3	2 digestors and 1 mould.
"	"	1,582	3	1 digestor, 1 mould and 1 producing no effect.
"	"	2,350	3	1 digestor and 2 moulds.
"	"	854	3	1 digestor and 2 moulds.
College ..	Dec......	1,327	4	2 digestors and 2 moulds.
" ..	"	2,225	3	1 digestor and 2 moulds.
" ..	"	1,825	4	1 digestor, 2 moulds and 1 producing no effect. (*See Photo.*)
" ..	"	640	3	2 digestors and 1 mould.
" ..	"	1,620	4	3 digestors and 1 mould.

Contamination of Milk from the Air.

Although it is difficult to separate contamination from animal and milker and that from the air, it is best to consider the latter source of infection separately, as the number of germs floating in the air depends to a great extent on the amount of dry fodder and straw that may be used in the stable. The greater the disturbance of these dusty stuffs at any time, the greater will be the germ content of the air at that time. To illustrate this point, plates $3\frac{1}{2}$ inches in diameter were exposed in the cow stable, when bedding and feeding were going on, and at different periods afterwards. The results of these experiments are given in tables F and G.

Cows are frequently bedded with dusty straw at the very time when milking is going on, a forkful of straw in some instances that have come under my observation, having been thrust under the cow that was being milked. This practice cannot be too severely condemned. Dusty fodders also are often thrown down from the loft when milking is in progress, filling the stable with dust, every particle of which carries spores of moulds or the germs of bacterial life. It must be remembered also that very undesirable spores, which it is very difficult to kill even by long continued steam heat, abound in straw and hay. To this class belongs the well know Hay bacillus which forms highly resistent spores; and we may add that Conn, of Wesleyan University, has found that this germ produces a disagreeable flavor in butter.

Again, if the manure is not frequently and thoroughly cleaned out, it gets dry and small particles from it help to swell the number of germs in the air.

Much benefit would ensue either from moistening the fodder, or from feeding and bedding an hour or so before milking commences, to allow the dust, etc., of the air time to settle. If all such work were finished even half an hour before milking, it would be a great improvement on what is now done in many stables.

TABLE F.—Germ content of stable air during bedding, feeding hay, cleaning up, etc.

Source.	Month.	No. of germs falling into 12 inch pail per minute.	No. of species.	Description of species.
College	November......	16,000	8	2 digestors, 3 moulds, 1 producing lactic acid and 2 no effect. (*Photo.*)
"	"	13,536	6	1 digestor, 4 moulds and 1 producing lactic acid.
Dairy	"	12,216	6	2 digestors, 3 moulds and 1 producing lactic acid.
"	"	12,890	6	1 digestor, 3 moulds and 2 producing no effect.
"	"	15,340	7	2 digestors, 4 moulds and 1 producing lactic acid.
"	"	19,200	5	2 digestors and 3 moulds.
"	December	23,400	4	1 digestor and 3 moulds.
"	"	27,342	4	1 digestor, 2 moulds and 1 producing lactic acid.
College	"	42,750	5	1 digestor, 3 moulds and 1 producing lactic acid.
"	"	27,820	3	1 digestor and 2 moulds.
"	"	18,730	4	1 digestor, 2 moulds and 1 producing lactic acid.
"	"	12,210	4	1 digestor, 2 moulds and 1 producing no effect.

TABLE G.—Germ content of stable air when bedding, feeding and sweeping were done an hour before.

Source.	Month.	No. of germs falling into 12 inch pail per minute.	No. of species.	Description of species.
Dairy stable	November......	483	5	2 digestors and 3 moulds.
"	"	610	5	1 digestor, 3 moulds and 1 producing no effect.
"	"	820	4	2 digestors and 2 moulds.
Dairy	December	715	5	2 digestors and 3 moulds.
"	"	1,880	3	1 digestor and 2 moulds.
"	"	1,987	3	1 digestor and 2 moulds.
"	"	2,112	5	1 digestor, 3 moulds and 1 producing no effect.
"	"	1,650	6	2 digestors, 3 moulds and 1 producing no effect.
College..........	"	990	5	1 digestor, 3 moulds and 1 producing lactic acid.
"	"	1,342	4	1 digestor and 3 moulds.
"	"	2,370	5	2 digestors, 2 moulds and 1 producing no effect.
"	"	1,750	5	2 digestors and 3 moulds.
"	"	1,345	4	1 digestor and 3 moulds.

CONTAMINATION OF MILK FROM THE USE OF IMPROPERLY CLEANED DAIRY UTENSILS.

Probably more trouble is caused to butter and cheese makers by the use of dirty utensils than in any other way.

Every article that is brought into contact with milk is at once infected with germs. When milk is left in storage cans for some time a tremendous amount of germ life is developed, and a vast number of spores, or latent forms of bacteria are produced.

In this way vessels are infected, and it is very difficult to cleanse them so as to get rid of the germs which lodge in all the cracks, crevices, etc. Often the water used for washing is very bad—so bad that epidemics of typhoid fever have sometimes arisen from the use of impure water in washing dairy utensils. The washing which cans ordinarily get is, first rinsing in tepid water, and then a momentary application of hot water. Even in some of the best creameries, the final washing is not with boiling water; and the result is, cans containing vast numbers of living germs, all ready to grow, are put away for future use.

In order to wash cans thoroughly, the following treatment is necessary.

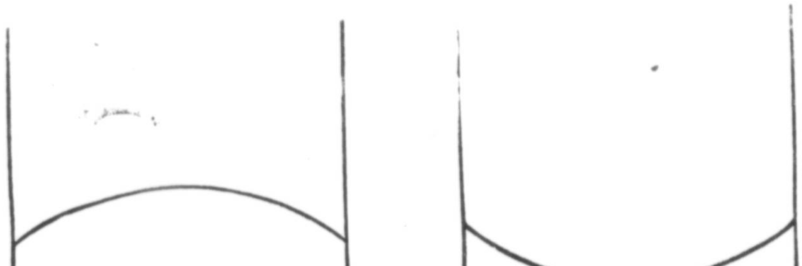
1. Wash and scrub in tepid water in which washing soda may be dissolved in order to free them from milk.

2. Rinse them thoroughly with boiling water, not water at 180° or 190° but at 212° F.

3. Put steam pipe into the can so that the jet is applied with considerable force to the bottom, in order to penetrate all cracks and crevices, and kill the germs that may have found lodgment therein.

4. In summer time have a shelf or rack against the wall of the dairy, choosing the sunniest aspect and lay the cans on their sides with the tops slightly tilted downwards for a thorough airing, remembering always that sunlight is a cheap and powerful germicide. It must be borne in mind that all utensils, dippers, cloths, strainers, etc., that come into contact with the milk should be treated in the same way; and wherever possible steam should be used in the final cleansing.

Care should be taken when buying cans, etc., to see that the seams are well and evenly soldered. Corners of vats should be rounded so as to present a curved surface that may be easily cleaned. Another point of importance is to have the bottoms of pails, cans, etc., with *concave* bottoms, *not* convex, as in the former case the milk drains into the centre of the can while in the latter some of it is left in a channel around the edge and cannot be easily removed by the brush.

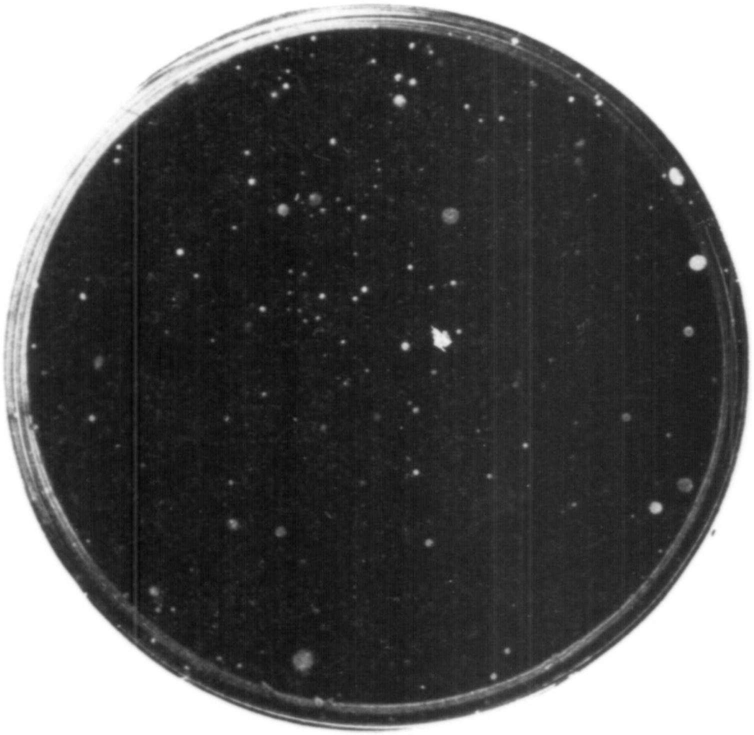


The wrong way. The right way.

By reference to Tables H and J, the importance of thorough washing and steaming can be readily seen. In each of these series, after the can had been washed and drained dry, 100 c. c. of sterile water was added, well shaken up in the can, poured into a sterile flask, immediately taken to the laboratory and there analyzed, with the results given in the tables. Russell has shown the effects of thorough cleaning in another way.

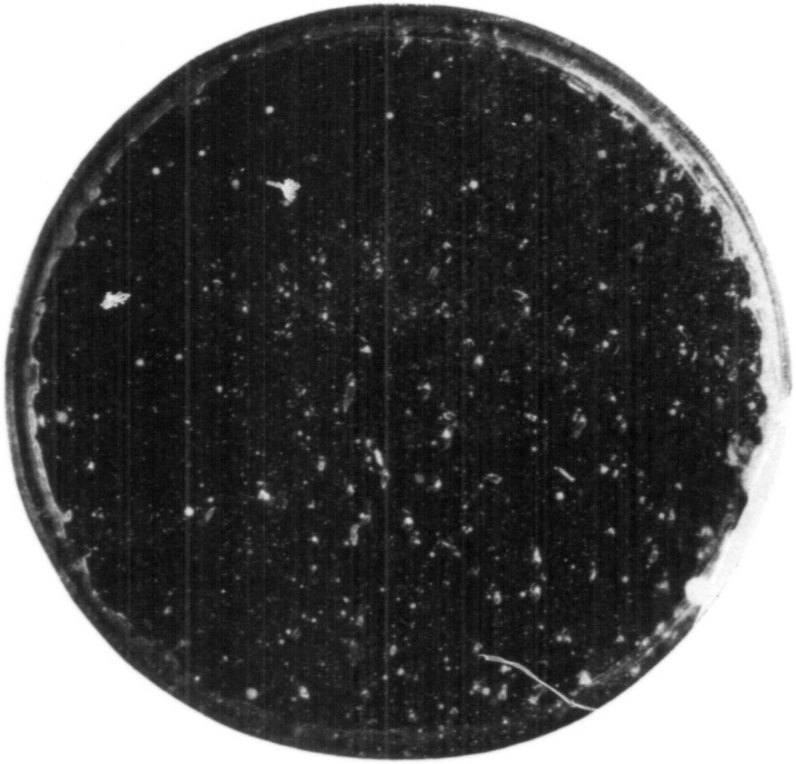
Contamination from the Use of Improperly Cleaned Dairy Utensils.

See Table J.



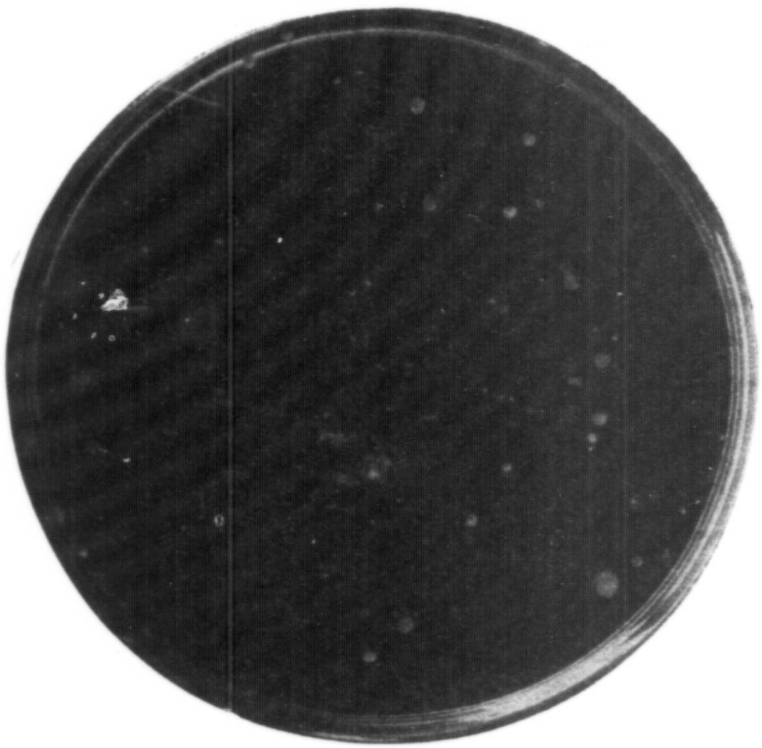
After a can had been washed, scalded, steamed for five minutes, and thoroughly drained a quantity of sterile water was poured in and the can thoroughly rinsed. This gelatine plate was then made from $\frac{1}{5}$ c.c. (about six drops) of this water.

See Table H.



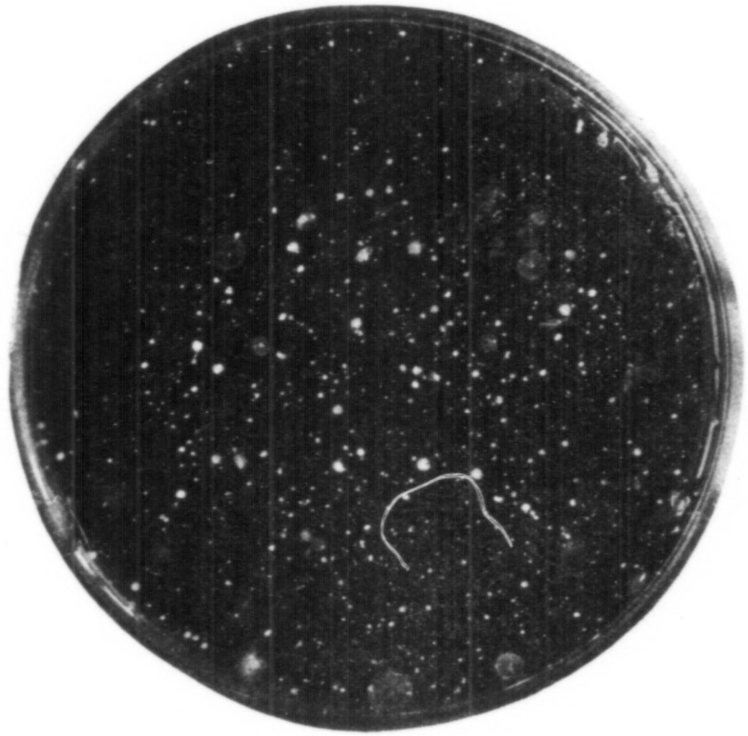
After a can had been washed with warm water, and thoroughly drained, a quantity of sterile water was added and the can thoroughly rinsed. This gelatine plate was made from $\frac{1}{100}$ c.c. (a very tiny drop) of this water.

Germ Content of Barn Air during Bedding, Cleaning Up, Feeding Hay, Etc. *See* Table G.



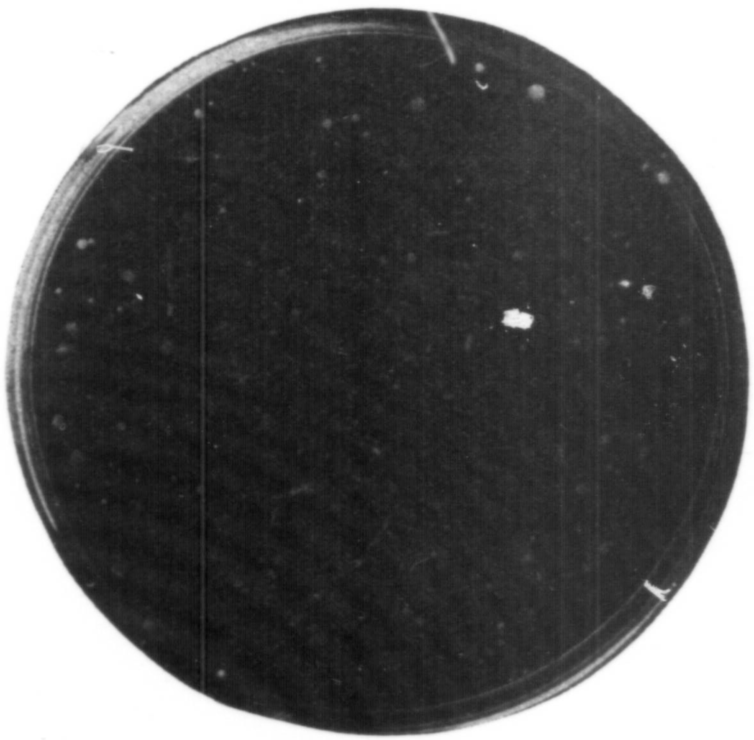
Gelatine plate exposed to the deposition of germs for one minute in a barn when all the above operations had been completed.

Germ Content of Barn Air during Bedding, Cleaning Up, Feeding Hay, Etc. *See* Table F.



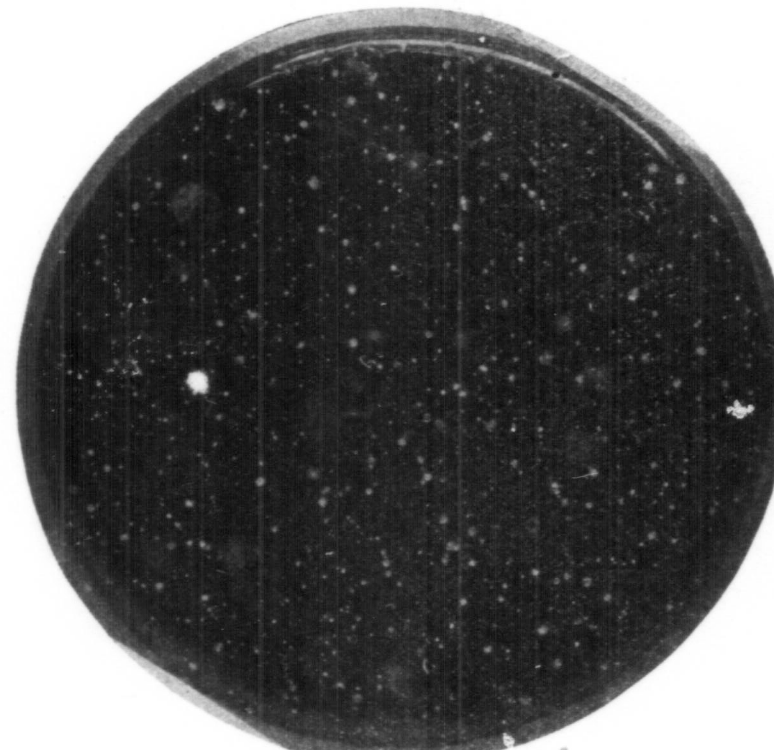
Gelatine plate exposed to the deposition of germs and moulds for one minute in a barn when some of the above operations were in progress.

CONTAMINATION FROM ANIMAL AND MILKER.
See TABLE E.



Gelatine plate exposed under udder of cow for one minute while milking. The udder and flanks well moistened with water.

CONTAMINATION FROM ANIMAL AND MILKER.
See TABLE D.

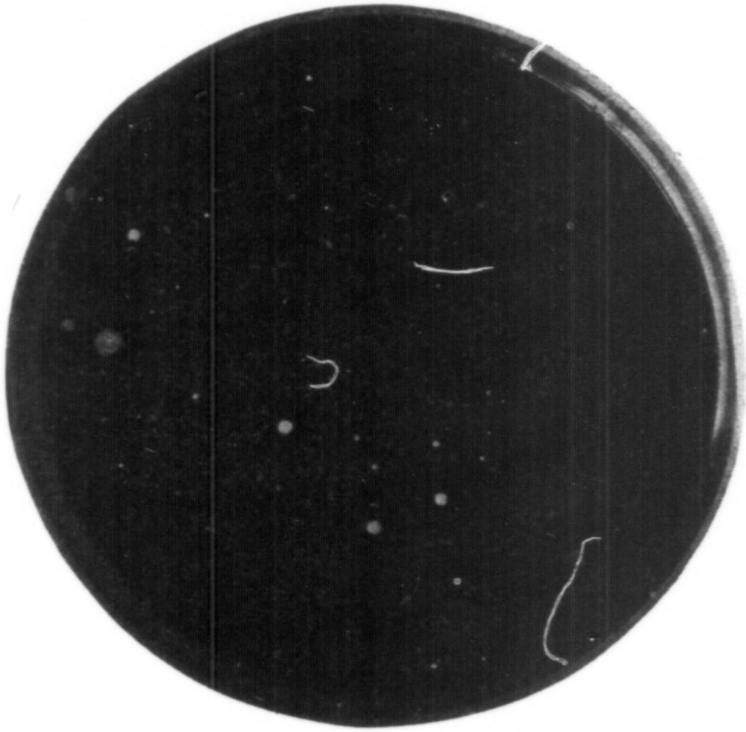


Gelatine plate exposed under udder of cow for one minute, while milking under ordinary conditions.

GERM CONTENT OF BARN AIR DURING BEDDING, CLEANING UP, FEEDING HAY, ETC. *See* TABLE G.

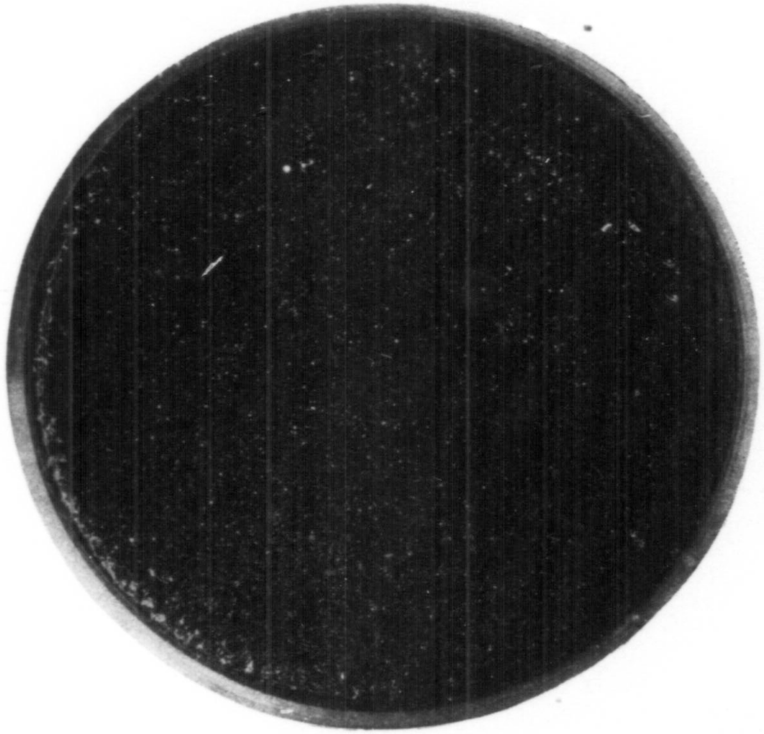
GERM CONTENT OF BARN AIR DURING BEDDING, CLEANING UP, FEEDING HAY, ETC. *See* TABLE F.

Germ Contents of Milk the fore Milk being Rejected.
See Table C.



Gelatine plate showing bacteria in $\frac{1}{15}$ c c. (about two drops) of milk. The Fore Milk being rejected.

Contamination from the Fore Milk.
See Table B.



Gelatine plate showing bacteria in $\frac{1}{15}$ c c. (about two drops) of the Fore milk. (First few streams from all four teats.)

In these illustrations each white spot represents a colony of bacteria that has developed from a single germ. Each colony is made up of myriads of individuals.

"Two covered milk pails were taken, one of which had been cleaned in the ordinary way, and the other sterilized by steam for half an hour. In order to exclude as far as possible the influence of other factors, the udder of the cow was thoroughly washed, the hands of the milker cleaned and the fore milk rejected. The milk was then received into the two pails and immediately cooled to 50° F., so as to stop the development of germ life. Gelatin cultures were prepared from these milks to determine the number of organisms present and there was found in milk taken in the sterile pail 165 germs per cc., while that which had been received in a vessel cleaned in the ordinary way contained 4,265 bacteria for an equal volume. The milk was allowed to stand in the respective cans at the temperature of the room (68°-75° F.) until it soured. That taken in the unsterilized pail turned in twenty-three hours while that received in the sterile pail remained sweet five and one half hours longer."

TABLE H.—Contamination of milk from the use of improperly cleaned dairy utensils.

Number of germs per c.c.	No. of species.	Remarks.
238,525	4	3 digestors and 1 producing lactic acid.
342,875	3	2 " 1 " "
215,400	3	2 " 1 " "
618,200	4	2 " 2 " "
806,320	3	2 " 1 " no effect.
510,270	3	1 " 1 " lactic acid.
230,100	4	2 " 2 " "
610,510	3	1 " 2 " "
418,810	3	2 " 1 " "
317,250	3	2 " 1 " "

TABLE I.—Contamination of milk from the use of cans washed in tepid water and then scalded out—the method usually employed in the best factories.

Number of germs per c.c.	Kinds.	Remarks.
89,320	2	2 digestors.
84,750	2	2 "
26,800	2	2 "
24,000	2	2 "
38,400	3	2 " and 1 producing no effect.
76,800	3	2 " 1 " lactic acid.
15,200	3	2 " 1 " "
13,080	3	2 " 1 " "
44,160	3	2 " 1 " "
93,420	3	2 " 1 " "
53,270*	4	2 " 1 no effect, and 1 mould.

* This can had been washed three months previously and left lying on its side in the cellar. The mould present was probably due to infection from the air.

TABLE J.—Number, etc., of germs found per c. c. after cans had been washed in tepid water and a steam pipe allowed to play in can for five minutes.

Number of germs per c.c.	No. of species.	Remarks.
1,170	3	2 digestors and 1 producing no effect.
1,792	3	2 " 1 "
890	2	2 digestors.
355	2	2 "
416	2	2 "
725	3	1 digestor and 1 producing lactic acid.

THE INFLUENCE OF TEMPERATURE ON MILK.

Milk is an excellent medium for germ life, and when milked is at a temperature which favors rapid multiplication of bacteria. Freudenrich found that the bacteria increased at the following rate when kept at different temperatures :

——	3 hours.	6 hours.	9 hours.	24 hours.
When kept at 59° F.	10,000	25,000	46,000	570,000
" 77° F.	18,000	172,000	1,000,000	577,000,000
" 95° F.	30,000	12,000,000	35,280,000	50,000,000

From this table it is manifest that the rapidity of growth is very great and depends largely on temperature. Therefore much may be done to restrain this rapid multiplication by cooling the milk as rapidly as possible. Milk allowed to cool naturally takes some time before it reaches the temperature of the air. Hence measures should be promptly taken to reduce the temperature quickly. For this purpose there are a large number of coolers on the market, many of which aerate the milk as well as cool it. In selecting one of these purchasers should bear in mind the ease with which the apparatus can be cleaned. They should also remember that in aerating a large surface of milk is exposed to the atmosphere for a certain space of time, and if the process be done in a place where the air is impure it will necessarily add vast numbers of bacteria to the milk.

In conclusion a summary of precautionary measures to be taken, so as to secure milk as free as possible from germ life is given. These points are of particular importance to dairymen supplying milk for consumption, and will amply repay the individual who carries them out, as the observance of them will give him milk that will remain in a marketable condition much longer than is the case with milk secured without such precautions.

1. Keep the stables clean and let in as much sunlight as possible.

2. Feed all dusty fodders, and finish the work of bedding, some time before milking starts.

3. Do not feed turnips, rape, or other foods which taint the milk.

4. Wash thoroughly and scald with boiling water or live steam all pails, cans, and other utensils used to hold milk or cream. Live steam, as shown in table J., is much better than boiling water.

5. Brush the flanks, udder, belly, and tail of each cow shortly before milking, to remove filth, loose hairs, etc.

6. Moisten these parts thoroughly with water immediately before milking ; but do not allow any dripping of the water to occur.

7. See that the milker uses a clean linen or cotton smock over his coat when milking, and that he invariably washes his hands immediately before milking.

8. Reject the first few streams from *each teat* by milking on the ground or into a separate pail.

9. Use a milk pail with as small a diameter as possible, and hold it at such an angle as to diminish the possibility of manure particles, hairs, etc., falling into it.

10. When a pail is full, remove it from the stable immediately ; and, if possible place it at once in a clean room kept for the purpose.

11. Do not mix the milk of fresh cows with that from cows advanced in lactation.

12. Strain, aerate, and COOL the milk as rapidly as possible in some place where the air is pure and sweet.

3.—The Library.

Thanks to the liberality of the Minister, we have this year been able to add a large number of books to the library, many of them very valuable works. We have also bought a commodious cabinet for our index cards; and the work of indexing has steadily progressed. It is with much pleasure that I am able to announce that all the books in our library are now indexed on the card catalogue system, both by author and subject. The Journals of the Royal Agricultural Society and Royal Highland Society, the Live Stock Almanac and many others have all been carefully examined, and matter in any way relating to our course of study has been catalogued by subjects The value of this to students and others who are looking up references or preparing papers, is incalculable; and we hope to continue this work to such an extent that our students shall have at their command the most ample information from many different sources.

We hope also some day to have both the time and the money to make the Agricultural College library of such excellence that any one wishing to write special articles or look up historical facts on our line of work, will be able to obtain the desired information from us. The value of such a library would increase greatly with time; and to accomplish our purpose in this matter we trust that the liberal vote of last year will be continued for a few years at least.

The library is open only six hours a day. We are aware that this is not as it should be; but part of the time of the assistant librarian has to be spent at work in the biological laboratory. I would, therefore, respectfully request that hereafter the assistant's time be wholly devoted to the work of the library, otherwise the full value of the library cannot be made available for either professors or students. That this step is important, is also urged by "Farming" for 1896, page 308, from which paper I quote the following: "A much greater use could be made of it, if it were open at all hours, and could have the services of a constant attendant."

The whole system of library work has been changed this year; and now, thanks to the new methods employed, the recommendations of the heads of departments, the ordering of books by the librarian, the passing of invoices at the customs, entering in the accession book, the indexing and shelving, are all systemized, and everything works with regularity and precision.

During the last year 374 books have been added to the library, as follows:

Herd Books	17	Physics	41
Reports	17	Dairying	11
Agriculture	48	Political Economy	2
Bacteriology	13	Mechanics	1
Botany	28	Veterinary	20
Zoology	14	Horticulture	8
Literature	128	Geology	4
Chemistry	13	Meteorology	2
History	1	General Science	4
Entomology	2	Geography	1

Also 5 copies of the Standard Dictionary, and one set (10 vols.) of Appleton's Century Dictionary and Cyclopædia.

Exchanges.

The following papers come to the College in exchange for reports and bulletins, and are of the greatest value to the officers of the College; they are also placed where they can be read and referred to by students and others.

Religious papers.—Young Men's Paper, Congregationalist, Christian Guardian, Presbyterian Review, Canada Presbyterian, Evangelican Churchman, and Canadian Baptist.

Weeklies.—Acton Free Press, Weekly Sun, Montreal Witness, Montreal Star, and Canadian Statesman.

Dairy.—American Cheesemaker, Hoard's Dairyman, Chicago Produce, Dairy World, Molkerei-Zeitung, L'Industrie Laetière, The Dairy, Holstein Friesian Register, The Creamery Gazette, Jersey Bulletin, and Cheesemaker.

Agricultural.—Swine Breeders' Journal, Farm Students' Review, O. A. C. Review, American Swine Herd, Poultry Review, The Ohio Farmer, Practical Farmer, Oregon Agriculturist, Dakota Field and Farm, Farm and Home, Home Market and Stockman, Co-operative Farmer and Maritime Dairyman, Journal of Agriculture, and Farmers' Gazette.

T. F. Paterson, B.S.A., has attended to the library this year, looking after the issue of books, indexing articles, etc., and I have much pleasure in placing on record my appreciation of his efficient services.

Conclusion.

In a word, I may say that we have made a bacteriological examination of fifteen samples of water during the year, three of which we had to condemn as unfit for use.

We have also examined several samples of diseased milk and have reported the results to those who sent them.

We have had many letters asking for information about the pasteurization of milk, and work in connection with the library has necessitated a large amount of correspondence.

In conclusion, I have to thank the Minister and yourself for assistance given me in the work of my department.

Respectfully submitted,

F. C. HARRISON.

Bacteriologist.

December 21st, 1896.

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 of the Ontario Agricultural College for the year 1896. I am pleased to report that the work carried on in connection with this department during the past year has given satisfactory results. The experimental grounds have been somewhat enlarged; the number of plots have been slightly increased; a few important experiments have been added to the list; several new and prominent varieties of farm crops have been imported; and the number of packages of seeds distributed to the farmers of Ontario has been considerably increased. Great care has been taken in selecting those experiments, the results of which would have a direc . bearing on the practical agriculture of Ontario. Although it is true that we add a few new experiments from year to year, yet the constant aim of the department is to conduct all experiments very carefully for several years in succession, in order that valuable lessons may be learned in connection with every experiment undertaken. To accomplish this we believe that it is necessary, not only to conduct each experiment with the greatest accuracy possible, but also in many cases to repeat the work in duplicate each season for a period of about five years, and in some cases even longer. After a test has been repeated for a few seasons, the results of each succeeding year increase in importance, because there is not only the results of the particular year in which the experiment is conducted, but also the accumulated data of the same experiment obtained on previous occasions. We firmly believe that the work in the experimental department is being appreciated more and more as the farmers become familiar with the character of the work which is done. Not only are the farmers becoming more interested in the experiments, but we are also pleased to notice that leading seedsmen, and fertilizer manufacturers as well, are manifesting a strong desire to keep in close touch with the experimental work. It is our pleasure frequently to entertain men from the agricultural colleges and experiment stations of the United States, who visit us with a view of becoming more familiar with the experiments conducted at the Ontario Agricultural College.

FIELD EXPERIMENTS IN 1896.

The year 1896 has been a favorable one for our experimental work. There were no late spring frosts to destroy the early spring crops this year. The amount of rain-fall during the summer was about normal, and there was no severe drouth at any one time to interfere seriously with the progress of the growing crops. The germination of seeds in nearly every experiment was much better than in 1895, and we have but few experiments to discard on account of unevenness in the germination of the seeds. We, therefore, have a greater number of successfully conducted experiments to report for the present year than at any time in the past.

Kind Words from Leading Men from Other Agricultural Colleges.

Within the past twelve months a great many kind letters have been received from men who are engaged in similar work in connection with other agricultural colleges and experiment stations. It might be encouraging to those who are interested in the work conducted in Ontario to have an opportunity to read a few of the letters from some of the leading agricultural professors and investigators in the United States, referring to the experimental department of the Ontario Agricultural College:

Burlington, Vermont, U. S. A.

Dear Sir,—It was my privilege to visit the Ontario Agricultural College in August, 1895. I left with the firm conviction that it is an educational institution unsurpassed in its line of work in America.

I was specially impressed with the extensive system of experimental plots, and shall long remember the outlook from the main college building, where it gives a view of the entire experimental field—more than 2,000 carefully attended plots—each of them a partial answer to some question in practical agriculture. I have never seen its equal for systematic plot tests, and it impressed me as being an ideal of plot work. I wish you long continued success in it.

Sincerely yours

L. R. Jones.
Professor of Botany.

Iowa Agricultural College, Ames, Iowa.

Dear Sir,—Last summer, while spending my vacation in the east, a trip to your College was a source of great pleasure to me. I was more impressed with the experiments than anything I had ever seen of the kind before.

The magnitude of your experiments astonished me. Your 2,200 plots of various kinds of grain, etc., and the length of time that you conducted these experiments, furnish the farmer with absolute proof of their reliability. By this means you have brought the Experiment Station in close touch with the needs of the farmers, and the benefit to be derived by the agriculturists of Ontario cannot be over esitmated.
In this work you are taking the lead, and other stations will eventually follow.

I am,

Yours very respectfully,

G. L. McKay,
State Dairy Instructor.

College of Agriculture, Madison, Wisconsin.

My Dear Sir,—I was both pleased and profited with my visit at the Ontario School of Agriculture and the Experimental Farm last summer. I was particularly impressed with the practical line of work you were conducting on the 2,000 or more plots in your experimental grounds. The different characteristics of grains, of grasses, and roots grown under the same conditions, were in themselves lessons valuable enough to compensate for time and expense in travelling one thousand miles to gain. Valuable lessons were also gleaned from plots sown at different times, under different conditions. I only regret that I was unable to spend more time in examining your work, but trust at some time in the future I shall be able to do so. Nowhere have I seen a system of experimental work better suited to the education of the farmer.

Wishing you success in your practical lines of assistance for the practical farmer,

I am,

Yours respectfully,

Geo. McKerrow,
Superintendent of Farmers' Institutes.

Agricultural College, Fargo, North Dakota.

Dear Sir,—I was greatly pleased during my visit last summer with an opportunity of seeing your experimental plots, and the variety of your experiments. I have visited a number of experiment stations and do not remember a single one where the work was carried on more intelligently to serve a practical end.

I have no doubt but this system of agriculture will work a revolution both in Canada and the United States, by making agriculture a profession, founded on scientific basis. The Guelph experiment station is certainly a fine demonstration of practical experiments.

Yours truly,

J. Worst,
President.

Equipment.

Never before was the experimental department so well equipped for carrying on a large amount of experimental work in connection with agriculture. The commodious building erected in 1895 gives ample room for the preparation of seed, fertilizers, etc., for the work in connection with the experimental department, and for that in connection with the Ontario Agricultural and Experimental Union. The experimental field of about fifty acres is well adapted for carrying on experiments of various kinds. As part of the land slopes to the southwest and part of it to the northeast, the water is prevented from lying on any portion of it for a great length of time. The various experiments can be conducted on low lying land or upon land somewhat elevated, thus affording a variety of conditions. A wagon with a tight rack; a scale with a platform of 72 square feet; a grain separator, especially adapted for the work; a five foot tread power for two horses, etc., are all exceedingly well adapted for the careful and accurate work which is being conducted. There is, however, a lack of the proper apparatus and appliances for seed investigation, which we believe should be conducted in connection with the other work. In order to have a proper equipment for this work, we should have a germinating apparatus; suitable balance, such as is used in chemical laboratories; a standard dissecting microscope, etc.

Co-operative Experimental Work.

One of the most extensive systems of co-operative experimental work in agriculture to be found at the present time, is the one established in Ontario. During the past year we distributed over 11,000 packages of grains, seeds, and fertilizers to Ontario farmers. The varieties thus distributed were those which had given the best results in a number of years' trials in our experimental department. The whole system of co-operative experimental work is conducted in close connection and in perfect harmony with our experimental work at the College. The two go hand in hand, each being made very much better by the help of the other. This work has increased year by year since it was started in 1886; and during the past four years the demand has been so great that we have been unable to supply material to the full number of applicants. In 1891 there were 2,642 plots; in 1892, 5,688; in 1893, 7,181; in 1894, 7,721; in 1895, 9,179; and in 1896, 11,124, used for these co-operative tests over Ontario.

This co-operative experimental work is conducted conjointly by the experimental department of the Ontario Agricultural College and the Ontario Agricultural and Experimental Union. Prof. Thos. Hunt, of the University of Ohio, who addressed the meeting of the Experimental Union held at the Ontario Agricultural College in the winter of 1892, writes very emphatically in regard to the work which is being conducted by the Experimental Union:

Ohio State University, Columbus, Ohio.

My Dear Sir,—I had the pleasure of attending the Ontario Agricultural College Experimental Union in December, 1892, and in visiting again the College in June, 1896. I was greatly impressed and delighted with what I saw and learned on both occasions. I am convinced that the Ontario Agricultural College is carrying on through this Union the most comprehensive and systematic series of co-operative experiments on the American continent, with which I am familiar.

"Imitation is the sincerest flattery." The alumni and ex-students of the College of Agriculture of the Ohio State University have perfected a similar organization as a result of your example.

I am very truly yours,

Thomas Hunt,
Professor of Agriculture.

Professor Jas. W. Robertson, Dominion Agricultural and Dairy Commissioner, who is so well known through the whole of Canada, has also furnished a letter in regard to the work of the Experimental Union, which will be read with much pleasure by those who are interested in the work of the Union. His letter reads as follows:

DEPARTMENT OF AGRICULTURE, Ottawa, Ontario.

DEAR MR. ZAVITZ,—I do not know of any organization which illustrates more fully the great gain which comes to the individual members of a community through co-operation for ends that are good than the Experimental Union in carrying on co-operative experiments in agriculture.

The work undertaken by the Union discovers information of the most apt and practical sort for the farmers of Ontario. It quickens the best quality of curiosity and directs it towards systematic investigation of the conditions, methods and agencies through which farm work can best be carried on. It generates a kindly and competitive enthusiasm, without leaving any room for invidious rivalry. It is a benefaction with a record of which you, as director, may be justly proud, and with a range of experience among its members which gives it matchless capacity for good service in the future. An organization does not create energy, but only directs it, yet the Experimental Union has called into active operation energies which otherwise would not have been used, and has directed them in such practical ways as to result in the growth of better crops, in the use of better methods of increasing and conserving the fertility of the soil, and in more skilful and economical management of live stock and products.

I am yours very truly,

JAS. W. ROBERTSON,

Agricultural and Dairy Commissioner.

THE FARM PROPER IN RELATION TO THE EXPERIMENTAL DEPARTMENT.

In order for the reader to understand clearly the nature of the work in agriculture which is being carried on at the College he should possess a general knowledge of the work of the farm proper, as well as that of the experimental department. Mr. Wm. Rennie, Farm Superintendent, has the immediate charge of the farm proper, which is entirely distinct from the experimental grounds. The two departments, however, very frequently receive assistance from each other. All kinds of farm crops which are grown for experimental purposes, and all seeds which are prepared for distribution throughout Ontario, are handled by the experimental department, and the crops which are grown for feed and for sale are managed by the farm proper. With this knowledge it will be clear to the reader that he should write to the experimentalist for any samples required for experimental work, and to the farm superintendent regarding the purchase of seed grain in quantity.

The two departments work together harmoniously, and it will be observed by the visitor who examines the crops closely that the varieties which are grown on the farm proper are those which have proven themselves to be the most successful in the experimental department in the average of several years' careful test. The experimental department is in that way enabled to supply the farm with some very excellent varieties. Small quantities of the varieties grown in the farm proper are sometimes handed over to the experimental department, in order that the large number of applications for seeds for testing purposes may be filled, if possible.

VISITS TO AGRICULTURAL COLLEGES AND EXPERIMENT STATIONS.

It has been the privilege of the writer to visit, within the past two years, a considerable number of the principal agricultural colleges and experiment stations of America. I wish to thank you very kindly for granting me this opportunity to visit so many of these institutions which are carrying on work somewhat similar to that which is being conducted in connection with our own institution. While I take this opportunity of saying that I have not yet visited an experiment station that is conducting a system of experimental work which seems better adapted to the needs of the farming community than that conducted in the Experimental department of the Ontario Agricultural College, still there are many very important features of work conducted at other institutions which can be examined with great advantage to our own work. The eight experiment stations visited in 1895 were enumerated in the report of last year. Those visited in 1896 are as follows: Delaware College and Agricultural Experiment Station, Newark, Delaware; Maryland Agricultural Experiment Station, College Park, Maryland; West Virginia Agricultural Experiment Station, Morgantown, West Virginia; Ohio Agricultural Experiment Station, Wooster, Ohio; Pennsylvania State College and Agricultural Experiment Station, State College, Pennsylvania. Besides these experiment stations, the writer spent a few days at the Department of Agriculture in Washington in examining the methods adopted in the investigation of seeds, soils, etc. The trial grounds of some of the principal seedsmen were also visited, such as W. Atlee Burpee, Doylestown, Pa., U.S.A.; D. Landreth & Sons, Bristol, Pa., U.S.A., and Samuel Wilson, Mechanicsville, Pa, U.S.A. I wish to state that the trial grounds of both W. Atlee Burpee & Co. and of D. Landreth & Sons are large in extent, neatly arranged and carefully looked after. The tests which are made at these places are comprehensive, but, as the objects of the tests are considerably different from those of the experiment stations, the results are much less valuable for the general public. The plots in nearly all instances are exceedingly small and the exact yields are seldom determined. These firms deserve a great deal of credit for so carefully examining and testing their seeds before offering them to the public for sale. The writer had a very pleasant and valuable trip throughout and received nothing but courtesy from all those with whom he came in contact, and he feels that the points gathered here and there will enable us to do better work at our own institution in Ontario.

Reports, Bulletins, Newspaper Articles, Etc.

Several articles and reports have been written within the last twelve months in order to bring before the public of Ontario the results obtained from experiments conducted here, and also those conducted throughout Ontario in connection with the Ontario Agricultural and Experimental Union. The following reports, newspaper articles, etc., have been issued by the Experimental Department during the past year:

1. Annual Report of the Experimental Department of the Ontario Agricultural College. (Ontario Agricultural College Report.)
2. Report of Experiments with Grain, Roots, Potatoes, Fodder Crops and Fertilizers Conducted Throughout Ontario. (Ontario Agricultural and Experimental Union Report.)
3. Co-operative Experiments in Agriculture for 1896. (Circular.)
4. Bulletin on Winter Wheat.
5. Winter Wheat Experiments. (*Farmers' Advocate*, London, Ont.)
6. Co-operative Experiments with Winter Wheat. (Circular for members of the Ontario Agricultural and Experimental Union.)
7. Summary Report of Winter Wheat Experiments. (Newspapers of Ontario.)
8. Co-operative Agriculture. (Newspapers of Ontario.)
9. Agricultural Experimental Work. (Newspapers of Ontario.)
10. The Ontario Agricultural and Experimental Union. (O. A. C. *Review*.)
11. High-class Seed Grain. (Toronto *Globe*.)
12. Agricultural Experiment Stations, with Special Reference to Cattle Feeding. (Report of the Superintendent of Farmers' Institutes.)

Besides the above-mentioned publications, the Experimental department has furnished numerous items for the agricultural press; nearly twenty separate sheets of instructions for use in connection with co-operative experiments in agriculture, etc.

Addresses Delivered at Agricultural Gatherings.

Within the past year, the writer has attended meetings of farmers' institutes in the counties of Lennox and Addington, Frontenac, Leeds, Grenville, Dundas, Stormont, Glengarry, and Prescott, and has delivered from one to four addresses at each place. He also delivered an address at the annual meeting of the Ontario Agricultural and Experimental Union, and has accompanied thousands of farmers through the experimental grounds when they have visited the College in large numbers in the summer season, and especially in the month of June.

Correspondence.

One of the strongest indications of the growing popularity of our experimental work is seen by the increasing number of letters received from the farmers, seedsmen, etc. During the past year, our correspondence with people in Ontario has been very large. We have also had a considerable amount of correspondence with leading agriculturists in other countries. Applications have been received for some of our best varieties of farm crops from England, France, Germany, Australia, Bermuda, United States, and each of the provinces of Canada. In order to give an idea of some of the correspondence in connection with the experimental department at the present time, it might be mentioned that during one week in August, no less than 510 letters were received, and from 350 to upwards of 400 letters were received per week at several different periods of the year. These contained a great variety of questions which required a considerable amount of time and thought to answer in a satisfactory manner. We are, however, always pleased to answer such enquiries to the best of our ability.

Grain Experiments.

There were in all about 700 plots devoted to grain experiments in 1896. These were all situated in the experimental grounds at the rear of the main College buildings. The soil in these grounds might be called an average clay loam. The plots varied in size from 1-10 to 1-100 of an acre, and the majority of them were uniform in size and shape, each being ten links wide by one hundred links long, thus forming an area of exactly 1-100 of an acre. The greatest of care is always exercised in having all the plots of each experiment exactly uniform in size and shape. In all instances the plots were a rectangular form, and a stake was driven at each of the four corners of every plot. In most instances the grain was sown broadcast. A line was drawn around the separate plots, and the packages of grain, which had been previously weighed out, were then sown upon their respective plots, inside of the enclosures made by the line. After the varieties relached to a height of about two inches, a line was again placed around each plot, and all pants outside of the plot limits were destroyed. Thus the areas devoted to the growing of the different crops were made exactly uniform.

There is frequently a marked difference between the crops grown on different plots, even when the plants are quite small; and necessary notes are taken of the various characteristics presented by the different crops from time to time throughout the entire season. The height of straw, the comparative amount of rust, the strength of straw, the date of maturity, etc., are carefully noted in every instance. Cutting is done with a cradle, when each crop reaches its proper stage of maturity. In order to have the results exactly uniform, all plots are cut by one person. As soon as the grain becomes sufficiently dry, it is hauled to the experimental barn in a wagon with a tight rack, made especially for the purpose. The whole crop is immediately weighed and threshed, great care being taken that no grain is lost and that no mixing occurs.

In 1896, experiments were conducted in testing varieties, dates of seeding, methods of cultivation, selection of seed, application of fertilizers, and growing grains separately and in various mixtures.

EXPERIMENTS WITH VARIETIES OF GRAIN.

Within the past eight years much attention has been devoted to experiments with different varieties of grain in order to find out the best varieties for cultivation in Ontario. In order to accomplish this, all the varieties obtainable throughout the Dominion of Canada have been secured, and also leading sorts from France, Germany, Italy, Sweden, Russia, England, Switzerland, Scotland, Hungary, Greece, Sicily, Egypt, Japan, New

Zealand, Australia and the United States. The most of these varieties have been carefully tested on the experimental plots for several years in succession. All varieties are grown for a period of at least five years, unless they show themselves to be very inferior within a shorter time. The kinds which give the most satisfactory results are continued for a much longer time. We are pleased to state that we have been successful in obtaining a few very excellent foreign varieties which have given better all round results than the best varieties which we have secured in Ontario. These leading varieties will be made prominent throughout the pages of this report.

Barley—Comparative Test of Forty-four Varieties.

Forty-four varieties of barley were sown in the experimental department in 1896. Of this number, fifteen were six-rowed, nineteen two rowed, and ten hulless. Within the past eight years, twenty-nine of the less prominent kinds have been discarded from our experiments after five years trial. The number of varieties, therefore, which are reported upon at the present time include all the varieties which we have had under experiment for at least five years, and only the leading varieties selected from those which we have grown for more than five years. The barley was all sown broadcast at the rate of 100 pounds of seed per acre on plots exactly 1,100 of an acre in size. Equal amounts were sown on the different plots, and the seeding took place on the 25th of April of the present year. The soil was neither heavy nor light, but what might be justly termed an average clay loam. Farmyard manure at the rate of twenty tons per acre was applied to the land in the spring of 1895, and a crop of corn was grown the same season. The yields per acre have been estimated from the actual yields of the plots.

The average yield of barley per acre for the year 1896, as determined from our experimental plots, is 50 bushels. This is about 7.5 bushels per acre less than the yields of 1895, and one bushel per acre less than the average yield for the past eight years. The weight of grain per measured bushel in 1895 was 51.5 pounds, and in the average of eight years it was 51.8 pounds, which shows that the quality of the grain during the past season was not quite equal to the average of a number of years past.

It will be observed that there is a great variation in the yield of grain per acre and in the weight per measured bushel in the different varieties reported upon. If we compare the first two varieties on the list, namely, the Mandscheuri and the Oderbrucker, both of which have been grown for eight years in succession, we find that the former has given an average of over eight bushels of grain per acre more than the latter, but has produced a grain which weighes nearly three pounds per measured bushel less. The differences in this respect for 1896 are even greater than in the average for the eight years. The varieties which produced the heaviest weight of grain per measured bushel in 1896 were the Vermont Champion, (54.3 pounds), and the Jarman's Selected Beardless, (54.3 pounds); and the varieties which produced the poorest quality of grain were the California Brewing (44.5 pounds), and the Cape (45.6 pounds). The Mandscheuri has certainly made an excellent record and has given a yield of grain per acre of about 13 bushels more than the common six-rowed, in the average experiments for seven years.

It will be observed that while some of the two-rowed barleys have given very good results, still on the whole the six-rowed varieties have taken the lead in yield of grain per acre. The varieties which gave the greatest length of straw in 1896 were Kinna Kulla (39 inches) New Zealand Chevalier (36 inches), and the Mandscheuri (35.5 inches); and the varieties which gave the shortest length of straw were the California Brewing (27 inches) and the Silver King (29 inches). There was not very much trouble from rust on the barley during the past season, but some varieties were affected more than others. The Oderbrucker was the least affected of all the varieties in this respect.

Success, Four-Rowed, North-Western, and Manitoba Six-Rowed were the first to mature; and the Jarman's Golden Champion, French Chevalier, Empress, and Carter's Gold Thorpe took the longest period to reach maturity. The Mandscheuri and Oderbrucker were about three days later than the varieties which were the very first to reach maturity.

COMPARATIVE TEST OF THIRTY-FOUR TWO-ROWED AND SIX-ROWED VARIETIES.

Varieties.	Seed obtained from—	Number of rows per head.	Results for 1896. Weight per measured bushel.	Results for 1896. Yield per acre. Straw.	Results for 1896. Yield per acre. Grain.	Average results for number of years grown on plots. Weight per measured bushel.	Average results. Yield per acre. Straw.	Average results. Yield per acre. Grain.
Grown for eight years:			lbs.	tons.	bus.	lbs.	tons.	bus.
Mandscheuri	Russia	6	49.63	2.20	88.73	50.72	1.88	**66.30**
2 Oderbrucker	Germany	6	52.50	1.57	55.33	53.51	1.67	**57.74**
3 French Chevalier	France	2	51.50	2.08	57.23	52.28	1.93	**56.04**
4 Scotch Improved	Ontario	6	53.25	1.67	61.85	52.04	1.52	**55.52**
5 Empress	England	2	51.88	1.92	57.48	52.58	1.72	**54.84**
6 Common Six-Rowed	Ontario	6	52.88	1.50	59.44	52.57	1.43	**53.31**
7 Two-Rowed Italian	France	2	52.50	1.76	57.75	53.01	1.94	**50.11**
8 Kinna Kulla	Sweden	2	51.50	1.90	54.04	51.89	1.80	**48.78**
Grown for seven years:								
9 New Zealand Chevalier	New Zealand	2	52.50	2.02	60.54	52.91	2.00	**55.71**
10 Mensury	Ontario	6	52.75	1.29	48.44	51.69	1.38	**52.83**
11 Cape	New Zealand	6	45.06	1.39	55.73	47.31	1.39	**52.80**
12 Early Minting	England	2	52.63	1.73	53.06	52.64	1.86	**52.77**
13 Australian	Germany	2	53.00	1.39	45.25	53.17	1.79	**51.18**
14 Italian	Italy	2	52.63	1.69	49.35	54.06	1.77	**46.78**
Grown for six years:								
15 Imperial Six-Rowed	Ontario	6	52.63	1.16	47.44	52.30	1.50	**60.50**
16 California Brewing	United States	6	44.50	1.10	42.83	46.32	1.48	**59.07**
17 Six-Rowed Baxter's Improved	Ontario	6	53.00	1.41	52.79	52.24	1.54	**54.10**
18 California Chevalier	United States	2	52.50	1.34	46.17	52.30	2.01	**52.88**
19 Highland Chief	“	2	52.44	1.28	44.46	52.77	1.66	**51.05**
20 Salzer's California Prolific	“	2	51.69	1.34	48.19	52.59	1.60	**49.03**
21 Duckbill	Ontario	2	51.56	1.28	41.42	52.56	1.62	**48.41**
22 Carter's Goldthorpe	England	2	51.63	1.41	43.42	52.06	1.79	**47.14**
Grown for five years:								
23 Gold Foil Hansfords	United States	2	53.50	1.47	49.15	52.89	1.86	**51.45**
24 Two-Rowed Canadian	Ontario	2	51.69	1.27	43.04	52.46	1.56	**44.49**
25 Selected Canadian Thorpe	“	2	51.38	1.21	41.15	51.66	1.56	**42.83**
Grown for four years:								
26 Four-Rowed	United States	6	52.28	1.86	55.79	51.85	1.46	**56.35**
27 Vermont Champion	“	2	54.31	1.60	51.23	54.05	1.69	**50.40**
28 Jarman's Selected Beardless	England	2	54.31	1.03	44.79	52.48	1.70	**48.32**
29 Jarman's Golden Champion	“	2	51.75	1.06	26.69	51.12	1.55	**38.32**
Grown for three years:								
30 Scotch	United States	6	49.75	1.32	50.19	50.31	1.49	**53.56**
31 North Western	“	6	49.75	1.46	58.92	50.48	1.49	**51.74**
32 Success	“	6	48.06	.83	23.56	48.07	1.24	**32.89**
Grown for one year:								
33 Silver King	United States	6	50.56	1.15	43.85	50.56	1.15	**43.85**
34 Manitoba Six-Rowed	Ontario	6	50.63	1.07	42.00	50.63	1.07	**42.00**

The barleys were all examined very closely just before they were harvested; and, in general appearance, the Mandscheuri occupied first place, and the French Chevalier, Two-Rowed Italian, Kinna Kulla, and the Oderbrucker followed in the order indicated in the above list.

Hulless Barley—Comparative Test of Ten Varieties.

There were ten varieties of hulless barley tested in the experimental department in 1896; of this number, five have now been grown for seven years in succession, three for four years, one for three years, and one for one year. The seed was sown on the 25th of April on plots of exactly the same shape and size as those used for the six-rowed and the two-rowed varieties. The soil was also quite similar to that used for the other barley.

Varieties.	Seed obtained from	No. of rows per head.	Results for 1896. Weight per measured bushel.	Results for 1896. Yield per acre. Straw.	Results for 1896. Yield per acre. Grain.	Average results for number of years grown on plots. Weight per measured bushel.	Average results. Yield per acre. Straw.	Average results. Yield per acre. Grain.
			lbs.	tons.	bus.	lbs.	tons.	bus.
Grown for seven years—								
1. Black Hulless....	Ontario	6	62.38	.93	30.63	63.36	1.51	39.77
2. Guymalaya	Sweden	6	59.69	1.24	36.25	58.31	1.39	39.40
3. Hungarian	Hungary ..	6	59.78	1.05	30.05	59.27	1.52	38.93
4. Large-Skinned...	France	2	59.44	1.31	34.63	60.01	1.52	33.61
5. Three-Rowed	Germany ..	6	62.38	1.05	28.18	61.05	1.26	28 36
Grown for four years—								
6. Guy Mayle	U.S........	6	60.38	1.57	47.72	61.71	1.38	47 23
7. Purple	U.S	6	62.88	1.38	36.40	63.32	1.73	43 94
8. Smooth Hulless..	U.S........	6	60.00	1.22	40.15	61.63	1.63	37 17
Grown for three years—								
9. Winnipeg No. 2..	U.S........	6	....	....	....	60.36	1.73	42 22
Grown for One year—								
10. New White Hulless	U.S........	6	60.13	1.35	30.88	60.13	1.35	30 88

The grain of the hulless varieties of barley more closely resembles that of rye or wheat than it does of the grain of the two and six-rowed varieties of barley. It will be observed in the foregoing table that nearly all the varieties give an average weight per measured bushel of upwards of 60 pounds, and the Black Hulless variety weighs about 63⅓ pounds per measured bushel in the average of seven years' experiments. The weight per measured bushel used in determining the yield per acre was 60 pounds, while that used for the two-rowed and six-rowed varieties was 48 pounds.

The average yield per acre of the ten varieties grown in 1896 was thirty-five bushels, which is about three bushels per acre less than the average of the varieties grown for seven years. The largest yield of grain per acre in 1896 was produced by the Guy Mayle, and the second largest by the Smooth Hulless. The Hungarian and Purple, however, gave the best general appearance in the plots. One of the greatest drawbacks to the hulless varieties is the tendency of the crop to become lodged, especially is this the case with some of the varieties. Winnipeg No. 2, Black Hulless, and the Smooth Hulless possessed the weakest straw in 1896; and the Hungarian, Guy Mayle, Three-Rowed, and New White Hulless varieties possessed straw which stood up best at the time of harvesting

Barley-Seed Broadcasted and Drilled on Six Different Dates.

An experiment was conducted in the summer of 1896 in sowing barley broadcast and with the grain drill on six different dates, commencing on April 18th and closing on May 26th. The plots were all similar in size, and the same quantities of seed were used in all cases. The land upon which these experiments were conducted was quite uniform in character and produced a crop of turnips in 1895. The crop on each plot was harvested when it reached its proper stage of maturity. The following table gives the results of the experiment conducted in 1896, and also the average results of this experiment and a somewhat similar one in 1895.

Dates of seeding.	Results for 1896.		Average results from different dates of seeding.			
	Methods of seeding.	Yield of grain per acre.	Weight per measured bushel. 1896	Weight per measured bushel. 2 years, 1895-6.	Yield of grain per acre. 1896.	Yield of grain per acre. 2 years, 1895-6.
		bus.	lbs.	lbs.	bus.	bus.
April 18	Broadcasted	53.5	49.97	51.18	54.40	**50.52**
	Drilled	55.3				
April 22	Broadcasted	59.3	49.82	51.35	59.00	**52.88**
	Drilled	58.7				
May 1	Broadcasted	41.0	48.41	49.08	41.40	**42.06**
	Drilled	41.8				
May 9	Broadcasted	19.9	44.03	44.83	26.25	**32.20**
	Drilled	32.6				
May 18	Broadcasted	18.5	40.85	44.99	20.15	**26.62**
	Drilled	21.8				
May 25-26	Broadcasted	12.8	40.29	41.65	12.08	**18.00**
	Drilled	....				

The results of the foregoing table are of much interest, as there are great variations in the yield of grain per acre and in the weight per measured bushel produced from the different methods of sowing, and also from the different dates at which the grain was sown. The best yield of grain per acre in 1896 was from sowing seed broadcast on the 22nd April. At this particular period the land was thoroughly moist and still not too wet for cultivation, and the grain which was sown broadcast remained very near the surface of the land, and therefore obtained the full advantage of the heat from the sun. The seeding, which took place on the 22nd of April, produced better results from sowing the grain broadcast than by sowing it with a grain drill, but this is the only instance in this experiment that the drilled grain did not give the largest crop per acre.

Taking the average of the whole experiment we find that the grain which was drilled produced 3.6 bushels per acre more than that which was broadcasted, and the grain weighed one pound per measured bushel more from the former than from the latter method of seeding.

The results of this experiment certainly point to the great advantage of early seeding in the case of barley. It, however, seems to indicate that there is a possibility of getting the barley into the ground too early in the spring, owing, no doubt to a lack of warmth in the soil. The fact that there was a decrease of over ten bushels per acre between the seedings of April 22nd and of May 1st in the average results of 1895 and 1896, is a point worthy of very careful consideration. In fact, the decrease in the yield per acre as the season advances from April 22nd was very marked. The crop produced on the 22nd of April was nearly three times as great as that produced on the 25th and the 26th of May.

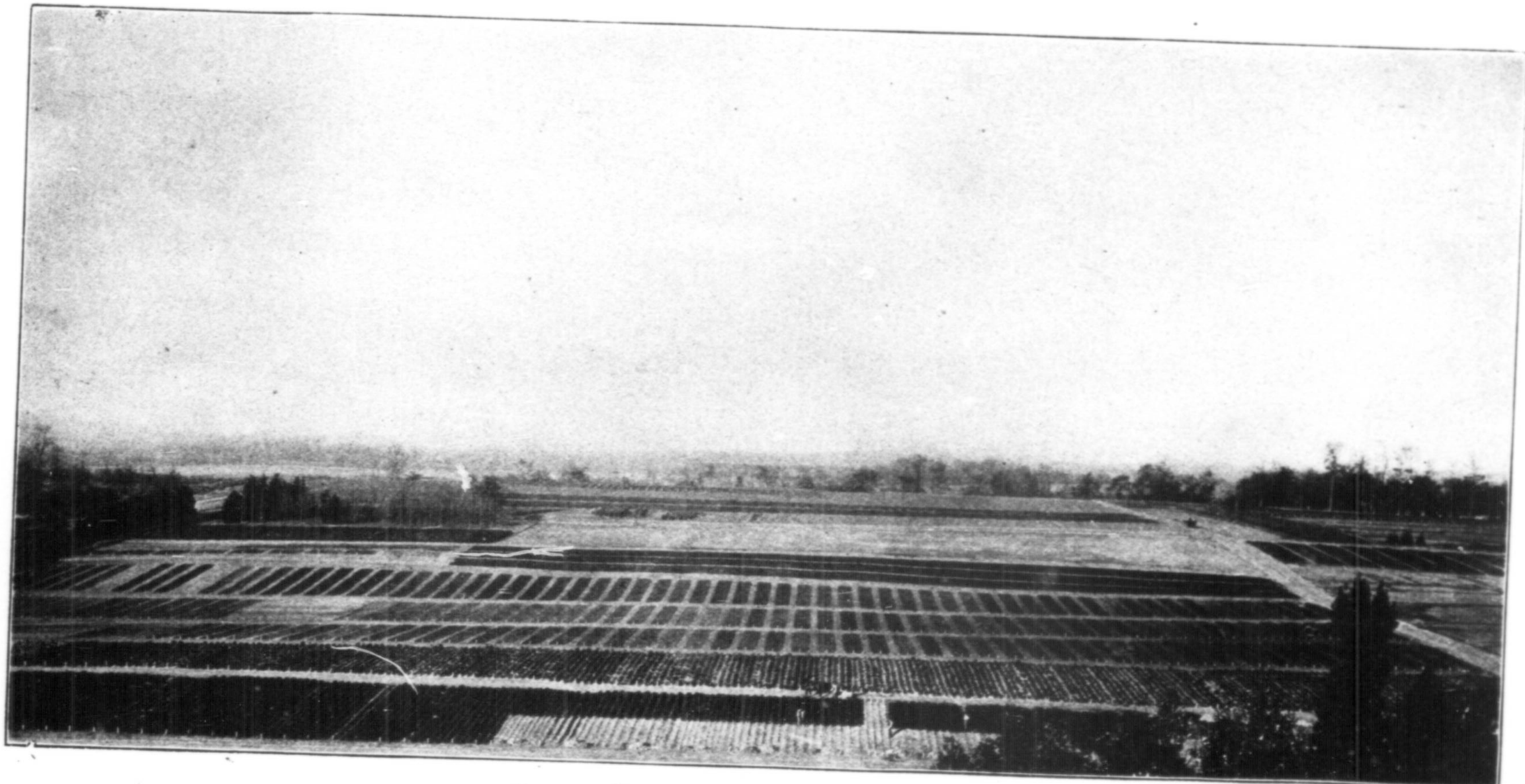
Peas—Comparative Test of Forty-six Varieties.

Varieties.	Date of maturity.	Results for 1896. Weight per measured bushel.	Results for 1896. Straw per acre.	Results for 1896. Grain per acre.	Average results for number of years grown on plots. Weight per measured bushel.	Average results for number of years grown on plots. Straw per acre.	Average results for number of years grown on plots. Grain per acre.
Grown for six years:		lbs.	tons.	bus.	lbs.	tons.	bus.
1 White Wonder (New Zealand)	August 1	66.00	1.69	60.47	63.60	1.19	**40.94**
2 Early Britain (England)	July 30	62.48	1.90	55.93	60.62	1.33	**40.67**
3 Field (New Zealand)	" 25	63.36	1.79	56.98	62.71	1.37	**39.20**
4 Mummy	August 5	65.52	1.83	49.68	63.95	1.60	**38.66**
5 Brown (New Zealand)	" 3	62.00	1.89	49.48	59.98	1.56	**37.46**
6 Princess Royal	" 1	63.04	1.51	48.02	60.68	1.25	**35.44**
7 Blue (New Zealand)	" 1	66.24	1.41	52.30	63.04	1.21	**35.16**
8 Prussian Blue	" 7	64.00	2.29	42.08	62.43	1.56	**35.06**
9 Glory	July 31	64.16	1.30	51.57	61.80	1.29	**34.46**
10 White Eyed Marrowfat	August 5	63.04	2.03	45.57	62.31	1.51	**33.72**
11 Black Eyed Marrowfat	" 5	64.00	1.83	44.14	61.88	1.42	**33.35**
12 Early Race-Horse	July 25	62.16	1.42	43.65	62.39	1.27	**33.02**
13 Multipliers	August 2	63.52	1.94	35.37	62.16	1.65	**30.64**
Grown for five years:							
14 Tall White Marrowfat	July 27	64.00	1.67	38.65	62.07	1.68	**37.61**
15 New Canadian Beauty	" 30	65.04	1.68	36.52	62.40	1.45	**33.63**
16 Canada Cluster	" 27	65.76	1.33	32.23	63.00	1.57	**33.21**
17 Centennial White	" 30	64.48	1.73	34.02	61.82	1.38	**32.30**
18 Golden Vine	" 27	65.76	1.33	31.67	62.57	1.43	**31.72**
19 Royal Dwarf Marrowfat	" 28	65.04	1.20	30.00	61.64	1.48	**31.53**
20 McLean's Advancer	" 27	66.00	1.19	31.25	56.46	1.05	**31.19**
21 Cleveland's Advancer	" 30	64.48	1.39	24.58	61.38	1.43	**30.84**
22 Scotchman	August 6	63.84	1.74	31.05	62.69	1.84	**30.80**
23 Prince Albert	" 10	64.16	1.59	30.42	62.19	1.57	**29.62**
24 Potter	July 28	64.88	1.36	36.25	61.59	1.29	**29.56**
25 Sword	August 3	63.28	1.55	28.23	62.15	1.46	**29.13**
26 Canada Field	" 8	63.52	1.43	27.30	61.59	1.37	**27.56**
27 Striped Wisconsin Blue	" 6	63.52	1.64	28.65	61.72	1.49	**24.77**
28 Oakshott Field	" 11	54 40	1.85	21.72	53.84	1.65	**24.34**
29 Pride of the North	July 26	63.12	1.31	28.75	60.38	1.09	**22.76**
Grown for four years:							
30 William the First	" 27	60.40	1.38	48.07	59.77	1 19	**38.62**
31 Chancellor	" 21	66.72	1.49	35.32	64.59	1.43	**37.99**
32 Nimble Taylor	" 30	61.60	1.74	35.42	59.69	1.42	**36.95**
33 Egyptian	August 10	63.52	.78	30.83	61.26	.96	**36.23**
34 Nine Pod	" 3	60.88	1.87	41.98	59.50	1.52	**35.94**
35 Common Grey	" 3	59.84	1.49	36.93	58.67	1.48	**35.19**
36 D'Auvergne	July 25	62.72	1.40	39.17	62.56	1.22	**33.84**
37 Tall Turkish	" 24	62.64	1.43	37.40	61.43	1.28	**32.20**
38 Early June	" 26	....	....	....	62.44	1.45	**31.89**
39 White Imperial	" 30	63.12	1.54	36.05	61.27	1.41	**31.73**
Grown for three years:							
40 Improved Grey	" 27	60.16	1.17	35.10	60.51	1.18	**37.59**
41 Crown	" 27	61.04	1.12	33.65	61.10	1.44	**34.01**
42 Coffee	August 3	61.04	1.47	24.32	60.43	1.58	**26.51**
Grown for two years:							
43 White Hundredfold	July 26	65.76	1.68	36.52	2.76	1.73	**44.41**
Grown for one year:							
44 Lindsay	July 25	57.28	.23	28.90	7.28	1.23	**28.90**
45 Grass Pea	August 6	65.04	1.58	24.12	5.04	1.58	**24.12**
46 Waterloo	July 25	57.12	.98	22.30	57.12	.98	**22.30**

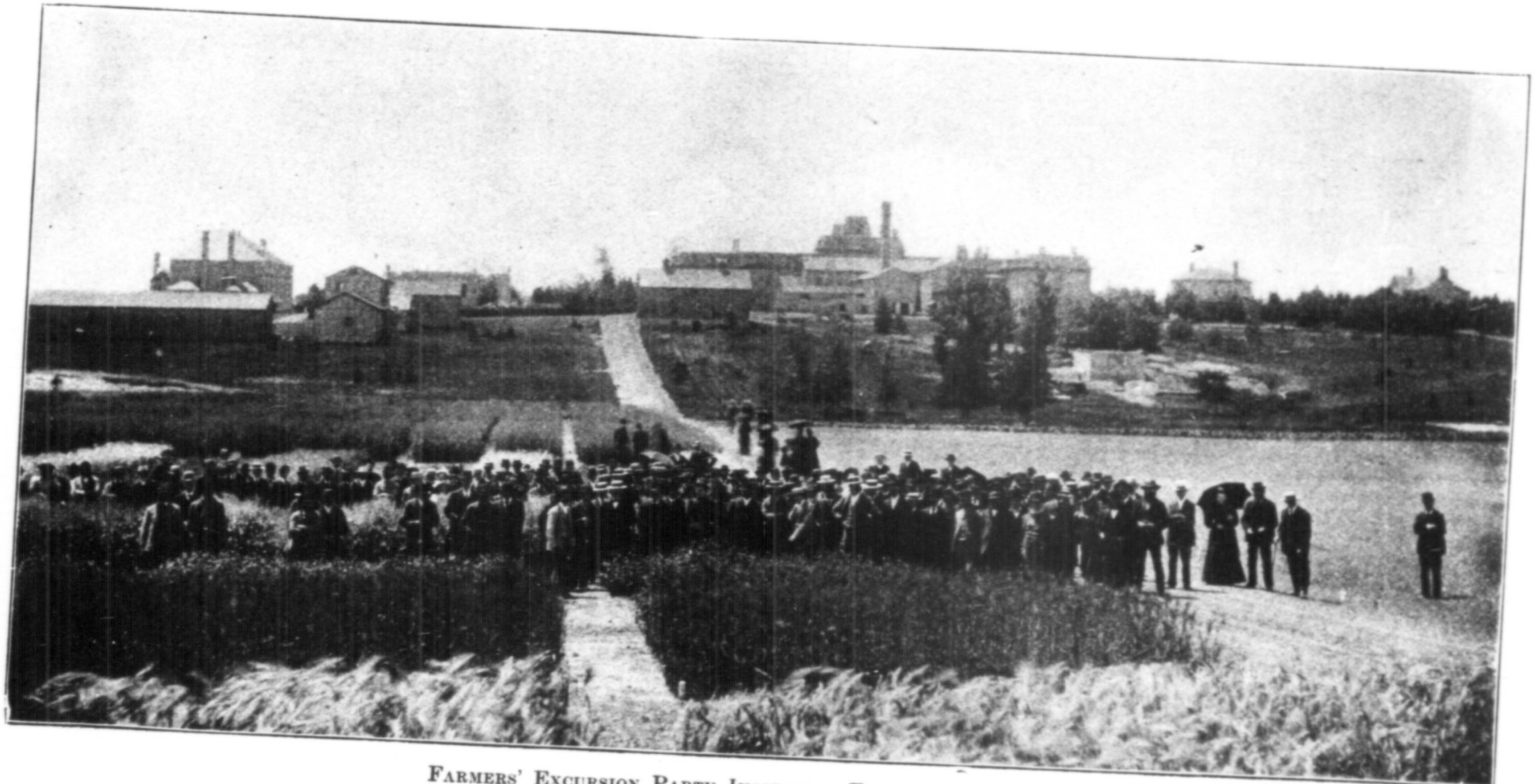
In 1896, forty-six varieties of peas were grown. Of this number sixteen have been grown for six years in succession, sixteen for five years, ten for four years, three for three years, one for two years, and three were grown in 1896 for the first time. Different quantities of seed were used upon the plots, owing to the great, variation in the size of the

Forty Six Varieties of Peas Tested in 1896.
25 Peas of Each Variety.

peas and in the character of the growth. The smallest varieties were sown at the rate of from two to two and a half bushels per acre. Seed of all the varieties were sown on April 28th, upon plots exactly 1/100 of an acre in size. The land devoted to the experi-



General View of Experimental Plots, 1896.



Farmers' Excursion Party Inspecting Experimental Plots.

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ment produced a crop of corn the previous year, and was given a dressing of twenty tons of farm yard manure per acre in the spring of 1895. The seed was sown with a grain drill, in order that it might be evenly covered. The yields per acre have been estimated from the actual results of the plots.

The foregoing table, giving the results of the different varieties of peas, shows that there is a marked difference in yield of grain per acre and in weight per measured bushel produced by the different varieties. The White Wonder, which was imported from New Zealand in the spring of 1889, has given excellent results, as it now heads the list in average yield per acre among all the varieties which have been grown in our grounds for six years in succession. It has also produced a grain with an average weight per measured bushel of 63.3 pounds, which is surpassed by only two or three other varieties. The Early Britain, which occupies second place in average yield of grain per acre, is a close rival of the White Wonder in several respects, but has produced a grain which weighs three pounds less than the White Wonder in the averaged weight per measurep bushel. It will be observed that the three leading kinds of peas are all foreign varieties, two having been imported from New Zealand and one from England.

There is a great variation in the size of the peas of the different varieties, some of the larger kinds being more than twice as large as the smaller sorts. Oakshott Field pea, Princess Royal, Lindsay, Coffee, New Zealand Beauty, Pride of the North, and Waterloo are the varieties possessing the largest grain; and the Chancellor, Golden Vine, McLean's Advancer and Sword are the varieties which possess the smallest grain, among the varieties under experiment. The size of the peas, however, seem to have but little influence on their respective yields per acre.

The different varieties of peas were all examined very carefully after harvesting, in order to determine as nearly as possible which were the most and which were the least subject to the ravages of the pea weevil (*Brucus pisi*). It was found that there were only two varieties in the entire list which were completely free from the injury of the weevil, namely, the Egyptian, or, as it is sometimes called, Brazilian Coffee pea, and the Grass pea. These two varieties, however, are very much different in their manner of growth from all ordinary varieties of peas. The other varieties which showed the least injury from the weevil were Chancellor, Potter, Pride of the North, Blue (New Zealand), Royal Dwarf Marrowfat, Centennial White, McLean's Advancer, Golden Vine, Nimble Taylor, and White Wonder.

Peas—Broadcasting and Drilling on Four Different Dates.

An experiment on twelve plots was conducted in 1896, by which peas were sown broadcast and with a grain drill at six different dates, commencing on April 18th and closing on May 26th. The plots are all 1/100 of an acre in size, and equal quantities of seeds were used for the various plots. The drilling was done with an ordinary grain drill, the broadcasting was done by hand, and the ground was afterwards harrowed. The yields per acre have been estimated from the actual yields of the plots.

Dates of seeding.	Results for 1896.		Average results from different dates of seeding.			
	Methods of seeding.	Yield of grain per acre.	Weight per measured bushel.		Yields of grain per acre.	
			1896.	2 years 1895-6.	1896	2 years 1895-6.
April 18	Broadcast	29.9	61.32	61.29	32.59	**32.60**
	Drilled	35.3				
April 22	Broadcast	37.0	60.94	61.13	36.36	**36.01**
	Drilled	35.7				
May 1	Broadcast	29.4	60.50	61.32	30.13	**36.03**
	Drilled	30 8				
May 9	Broadcast	23 3	60.44	61.38	25.39	**34.55**
	Drilled	27.5				

The reader will observe that the drilled grain gave a larger yield of peas per acre than that which was broadcasted, in every instance except one. As in the case of the barley, grain which was drilled on April 22nd did not give so large a yield as that which was broadcasted on the same date. In averaging the results for the four different dates of seeding, we find that there wa 2.4 bushels per acre more grain produced by the seed which was drilled than by that which was broadcasted.

In comparing the yield of peas per acre produced from seed sown at four different dates in 1895 and again in 1896, we find that the largest yields of grain have been produced from the second and third dates of seeding. In 1896, however, much better results were obtained from seeding on April 22nd than on May 1st, and decidedly the poorest results were from the last seeding. In weight of grain per measured bushel, there is but little difference between the crops produced from the different dates of sowing.

Spring Wheat—Comparative Test of Forty-eight Varieties.

Eighty-three varieties of spring wheat have been tested in the trial grounds within the past eight 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 1896, forty-eight varieties were tested. Four of these were grown in 1896 for the first time, and three of these four were kindly furnished by the Central Experimental Farm, Ottawa. The soil on which the variety experiment with wheat was conducted was situated in the south-east portion of the experimental grounds, and was quite uniform in character. It was plowed in the autumn of 1895, and was well cultivated and harrowed in the spring of 1896. The seed was sown broadcast on April 23rd on plots one one-hundredth of an acre in size. The yields per acre have been determined from the actual yields of the individual plots.

Spring Wheat—Comparative Test of 48 Varieties.

Varieties.	Nature of head.	Results for 1896.			Average results for number of years grown on plots.		
		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 eight years:		lb.	tons.	bush.	lb.	tons.	bush.
1 Bart Tremenia	Bearded	59.34	1.19	16.88	62.41	1.73	28.43
2 Herison Bearded	"	59.63	.80	11.62	62.75	1.82	27.03
3 Pringle's Champion	"	58.06	.86	10.37	60.00	1.76	25.05
4 Saxonka	"	60.25	.90	14.22	60.43	1.70	24.16
5 Konisburg	"	59.75	.96	13.90	61.26	1.57	23.71
6 Holben's Improved	Bald	55.75	.96	9.68	58.46	1.73	22.82
Grown for seven years:							
7 Wild Goose	Bearded	59.06	1.66	20.42	60.90	1.99	33.69
8 Red Fern	"	58.28	1.20	15.15	60.66	1.95	30.17
9 White Russian	Bald	54.69	1.10	12.40	58.36	1.85	28.81
10 Medea	Bearded	58.94	1.74	24.48	60.67	1.73	28.67
11 Sorentino	"	57.38	1.81	21.20	59.44	1.84	27.07
12 Red Fife	Bald	56.13	1.45	15.73	60.58	1.81	26.67
13 Algiers	Bearded	55.34	1.58	15.83	57.62	1.81	25.70
14 White Fife	Bald	55.63	1.22	9.48	60.51	1.61	25.00
15 Colorado	Bearded	55.56	.87	9.38	59.33	1.62	22.85

SPRING WHEAT—COMPARATIVE TEST OF 48 VARIETIES—*Continued.*

Varieties.	Nature of head.	Results for 1896. Weight per measured bushel.	Results for 1896. Yield of straw per acre.	Results for 1896. Yield of grain per acre.	Average results for number of years grown on plots. Weight per measured bushel.	Average results for number of years grown on plots. Yield of straw per acre.	Average results for number of years grown on plots. Yield of grain per acre.
		lb.	tons.	bush.	lb.	tons.	bush.
Grown for six years:							
16 McCarlin	Bearded	57.31	1.01	10.37	58.87	1.91	**25.40**
17 Rio Grande	"	57.63	1.24	12.03	59.20	1.80	**25.29**
18 Manitoulin	Bald	55.50	.98	8.13	59.01	1.60	**24.70**
19 Okanagan Valley Velvet Chaff	"	54.36	1.17	9.27	54.93	1.71	**24.05**
20 Washington	Bearded	57.00	.99	10.27	59.08	1.54	**22.68**
21 Saskatchewan Red Fife	Bald	54.44	.93	8.23	58.61	1.54	**22.51**
22 Salzer's Assiniboia Fife	"	55.31	.79	7.03	58.54	1.38	**22.06**
Grown for five years:							
23 Wellman Fife	Bald	55.56	1.10	10.88	58.51	1.80	**26.10**
24 Lost Nation	"	52.94	1.00	8.48	58.32	1.76	**25.42**
25 Velvet Chaff Blue Stem	"	52.36	.82	6.77	57.01	1.72	**24.75**
26 New York	Bearded	54.00	.80	7.55	57.67	1.56	**21.80**
27 Hayne's Blue Stem	Bald	51.69	1.00	6.72	56.34	1.67	**21.41**
28 Manitoba Red	"	55.42	.96	5.57	58.80	1.58	**21.23**
29 Dakota Marvel	"	53.31	1.05	8.38	56.53	1.62	**20.40**
30 Campbell's White Chaff	"	51.00	.69	4.48	54.27	1.25	**14.35**
Grown for four years:							
31 Blue Democrat	Bearded	57.50	1.16	11.35	59.11	1.81	**24.16**
32 Champion Bearded	"	57.42	1.09	11.30	58.70	1.65	**20.79**
33 Amythest	Bald	54.81	.92	8.65	58.50	1.42	**20.50**
34 Ontario	Bearded	54.50	2.02	12.55	56.95	1.79	**20.34**
35 French Imperial	Bald	55.69	.93	9.87	58.47	1.32	**19.37**
36 Early Scotch Bearded	Bearded	54.94	1.06	8.75	57.66	1.50	**17.71**
37 Scotch Fife	Bald	55.00	.68	6.67	58.16	1.13	**15.71**
38 Canadian Club	"	51.63	.50	4.48	56.22	....	**14.73**
30 Niagara	"	50.00	.67	3.55	53.85	1.17	**12.80**
40 White Australian	"	....	.40	2.50	....	1.65	**9.57**
Grown for three years:							
41 Salzer's Marvel	Bald	54.18	.45	5.68	56.82	1.24	**18.86**
42 Red North Dakota	"	54.36	.86	7.92	57.87	1.14	**18.23**
43 May's Early Wonder	"	....	.14	1.30	....	1.08	**16.72**
Grown for two years:							
44 Manitoba Hard	Bald	53.56	.72	6.88	56.91	.78	**11.57**
Grown for one year:							
45 Stanley	....	54.88	.56	5.47	54.88	.56	**5.47**
46 Preston	....	53.69	.49	5.42	53.69	.46	**5.42**
47 Percy	....	54.13	.59	5.27	54.13	.59	**5.27**
48 Seven Headed	....	....	1.03	2.45	....	1.03	**2.45**

The spring wheat crop in 1896 was very poor, the yield being less than for several years past. When it is remembered, however, that our experiments extend over a period of several years, the average results for the different varieties for the full number of years which they have been grown in the experiments should indicate very well the comparative value of the different varieties for general cultivation. Some varieties do well in favorable years; others, and especially strong growing sorts, are likely to give the best satisfaction in seasons in which the weather and other conditions are less favorable. When the experiments extend over a number of years, however, a variety of conditions are experienced, and those kinds of spring wheat which will give the best satisfaction under varied conditions are varieties from which we may hope to receive the most satisfactory results in general use.

The average yield per acre of the forty-eight varieties of spring wheat grown in 1896 was only 9.7 bushels. This is exceedingly low as compared with the 26.7 bushels in 1895, 30.3 bushels in 1894, and 21.1 bushels in 1893. It will be observed that the varieties which gave the best results in 1896 are wheats of a coarse nature, such as Wild Goose, and others of somewhat similar characteristics, as the Bart Tremenia, Medea, Sorentino, Algiers and Ontario. The Stanley, Preston, and Percy varieties of spring wheat, which were kindly furnished by the Dominion Experimental Farm, Ottawa, have not given very satisfactory results during the past season; but, as this is the first time we have grown these varieties in our experimental grounds at Guelph, we think that perhaps the results of future years may be more favorable. It will be observed that the Herison Bearded gave about two bushels per acre more than the average of all the varieties, and produced a grain which weighed nearly sixty pounds per measured bushel, which was exceedingly good for the past season, and was surpassed by only two other varieties, namely, the Saxonka and the Konisburg. It will be observed that the weight per measured bushel of the Herison Bearded is 62.75 pounds in the average of eight years. This is the highest record of all the varieties when the average results for the years in which the experiments have been conducted are taken into consideration.

The spring wheats were considerably injured by the rust during the past season. Especially was this so in the case of Lost Nation, Velvet Chaff, Blue Stem, Canadian Club, Niagara, Stanley, Campbell's White Chaff, McCarlin and Preston. The varieties which produced the greatest length of straw in 1896 were Ontario, Sorentino, Red Fife, Medea, Blue Democrat, Champion Bearded; and those which produced the shortest straw were the Bart Tremenia, White Australian, and Canadian Club.

Spring Wheat.—Broadcasting and Drilling on Six Different Dates.

The spring wheat was sown with an ordinary grain drill, and was broadcasted by hand on April 18th, April 22nd, and May 1st, May 9th, May 18th, and May 25th, 1896. The plots used for these experiments 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. The yields per acre have been determined from the actual yields of the plots.

Dates of seeding.	Results for 1896.		Average results for different dates of seeding			
	Methods of seeding.	Yield of grain per acre	Weight per measured bushel.		Yield of grain per acre.	
			1896.	2 years, 1895-6.	1896.	2 years, 1895-6.
April 18	Broadcasted Drilled	.... 23.02	62.13	61.38	23.02	22.66
April 22	Broadcasted Drilled	18.97 20.42	59.78	59.77	19.70	18.37
May 1	Broadcasted Drilled	12.45 16.30	58.90	59.39	14.38	15.55
May 9	Broadcasted Drilled	9.95 9.58	57.59	58.99	9.77	12.73
May 18	Broadcasted Drilled	4.58 4.27	49.38	55.01	4.43	8.28
May 25-26	Broadcasted Drilled	2.60 1.67	50.01	55.63	2.14	8.31

The average yield per acre from the drilled plots was 10.45 bushels, and that from the plots which had been broadcasted was 9.71 bushels, thus showing that there was about two-thirds of a bushel per acre in favor of the drilled grain in the average of the six different dates of seeding.

A very interesting feature in this experiment is the great importance of early seeding. Experiments in sowing grain on different dates have been conducted in the experimental department for several years, and these past experiments have shown that while it is important to get oats and barley sown early in the spring, it is of still greater importance to have the spring wheat in the ground at the earliest possible moment after the ground is in a suitable condition for cultivation. In the experiment for 1896, we notice that there were upwards of four bushels per acre more from the grain which was sown on April 18th than from that which was sown only four days later. There was also a decrease of five-and-a-half bushels per acre between the sowings of April 22nd and of May 1st. The great importance in the early seeding of spring wheat is also shown in the weight of grain per measured bushel, as that sown on April 18th gave an average weight of over 62 pounds per measured bushel. It was the only instance in which the wheat gave a heavier weight than the standard. The average weight per measured bushel from the last two days of seeding was less than fifty pounds per measured bushel.

Experiments with Winter Wheat.

A bulletin was issued in August giving the results of experiments with winter wheat. As this bulletin received a wide circulation we shall present only a few of the particular features in the winter wheat experiments.

One hundred and thirty-three varieties of winter wheat have been tested at the Ontario Agricultural College within the last seven years. Of this number, fifty-three varieties have been grown for five years, and the remainder have been tested from one to four years. Besides testing the varieties, there have been experiments conducted in different dates of seeding, methods of seeding, selection of grain for seed, quantities of seed per acre, application of fertilizers, sowing of spring grain to act as a mulch for winter wheat, 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 different experiments have occupied eight hundred and eighty-five plots.

Observations on the Variety Tests.

1. The numbers of bearded and of bald varieties of winter wheat which have been grown in our trial grounds are about equal.

2. In each of the seven years past, the bearded varieties have given a heavier weight per measured bushel than the bald varieties, the average being 1.2 pounds in favor of the bearded.

3. In yield of grain per acre for the past seven years, the bald varieties have given an average of 38.8 bushels, and the bearded varieties 38.2 bushels. In 1896, however, the bearded varieties gave about five bushels per acre more than the bald; and in 1891 the bald varieties surpassed the bearded by nearly ten bushels per acre.

4. Of all the winter wheats tested in 1896, fifty-four were red grained and twenty-seven were white grained varieties.

5. In six of the past seven years, the red wheats have given a heavier average weight per measured bushel than the white wheats by about one pound.

6. In 1896 the red wheats gave an average of exactly ten bushels per acre more than the white wheats; but in 1891 and 1894 the white wheats gave considerably larger yields than the red varieties, the average for the seven years being about equal.

7. In 1896, the varieties with bald heads and white grain gave only two-thirds as much in average yield of grain per acre as the varieties with bearded heads and red grain.

8. The varieties which produced the least amount of rust in 1896 are, Reliable, Turkish Red, Egyptian Amber, Imperial Amber, Emporium, and Amherst Isle; and the variety most subject to rust was Hindostan.

9. The varieties which gave the heaviest weight per measured bushel in 1896 are, Velvet Chaff, Russian Amber, Longberry Red, Pride of Illinois and Egyptian Amber.

10. The varieties which gave the largest yield of grain per acre in 1896 are, Imperial Amber, Russian Amber, Poole, Giant Square Head, Hunter's Wheat and New Columbia.

11. The varieties which were first in reaching maturity in 1896 are, Fultz, Turkish Red, Egyptian Amber, McPherson, Arnold's Hybrid, Imperial Amber, Geneva, Red May and Tuscan Island.

12. The varieties which produced the longest straw in 1896 are, Andrew's No. 4, Giant Square Head, Emporium, Golden Tankard, Simcoe Red and Imperial Amber.

13. The varieties which produced the longest average heads in 1896 are, Long Amber, Manilla, Pride of Genesee, Stewart's Champion and Silver Star; and those which produced the shortest average heads are Queen Meg, Giant Square Head and Early Genesee Giant.

14. On examination of the yields per acre of eighty-one varieties of winter wheat tested in 1896, it is found that the ten varieties possessing the shortest heads produced an average of eleven bushels per acre more than the ten varieties possessing the longest heads.

15. The varieties which produced the largest grains, or kernels, in 1896, are Rudy, Longberry Red, Deitz Longberry, Early Red Clawson, Kentucky Giant and Tuscan Island.

16. Dawson's Golden Chaff, Egyptian Amber, Imperial Amber, Poole and Giant Square Head varieties all came through the winter exceptionally well, and made a fine appearance in the spring of 1896.

Experiments in the Methods of Winter Wheat Growing.

The following concise reports are made upon the different wheat experiments conducted in the same portion of the experimental grounds that was used for the variety test. Some of these experiments extend over a period of three, and some over a period of four years.

Different Dates of Seeding. Two or more varieties of winter wheat have been sown at three different dates, in the month of September, in each of the past four years, and at four different dates in 1896.

The following table gives the average results for each date of seeding in 1896, and also for four years in which these experiments have been conducted:

Dates of seeding.	General appearance of plot in 1896.	Height of crop in 1896.	Straw per acre.		Weight per measured bushel.		Yield of grain per acre.	
			1896	Average 4 years.	1896.	Average 4 years.	1896.	Average 4 years.
		ins.	tons.	tons.	lbs.	lbs.	bus.	bus.
Sept. 2-3	Good	51	3.4	2.8	61.2	58.7	61.9	39.3
Sept. 7-9	Good	50	3.3	2.8	60.9	58.7	58.4	38.1
Sept. 17-20	Medium	45	2.5	1.9	59.6	56.9	44.9	30.1
Sept. 26	Poor	41	1.7	....	57.1	......	27.3	....

It will be observed from the foregoing table that, in 1896, the best yield of both grain and straw per acre, and the heaviest weight of grain per measured bushel, were produced from the first seeding, which took place on the 3rd of September. The seeding of September 26th produced less than that of September 3rd, by 34.6 bushels of grain and 1.7 tons of straw per acre, and by 4.1 pounds of grain per measured bushel. In the average results for four years, it will be seen that there is an average result of over 9 bushels of grain per acre, and a weight of nearly 2 pounds per measured bushel in favor of the seedings on September 2nd and 3rd, as compared with those of September 17th and 20th.

Methods of Seeding. An experiment in sowing winter wheat broadcast, and with a grain drill, has been conducted in duplicate in each of the past three years. The average results from sowing the same qualities of grain by the two methods are very similar, there being a very slight advantage in favor of the drilled crop in both yield of grain and straw per acre, and in weight per measured bushel.

Different Quantities of Seed per Acre. In 1894, 1895 and 1896, two varieties of winter wheat were sown broadcast on small plots, at the rates of 1, 1½ and 2 bushels per acre. The best yields of both grain and straw were obtained from the thickest seeding, and the smallest yields from the thinnest seeding, in each of the three years. It must be remembered that this experiment was conducted on small plots.

For wheat growers to determine the proper quantity of winter wheat to sow per acre in order to get the best results upon their respective farms, it will be advisable for them to observe and experiment for themselves, as so much depends upon the fertility of the soil and other conditions.

The Yield and Quantity of Winter Wheat as Affected by Cutting at Different Stages of Maturity. Five plots each, of the Dawson's Golden Chaff and the Early Genesee Giant winter wheats were sown on the same date in 1893, 1894, and again in 1895. These two varieties reached the stage of maturity at which winter wheat is usually cut in Ontario, on the 19th of July, 1894, the 18th of July, 1895, and the 11th July, 1896. The two wheats were cut at five different periods during the three years, commencing on July 4th in 1894 and in 1895, and on June 30th in 1896. The periods between the cuttings were one week in length. In each of the three years the greatest yield of straw was obtained from the first cutting, and the heaviest weight of grain per measured bushel from the second and third cuttings. The yield of grain per acre was best from the last cutting in 1894 and in 1896, and from the second last cutting in 1895. The lowest results in yield of grain per acre and in weight of grain per measured bushel were obtained from the first cutting of each variety in each year. The quality of the straw in 1896 was decidedly the best from the first two cuttings, and was decidedly the poorest from the last two cuttings.

Value of Grain for Seed as Affected by Cutting at Different Stages of Maturity. Dawson's Golden Chaff and the Early Genesee Giant varieties of winter wheat, were both sown on the same date in 1893, and again in 1894; and the plots were cut on July 4th, 11th, 18th, 19th and 25th, and August 2nd in 1894 and in 1895. The first cutting took place about two weeks before and the last cutting about two weeks after that stage of ripeness at which winter wheat is usually cut. A quantity of seed of each variety was taken both years from each of the five different cuttings, and these equal amounts of grain were sown upon a smaller number of uniform plots in the autumn of 1894 and 1895. The plots of the one year were all harvested at one time in July, 1895, and of the other year in July, 1896. It was found in the results of each year that the largest yield of grain per acre was produced by the seed of the last cutting of the previous year.

Conclusions.

1. The average results of winter wheat growing on the experimental plots for seven years in succession are as follows: Weight of grain per measured bushel, 60.5 pounds; yield of straw per acre, 2.5 tons; and yield of grain per acre, 38.7 bushels.

2. Dawson's Golden Chaff has given the largest average yield of grain per acre among fifty-three 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, and nine varieties in 1895.

3. The Early Genesee Giant has given the largest average yield of grain per acre among twenty-eight new varieties which were tested for the first time in 1894, and have now been tested for three years in succession. This variety also stood second in average yield per acre among nine leading varieties of winter wheat tested over Ontario in 1894, and nine leading varieties tested over Ontario in 1895.

4. The Early Genesee Giant, Giant Square Head, and Queen Meg varieties of winter wheat, which head the lists in average yield per acre among the varieties grown for three years, for two years, and for one year, respectively, are very similar in all characteristics.

5. Among eighty-one varieties of winter wheat tested in 1896, the Dawson's Golden Chaff, American Bronze, New Columbia, Early Genesee Giant, Giant Square Head, and Queen Meg produced the stiffest straw.

6. In the average of four years experiments in seeding winter wheat on different dates, it is found that when the wheat was sown later than September 9th, the crop was much poorer than when the seeding took place on or before that date.

7. In the average results from growing winter wheat for seven years in succession, it is observed that the white grained varieties have given the largest yields per acre in those seasons when there was but little rust, and the red grained varieties in those seasons in which the rust was abundant.

8. The varieties which have given the best average results in the experiments at the College are the varieties which have also given the best satisfaction throughout Ontario.

Oats.—Comparative Test of Ninety-five Varieties.

We observe from the reports of the Ontario Bureau of Industries that the area devoted to the cultivation of oats in 1895 was 2,373,309 acres, and in 1896 it was 2,425,107 acres. This shows that the oat crop in Ontario is an exceedingly valuable one, as it is almost exactly equal to the area devoted to hay and clover, and is three times as great as that devoted to the cultivation of any other farm crop. The figures also show that the area devoted to the growing of oats is increasing. Any methods that can be adopted that will increase the annual yield of oats one bushel per acre throughout Ontario, will increase the total number of bushels of oats grown in one year by more than two million bushels. An increase of one bushel per acre seems to be a small amount; but when obtained over the whole of the Province, it means a large total amount. All farmers who are interested in the cultivation of oats should study very carefully the results of the experiments pertaining to this crop, as perhaps this variety test is the most comprehensive and the most complete of any that can be found on the American continent.

Ninety-five varieties of oats were tested in the experimental grounds in 1896. Within the last eight years one hundred and sixty-eight varieties have been grown in the experimental department. The greater part of these have been grown for at least five years, and some of the best kinds have been grown for six, seven, and eight years in succession. The plots used for the variety tests for oats in 1896 were all 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 grain was sown broadcast at the rate of seventy-five pounds per acre, and the seeding took place on April 27th. The land on which the oats were grown was an average clay loam, which had received farm yard manure at the rate of twenty tons per acre in the spring of 1895, after which it produced a crop of roots. The yields per acre have been determined from the actual yields of the plots.

As a description was given in the report of 1895 of the Joanette Black, Siberian, Waterloo, Barvarian, Egyptian, Poland White, and Vick's American Banner varieties of oats, as well as a summary report of the results of these varieties for the length of time that they had been grown in the experimental department, the reader is referred to that report for particulars in regard to these special varieties. We are pleased to state that in our experiments of this important and popular crop in Ontario, the results have been very satisfactory. We have been enabled to determine with a good deal of accuracy the relative importance of the different varieties of oats, which are more or less known throughout the Dominion of Canada. We are also enabled to present to the farmers a Ontario a record of the average results of a large number of imported varieties, in comparison with those with which they are more or less familiar. By obtaining varieties from different sources and growing them side by side for five, six, seven and eight years, as the case may be, very valuable results are obtained, and the reader is especially directed to a careful consideration of the following table. Those who have watched our reports carefully, will notice that the results presented from year to year are fairly uniform. We do not draw special attention to certain varieties at one time, and at another time discard these and refer in particular to others, unless there are excellent reasons for doing so. The varieties which occupy prominent places in the foregoing table are in many cases the identical varieties which occupied prominent places in the results of 1895, 1894 and 1893. We believe that experiments which are very carefully conducted for a period of five years will place the varieties in about the right comparative order as a practical guide for the farmer. The fact that the Joanette oats, which was imported from France in the spring of 1889 now occupies first place in yield of grain per acre in the average results of the varieties grown for eight years in succession, impresses a person at once of the great power of this variety for producing large yields. It should be remembered, however, that the Joanette is a very short strawed variety, and will produce the best results only on good average or rich land, or, in other words, land that usually produces a large amount of straw. On soil where the oats usually grow a very large amount of straw of a very succulent nature, which is apt to lodge, the Joanette variety will fill in a most important place. The Siberian, however, which is a long strawed variety seems well adapted for average or poor soils. It has given very excellent results in our experimental trials at Guelph, and also in the co-operative experimental work throughout Ontario. It will be somewhat surprising to many of the readers of this report to learn that the thousands or perhaps millions of bushels of Siberian oats, which are now grown in Ontario, were started from a little plot 1/100 of an acre in size in our experimental grounds. There has been no large sum of money paid out by the Experimental Department for the importation of this or any other single variety of grain. All the imported varieties which have done well on the plots, and which are now being grown throughout Ontario in the general farm practice, were started from small plots of not more than ten pounds of any one variety. The Oderbrucker variety of oats, which occurs as third on the list, is a very close rival of the Siberian in yield of grain per acre. It, however, possesses a straw which is much weaker than that of the Siberian, and a grain which weighs fully three pounds per measured bushel less. The reader's attention is directed to the comparative weights per measured bushel of the different varieties reported upon in the following table.

It will be observed that in 1896 the Joanette, Siberian and Oderbrucker varieties of oats occupied a very high place in yield of grain per acre when compared with all the other varieties under experiment. These three varieties were not surapssed by any other kinds of oats in the experiments of the past season, they being the only ones which gave yields of upwards of eighty bushels per acre.

The Abundance variety of oats was imported by us in the spring of 1889, and was grown in our trial grounds for five years in succession, with seventy-eight other kinds. At the end of this period we retained seventeen of the most promising varieties and discarded seventy-one of the less satisfactory sorts. The Abundance occupied twenty-fifth place in yield of grain per acre among the seventy-nine varieties grown for five years in succession, and its average weight per measured bushel for the five years was 31.9 pounds. The Abundance variety was tested at the Dominion Experimental Farm at Ottawa in the year 1892, 1894 and 1895, and occupied second place in yield per acre among the forty-five varieties which were grown in 1895. On plots side by side we sowed the samples of the Abundance variety received from Prof. Saunders and a sample of the same variety which we had grown for the five years previous to 1894. The seed, therefore, in the latter instance was three years old. The two samples proved to be quite similar, and the results are reported in the foregoing table, under the names of Abundance (D.E.F.) and Abundance (O.A.C.). Prof. Saunders also kindly furnished us with a quantity of the Improved Ligowo variety of oats for trial in our experimental grounds for the past season.

OATS—COMPARATIVE TEST OF 95 VARIETIES.

No.	Varieties.	Seed obtained from—	Color of grain.	Results for 1896.			Average results for number of years grown on plots.		
				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 eight years:			lbs.	tons.	bush.	lbs.	tons.	bush.
1	Joanette	France	Black	34.94	3.38	98.35	35.88	2.81	**88.99**
2	Siberian	Russia	White	30.13	3.42	85.85	35.06	2.80	**83.26**
3	Oderbrucker	Germany	"	28.06	2.99	84.56	31.80	2.64	**82.18**
4	Waterloo	"	"	28.56	2.64	76.94	31.60	2.65	**81.09**
5	Probsteier	"	"	29.25	2.83	77.85	32.82	2.55	**80.82**
6	Danebrog	"	"	28.63	2.73	66.09	33.01	2.55	**79.22**
7	Bavarian	Ontario	"	28.69	2.96	70.24	31.46	2.83	**78.53**
8	Improved Besthorne	Germany	Yellow	28.88	2.52	67.91	33.04	2.21	**77.14**
9	Poland White	France	White	32.38	2.60	60.21	37.20	2.56	**76.82**
10	Georgian	Germany	"	30.25	2.71	56.62	32.62	2.79	**73.84**
11	Yellow Gigantic	France	Yellow	25.63	2.46	58.47	29.06	2.72	**73.43**
12	Egyptian	Ontario	White	34.88	2.73	52.85	35.27	2.81	**72.36**
13	Black Poland	Scotland	Black	27.13	2.42	49.09	29.84	2.87	**69.85**
14	Black Champion	Ontario	"	26.00	2.64	47.53	29.45	2.62	**68.44**
15	Victoria White	Scotland	White	37.63	2.33	61.29	39.36	2.64	**67.59**
16	Rosedale	Ontario	"	34.00	2.32	47.53	34.40	2.86	**67.26**
17	Black Tartarian	Scotland	Black	27.31	2.19	47.88	31.41	2.77	**66.96**
	Grown for six years:								
18	White Schonen	Ontario	White	29.94	2.31	71.59	32.49	2.3[illegible]	**85.14**
19	Vick's American Banner	United States	"	26.50	2.37	63.71	31.37	2.40	**84.19**
20	Danish	New Zealand	"	28.38	2.00	70.68	24.26	2.34	**82.17**
21	Wide Awake	Ontario	"	31.94	1.82	63.71	33.87	2.37	**82.02**
22	White Mane	"	"	31.88	2.12	72.32	32.29	2.73	**81.20**
23	Magnet	"	"	28.69	2.01	55.24	30.97	2.69	**80.98**
24	Holstein Prolific	"	"	31.94	1.85	72.23	32.51	2.22	**80.81**
25	Golden Giant	"	Yellow	26.44	1.90	55.79	28.59	2.51	**78.81**
26	Early Calder	"	White	31.38	2.23	78.94	32.53	2.47	**77.99**
27	Giant Swedish	"	Yellow	27.56	1.89	56.62	29.17	2.57	**77.15**
28	Early Gothland	"	White	35.50	2.42	57.44	35.87	2.45	**69.48**
29	Clydesdale	"	"	38.13	2.44	63.88	38.27	2.61	**69.41**
30	White Belgian	"	"	38.31	2.32	60.38	38.07	2.42	**68.30**
31	Giant Yellow	United States	Yellow	33.75	2.02	37.32	34.98	2.31	**67.52**
32	Japan	" "	White	38.50	2.38	62.97	30.83	2.46	**67.05**
33	White Swiss	" "	"	36.56	2.38	51.74	35.91	2.42	**65.82**
34	Black Mane	Ontario	Black	28.50	2.06	41.82	30.01	2.45	**64.34**
	Grown for five years:								
35	Baltic White	United States	White	32.31	1.88	67.09	35.44	2.37	**72.91**
36	Abyssinian	Ontario	"	34.88	2.20	49.82	36.38	2.61	**65.60**
37	American Beauty	"	"	34.56	2.39	50.41	27.90	2.47	**63.48**
38	Thousand Fold	United States	"	35.13	2.16	52.59	35.43	2.42	**61.31**
39	Badger Queen	" "	"	40.06	2.04	57.91	39.71	2.42	**59.85**
40	New Wonderful	Ontario	"	39.19	2.08	57.09	39.34	2.26	**58.69**
41	Wilson's White Prolific	United States	"	30.38	......	38.79	32.35	......	**55.80**
	Grown for four years:								
42	New American	United States	White	27.25	2.19	72.88	31.65	2.31	**75.96**
43	Improved American	" "	"	28.44	2.24	72.88	32.45	2.28	**74.44**
44	High Bred	" "	"	35.81	1.91	61.03	37.87	......	**72.93**
45	New Zealand	" "	"	28.19	2.58	71.59	31.75	2.31	**72.84**
46	Green Mountain	" "	"	27.31	1.78	57.09	31.66	2.09	**72.29**
47	Black Beauty	" "	Black	33.06	1.83	64.24	33.55	2.25	**72.14**
48	Lincoln	" "	White	32.00	1.74	57.74	34.51	2.21	**71.95**
49	Pringle's No. 6	" "	"	31.38	2.66	72.71	32.57	2.77	**68.65**
50	Excelsior	" "	"	27.13	2.88	71.79	31.33	2.57	**67.56**
51	Royal Prize Cluster	England	"	37.25	2.37	59.00	39.42	2.39	**65.32**
52	South Carolina Black	United States	Black	30.75	1.94	52.03	33.76	2.43	**64.26**

OATS.—COMPARATIVE TEST OF 95 VARIETIES.—*Concluded.*

No.	Varieties.	Seed obtained from—	Color of grain.	Results for 1896. Weight per measured bushel.	Results for 1896. Yield of straw per acre.	Results for 1896. Yield of grain per acre.	Average results for number of years grown on plots. Weight per measured bushel.	Average results for number of years grown on plots. Yield of straw per acre.	Average results for number of years grown on plots. Yield of grain per acre.
				lbs.	tons.	bush.	lbs.	tons.	bush.
53	Rust Proof	United States	White	34.06	2.56	55.82	35.28	2.46	**64.19**
54	Jarman's White Monarch	England	"	33.94	2.83	55.88	37.16	2.48	**61.84**
55	North Star	United States	"	38.38	1.35	51.74	38.46	2.14	**58.85**
56	Challenge	Ontario	"	35.19	2.38	43.94	37.31	2.59	**58.69**
57	Jarman's Black Defiance	England	Black	25.19	2.00	54.24	28.43	2.45	**58.05**
58	Texas Rust Proof	United States	Dun	17.13	1.75	14.79	27.35	2.28	**45.36**
	Grown for three years:								
59	Peerless	Ontario	White	27.63	2.22	72.53	31.98	2.84	**91.77**
60	Surprise	United States	"	30.31	1.74	61.03	33.40	2.78	**84.44**
61	Bolton	" "	"	27.88	2.14	71.32	32.55	2.44	**83.89**
62	Bonanza King	" "	"	30.06	1.86	62.41	34.05	2.24	**82.57**
63	Negro Wonder	" "	Black	30.50	1.86	61.03	33.01	2.55	**82.11**
64	Improved White Russian	" "	White	31.75	1.94	62.41	33.25	2.67	**76.99**
65	Hull	Ontario	"	29.44	2.23	58.47	32.07	2.68	**76.73**
66	Pride of America	United States	"	34.75	2.35	57.09	36.48	2.75	**76.14**
67	White Swede	" "	"	31.81	2.37	64.88	33.79	2.78	**74.75**
68	Australian Square Head	" "	Yellow	27.50	2.20	56.06	30.69	2.61	**74.39**
69	Mammoth Cluster	" "	Black	26.19	2.58	55.88	29.68	2.61	**66.91**
70	Lousinee	Ontario	White	28.69	2.13	72.06	32.62	1.71	**61.95**
71	Salzer's Great Northern	United States	"	29.13	2.26	72.71	32.88	1.72	**57.33**
72	Red Tamworth	Ontario	Dun	16.50	1.90	16.18	27.09	2.15	**51.35**
	Grown for two years:								
75	New Electric	Ontario	White	26.94	2.38	70.50	32.29	2.55	**92.97**
74	Nameless Beauty	United States	"	27.13	2.18	61.41	31.95	2.55	**91.74**
75	New Siberian	" "	"	28.00	2.37	62.03	32.06	2.88	**91 13**
76	White Bedford	" "	"	27.56	2.53	69.12	26.90	2.78	**90.81**
77	Black Diamond	Ontario	Black	32.50	2.35	64.88	34.51	2.57	**88.69**
78	Danbings	United States	White	34.75	1.79	75.56	36.26	1.81	**86.31**
79	Mexican Grey	" "	Grey	30.75	2.07	62.03	33.00	2.47	**83.59**
80	White Superior Scotch	" "	White	39.38	2.27	53.59	41.37	2.42	**75.69**
81	Prolific Side	" "	"	34.06	2.72	48.62	36.29	2.79	**69.16**
82	Royal Doncaster	" "	"	32.00	2.20	35.30	34.94	2.65	**63.98**
	Grown for one year:								
83	Illinois	Ontario	White	34.19	1.96	71.50	34.19	1.96	**71.50**
84	Early Golden Prolific	....	....	32.38	2.32	69.59	32.38	2.32	**69.59**
85	Danish Island	United States	....	29.88	2.21	66.82	29.88	2.21	**66.82**
86	Abundance (O.A.C.)	Ontario	White	28.88	2.42	66.65	28.88	2.42	**66.65**
87	Pearce's Black Beauty	"	Black	33.13	2.09	62.59	33.13	2.09	**62.59**
88	Abundance (D.E.F.)	"	White	26.50	2.53	61.29	26.50	2.53	**61.29**
89	White Star	....	"	33.19	2.32	60.38	33.19	2.32	**60.38**
90	Improved Ligowo)	Ontario	"	27.19	2.78	59.94	27.19	2.78	**59.84**
91	White Dutch	....	"	36.31	2.65	57.44	36.31	2.65	**57.44**
92	Michigan University	United States	"	32.81	2.07	54.50	32.81	2.07	**54.50**
93	Black Irish	Ontario	Black	28.50	2.64	50.65	28.50	2.64	**50.65**
94	Perpetuated White Tartarian	"	White	27.75	1.96	37.88	27.75	1.96	**37.88**
95	Fyfe	"	"	27.25	2.01	37.68	27.25	2.01	**37.68**

The varieties of oats were all carefully examined before harvesting, and the Siberian and the Joanette varieties were given first place in regard to general appearance of the crop. The average height of the Joanette oats was only forty inches, while that of the Siberian was about fifty inches. The variety of oats which is decidedly the earliest of all those which we have grown any time in our experimental grounds is the Danbings, which was kindly furnished two years ago by Mr. Shore, M.P.P., of East Middlesex. The Joanette and the Siberian reached maturity a little earlier than the average of all the varieties. The Oderbrucker ripens at about the same time as the two last mentioned varieties.

Oats—Broadcasting and Drilling on Six Different Dates.

This experiment commenced on April 18th and closed on May 25th, and occupied twelve plots. The oats were sown at the rate of seventy-five pounds per acre with an ordinary grain drill, and also by hand on six separate dates. Each plot was 1/100 of an acre in size, being ten links wide by one hundred links long. The land produced a crop of turnips in 1895, after receiving a dressing of twenty tons of farm yard manure per acre in the spring of the same year.

Dates of seeding.	Results for 1896.		Average results for different dates of seeding			
	Methods of seeding.	Yield of grain per acre.	Weight per measured bushel.		Yield of grain per acre.	
			1896.	Two years 1895-6.	1896.	Two years 1895-6.
April 18	Broadcasted Drilled	81.15 87.97	34.63	35.38	84.56	93.21
April 22	Broadcasted Drilled	92.91 98.79	35.26	35.01	95.85	102.57
May 1	Broadcasted Drilled	69.03 78.12	33.94	34.41	73.58	86.66
May 9	Broadcasted Drilled	35.29 54.80	30.76	31.95	45.05	68.67
May 18	Broadcasted Drilled	26.00 31.79	24.32	28.79	28.90	48.00
May 25 26	Broadcasted Drilled	12.68 11.21	17.13	24.32	11.95	42.64

From the foregoing table it will be seen that the grain which was sown with the drill gave the best yield per acre in every case, with the exception of the last date of seeding, in which case the broadcasted seed gave a little larger yield of grain than the seed which was put in with the drill. When we average the results, however, for the entire experiment we find that the drilled plots gave about eight bushels of oats per acre more than those which were sown broadcast.

As in the case of barley, the grain which was sown on the 22nd of April gave a larger yield of crop per acre than that which was sown on April 18th, or at any date in the month of May. In the average of two years' experiments, we find that over one hundred bushels per acre were realized from the plots which were sown on April 22nd, and only about forty-two bushels per acre were secured from the crop produced from the seed sown on the 25th of May. It is interesting to notice how the yield per acre decreased as the season advances after the 22nd of April. In yield per acre in 1896 the average production of grain from the seeding of the 22nd of April was 95.85 bushels, and from that of May 22nd it was only 11.95 bushels, a decrease of about eighty-four bushels per acre, caused by the difference of thirty-three days in the dates ef seeding.

Beans—Comparative Test of Eleven Varieties.

Experiments with different varrieties of beans have been conducted in the experimental grounds for four years in succession. In 1896 there were in all eighteen varieties of beans under experiment, but some of these were the Soja and Horse beans, which did not ripen and produce grain at the same time as the rest of the varieties. These are not included in the foregoing table. Nearly all of the eleven varieties reported upon at this time have been grown for four years in succession. The size of the plots used for the experiment in 1896 was 1/100 of an acre, and the seeding took place on June 10th. The beans were planted in rows three one-third links (twenty-six and two-thirds inches) apart, and were planted one link (9.92 inches) apart. Good cultivation was given throughout the season.

Varieties.	Weight per measured bushel.		Yield of beans per acre. Average three years, 1893-4-5.
	1896.	Average three years, 1894-5-6.	
1. California Pea	67.2	64.8	**18.66**
2. Small White Field	66.5	64.7	**18.22**
3. Prolific Dwarf Tree	66.2	65.1	**18.11**
4. Boston Pea	66.0	64.9	**18.00**
5. Medium or Navy	66.8	64.2	**16.76**
6. Yellow or Soy	58.2	57.9	**16.09**
7. Yellow-Eyed or Boston Favorite	62.5	61.2	**10.93**
8. Giant Dwarf Wax	55.2	53.1	**10.57**
9. Marrowfat	64.2	63.6	**10.15**
10. Royal Dwarf Kidney	63.4	61.0	**13.83***
11. Snow Flake	67.2	65.2*	**13.35†**

*Average for two years. †Yield for one year.

Owing to failure to germinate in the case of several varieties, the yield of beans per acre is not given for 1896. The grain, however, was of good quality. We notice that six of the varieties gave an average weight per measured bushel of upwards of sixty-five pounds, and only two of the varieties went below sixty pounds. In average weight per measured bushel for the years 1894, 1895, 1896, the Prolific Dwarf Tree bean heads the list, with an average of over sixty-five pounds. Giant Dwarf Wax stands at the bottom of the comparative results, with an average of only 53.1 pounds.

Buckwheat—Comparative Test of Three Varieties.

Three varieties of buckwheat have been grown in the experimental department for three years in succession. The plots used for the experiment in 1896 were 1/100 of an acre in size, and the land produced a crop of potatoes in the summer of 1895. The buckwheat was sown broadcast at the rate of one bushel per acre.

Varieties.	Weight per measured bushel.		Yield of straw per acre.		Average yield of grain per acre, 2 years, 1894-5.
	1896.	Average two years, 1895-6	1886.	Average 3 years, 1894-5-6.	
	lbs.	lbs.	tons.	tons.	bus.
Japanese	40.2	43.2	2.0	3.1	**19.7**
Silver Hull	48.2	49.1	2.1	2.6	**12.3**
Common Grey	47.5	47.3	1.9	2.4	**11.6**

Owing to the fact that the sparrows ate part of the grain after the buckwheat had been cut, the yields of grain for 1896 are not included in the above table. The weight per measured bushel, however, and the yield of straw per acre for the past season were determined and are included in the results given in the table. For two years in succession the Silver Hulled variety of buckwheat has produced the heaviest weighing grain, the average weight being 49.1 pounds. The Japanese variety, although decidedly the best yielder, possessed a somewhat coarse angular grain, which is rather light in weight.

SPRING RYE—COMPARATIVE TEST OF TWO VARIETIES.

For two years in succession the Prolific Spring and the Dakota Mammoth varieties of rye have been grown in competition in our experimental grounds. These varieties were sown upon plots 1/100 of an acre in size on April 25th, 1896. Two bushels of seed per acre were used, and it was sown broadcast.

Varieties.	Results for 1896.			Average results for two years, 1895-6.	
	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.	bus.
1. Prolific Spring	55.88	1.44	23.55	57.09	37.88
2. Dakota Mammoth	56.75	1.12	19.93	58.13	35.67

From the results of 1896 it will be observed that the Prolific Spring rye gave nearly four bushels per acre more than the Dakota Mammoth variety. It will be remembered that the order of yield of these two varieties was the same last year. The weight per measured bushel, however, of the Dakota Mammoth variety was greater than that of the Prolific Spring rye in both 1895 and 1896.

GRAIN SOWN IN MIXTURES FOR THE PRODUCTION OF GRAIN AND STRAW.

For four years past oats, wheat, barley and peas have been grown separately and in various combinations for the production of grain and straw. The combinations consisted of six mixtures, with two kinds of grain used in each case; four mixtures with three kinds of grain, and one mixture with all four kinds of grain. There were eleven mixtures in all, and four varieties of grain grown separately. These were all sown in duplicate on April 21st, 1896, upon plots 1/100 of an acre in size. Thirty plots were therefore included in this experiment. The land on which the mixtures were sown received a dressing of twenty tons of farm yard manure per acre in the spring of 1894, and produced a crop of turnips in 1895. The following table gives the results of this experiment for 1896, and also for the four years during which this experiment has been conducted.

Mixtures.	Yield of straw per acre.				Yield of grain per acre.			
	Sown separately.		Sown in mixture.		Sown separately.		Sown in mixture.	
	1896.	Average 4 years.	1896.	Average 4 years.	1896.	Average 4 years.	1896.	Average 4 years.
	tons.	tons.	tons.	tons.	lbs.	lbs.	lbs.	lbs.
Barley and peas	1.28	1.21	1.40	1.36	1,828	1,679	1,907	1,593
Peas and wheat	1.09	1.21	1.26	1.34	1,304	1,360	1,441	1,249
Wheat and oats	1.21	1.44	1.57	1.57	1,514	1,483	2,069	1,834
Barley and oats	1.39	1.42	1.54	1.68	2,038	1,802	2,221	2,217
Wheat and barley	1.20	1.16	1.18	1.26	1,344	1,307	1,266	1,352
Peas and oats	1.28	1.43	1.37	1.69	1,998	1,847	2,182	1,950
Barley, peas and wheat	1.19	1.21	1.28	1.44	1,492	1,450	1,514	1,516
Peas, wheat and oats	1.19	1.36	1.37	1.69	1,605	1,556	1,897	1,793
Barley, wheat and oats	1.26	1.39	1.42	1.65	1,632	1,549	1,903	1,990
Barley, peas and oats	1.31	1.36	1.39	1.64	1,955	1,776	2,135	2,082
Barley, peas, wheat and oats	1.24	1.32	1.41	1.68	1,671	1,580	1,905	1,940

It will be observed by a careful study of the foregoing table that the grain grown in mixtures gave larger yields of grain per acre than the same kinds of grain grown separately, in ten experiments out of eleven conducted in 1896. It will also be observed when comparing the results of the yield of the various mixtures grown separately and in combination for four years in succession, that the mixtures produced the largest yield of grain per acre in nine out of eleven experiments. The greatest yield of grain produced in the average of four years' experiments is from the mixture of oats and barley, and the second largest yield from the mixture of barley, peas and oats; while the smallest average yield has been produced from peas and wheat sown in mixture and also sown separately, and from barely and wheat sown in mixture and separately. The largest yield of straw per acre in the average of four years' experiments, was produced from peas and oats grown together, and from peas, wheat and oats grown together; and the smallest yield from wheat and barley grown separately.

Spring Grains—Selection of Seed.

The reader who has studied the previous part of this report will have noticed that a large amount of very careful experimental work has been done at the College in order to find out which are the most profitable varieties of grain for the Ontario farmer to grow. While we believe that this is a very important line of experiments, still we are of the opinion that experiments conducted in the selection of seed grain are also of very great value. From the results of the tests which we have already made within the past few years, we feel convinced that many thousands of dollars are lost annually by the farmers of Ontario, from not making a proper selection of the seed which they sow from year to year. There is a great lack of care in the cleaning of grain and of seeds of various kinds in our general cultivation of farm crops. The writer is of the firm opinion that the man who starts with a small quantity of seed grain, and picks it thoroughly and sows nothing but the best grain, and then in future years cleans the grain very thoroughly in order to secure a fine sample of seed, will be highly repaid for all the trouble he has taken, by the increased crops which he will surely realize. If, in conjunction with this, he were to go a little farther and make a careful examination of his fields and select his seed grain from those portions where the crop had reached the highest stage of development, and then select the best heads from the best plants in those portions of the field, he would soon improve his grain to such an extent that it would not only give him better returns upon his own lands, but his surplus seed would be eagerly sought after by those who knew what had been accomplished, and who would witness the growing crops for themselves.

The attention of the reader is directed to a very careful study of the results of the experiments which have been conducted in the experimental department, in sowing seed of different quality, of nearly all kinds of farm crops. This work which has had a good start, will likely be continued for several years, in order to find out the possibilities of improving the crops from a careful selection of seed for several years in succession.

Barley—Selection of Seed.

Large plump, small plump, shrunken, and cracked barley were sown on experimental plots in 1894, 1895 and 1896. Each of the samples mentioned was selected from a large bag of Mandscheuri barley in the spring of 1896. For the large plump sample, none but well developed grains were selected; and for the small plump sample, the grains selected were all of a nice uniform, plump character; but the kernels were much smaller in size than those selected as large plump. The term "shrunken" did not have much reference to the size of the kernel, but referred more particularly to those kernels which were not well filled out and were of a shrivelled and angular form. The sample of cracked barley contained nothing but grains which were broken crosswise, as is frequently done by the grain separator in threshing. The grain was sown on the 9th of May on plots 1/100 of an acre in size. There was an equal number of grains sown on each plot, namely, 4,643. In the case of the cracked grain, however, the same weight was used as of the large plump. The yields per acre have been determined from the actual yield of the plots.

Selections.	Weight per measured bushel.		Yield per acre.			
			Straw.		Grain.	
	1896.	Average 3 years.	1896.	Average 3 years.	1896.	Average 3 years.
	lbs.	lbs.	tons.	tons.	bush.	bush.
Large plump............	44.81	48.14	1.05	1.28	32.93	39.31
Small plump	41.75	46.58	1.33	1.35	31.27	36.09
Shrunken................	42.75	46.72	1.25	1.24	31.13	33.44
Cracked	41.75	46.18	.89	1.15	22.93	29.31

From an examination of the foregoing table it will be seen that the large plump grain gave the most satisfactory results, both in weight per measured bushel and in yield of grain per acre, as compared with the other selections. It will also be seen that the cracked grain give the lowest results in every instance. In the average results for three years, the cracked grain gave about two pounds per measured bushel less than that produced by the large plump seed; and in yield of grain per acre, there was only about three-quarters as large a crop from the cracked as from the large plump seed. This certainly points to the importance of a careful watch in the cleaning of seed barley, as it is not an uncommon thing to have quite a large amount of cracked barley, unless the grain separator is carefully looked after.

Spring Wheat—Selection of Seed.

In this experiment a very nice selection could be made, as it was very easy to obtain from the same bag of grain large plump seed, small plump seed, and shrunken seed. These were all selected with care. One-half pound of the large plump seed was weighed out, and the grains were carefully counted, and it was found that there were 7,115 grains contained in the one-half pound. An equal number of grains for the small plump and also for the shrunken were taken. These selections of seeds were sown on five plots, one rod square, on May the 11th.

Selections.	Weight per measured bushel.		Yield per acre.			
			Straw.		Grain.	
	1896.	Average 4 years.	1896.	Average 4 years.	1896.	Average 4 years.
	lbs.	lbs.	tons.	tons.	bush.	bush.
Large plump seed	55.00	58.86	.73	1.17	7.68	18.35
Small plump seed	52.63	58.17	.57	.92	6.43	14.66
Shrunken seed	51.80	57.58	.62	.95	4.75	14.61

This experiment has now been conducted for four years in succession, starting with fresh seed each year, in order to find out as accurately as possible the influence of selection of seed in one season's growth. In the average results of four years, we find that in yield of grain per acre practically the same amounts have been realized from the small plump seed and from the shrunken seed, but from each of these there has been an average of about four bushels per acre less than from the large plump seed. There was also a considerably larger amount of straw from the best seed which was sown. In weight of grain per measured bushel, it will be noticed that the large plump seed produced grain which weighed over one pound per measured bushel more than that which was produced from the shrunken seed.

White Oats—Selection of Seed.

In 1894, 1895, and 1896, experiments were conducted in which large plump, medium, and small-sized grains were used on plots, situated side by side. One-half pound of the large plump grain and was selected from a bag of the Siberian oats and the grains were counted. It was found that there were 5,610 grains in the half-pound sample. A similar number of the medium-sized grains and also of the small-sized grains were then selected from the same bag of oats. These three packages were sown on May the 11th, 1896, on plots exactly one rod square. The yields per acre have been determined from the actual results of the plots.

Selections.	Weight per measured bushel.		Yield of straw per acre.		Yield of grain per acre.	
	1896.	Average 3 years.	1896.	Average 3 years.	1896.	Average 3 years.
	lbs.	lbs.	tons.	tons.	bush.	bush.
Large plump	25.56	32.59	2.20	1.59	35.01	50.50
Medium	22.06	31.15	2.10	1.59	27.34	44.07
Small	24.25	32.15	1.99	1.62	14.54	36.37

The grains sown in this experiment had a very severe test in 1896, as the seeding was late and the amount of rust was large. The results show very clearly the importance of sowing seed of the best quality. In yield of grain per acre in 1896, there was about eight bushels per acre more grain produced from the large plump seed than from the medium seed, and about fourteen bushels per acre more grain from the medium-sized seed than from the small seed. The average yields per acre from the different selections of seed grain in the experiments for three years show a marked difference, as the large seed produced upwards of fourteen bushels per acre more than the small seed.

Seed Peas—Injured by the Pea Weevil

In 1894, 1895, and 1896, peas were selected, each of which had been partially eaten by the pea weevil (*Brucus pisi*). In comparison with these peas, others were also selected of the same variety, which had not received any injury from the weevil. In the experiments in 1896, a large variety of peas (Marrowfat) and a small variety (Golden Vine) were selected. From these varieties, peas which had been injured and some which were sound were selected. Of the small variety, 2,445 peas were used for the plot, and of the large variety 2,118 peas were used for the plot. The plots used in this experiment were each one rod square. The grain was sown on May the 2nd. The yields per acre have been calculated from the actual yields of the plots in 1896.

Selections.	Yield of straw per acre.			Yield of grain per acre.		
	Large peas (Marrowfat)	Small peas (Golden Vine).	Average.	Large peas (Marrowfat)	Small peas (Golden Vine).	Average.
	tons.	tons.	tons.	bush.	bush.	bush.
Sound peas	1.70	1 69	1.70	41.92	34.43	38.17
Buggy peas	1.40	1.05	1.23	33.25	18.43	25.84

In 1894, a small variety of peas was used for this experiment, and only twenty-four per cent. of the peas germinated. In 1895, however, a larger variety of peas was used, and evidently ths ravages of the pea weevil did not injure such a large percentage of the germs, as forty-five per cent. of the seed germinated.

In the results for 1896, in which the yields are given, it will be noticed that in the case of the large peas, the seed which was sound produced eight and two-thirds bushels per acre more than that which had been injured by the pea weevil. In the case of the small variety of peas, however, it will be seen that the sound peas produced nearly twice the yield of grain per acre of that produced by the injured seed. It would be well for those who usually grow peas in considerable quantities, to sow as large a percentage as possible of sound peas. Only about two-thirds of the peas injured by the pea weevil will germinate, and the plants produced by the injured peas are usually much weaker and smaller than those produced by the sound peas.

Selection of Seed for Three Years in Succession.

In 1894 a careful selection was made of different qualities of seed, of oats, barley and spring wheat. The selected grain was 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 the present year, and the different selections of seed thus secured were sown upon plots each of which was one rod square. Exactly the same number of grains were used for the plots in the experiment with each class of grain; there were, therefore, 6,776 grains sown on each barley plot, 5,223 grains sown on each spring wheat plot, and 6,012 grains sown on each oat plot in the spring of the present year. As this experiment is more especially concerned with the effect of the continued selection upon the size and quality of the grain produced, a table has been arranged giving the number of grains per ounce in the crop produced from the different selections of barley, spring wheat and oats in each of the past two years. The smallest grains per ounce, of course, means the largest-sized grains. The following table does not indicate exactly the selection made in the case of the oats, as the selection was large, plump grains, medium-sized grains and small grains, which should be considered when examining the following table:

Selection.	Average number of grains per ounce in crop.					
	Barley.		Spring wheat.		Oats.	
	1895 2nd year.	1896 3rd year.	1895 2nd year.	1896 3rd year.	1895 2nd year.	1896 3rd year.
Large plump	600	782	958	1,043	1,143	1,874
Small plump	704	844	1,137	1,147	1,161	1,845
Shrunken	807	897	1,161	1,306	1,196	1,917

The reader will notice from the preceding table that in every instance the large plump seed produced the largest-sized grains, with but one exception, that being in the case of the oats in 1896, in which the small plump seed evidently produced a little larger grain than the large plump. In every single instance the shrunken seed produced smaller grains than those produced from the small plump seed. The greatest variation in the size of the grain produced from the different selections was in the case of the spring wheat, and the least variation in oats.

Selection of Seed Oats for Four Years in Succession.

In the years 1893, 1894, 1895 and 1896, an experiment has been conducted with the Joanette oats by selecting large, plump, well developed seeds, light seed, and also seed from which the hull had been removed by the separator. The experiment was started in the spring of 1893 by selecting seed from the general crop of Joanette oats of the previous year. The selection made in the spring of each of the following years was from the product of the selected seed of the previous year. The size of the plots used for the experiment was one square rod in every instance. 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 has been conducted.

Selection.	Number of grains per ounce, 1896.			Weight of grain per measured bushel.				Yield of grain per acre.		
	Total.	Hulled.	Not hulled.	1893	1894	1895	1896	1893	1894	1896
				lbs.	lbs.	lbs.	lbs.	bus.	bus.	bus.
Large black	2,101	66	2,035	32.3	34.5	32.9	27.94	45.7	67.34	43.39
Light seed	2,469	28	2,441	30.2	32.8	31.1	24.00	38.0	50.87	28 66
Hulled seed	2,238	90	2,148	33 8	34.9	33.4	26.63	34.4	57.36	41.48

In the results, which are presented in a tabulated form, it will be seen that the comparative size of the grains produced in the fourth year from the selection of the seed, the comparative weight per measured bushel for the first, second, third and fourth years of this experiment, and the yield of grain per acre for the first, second and fourth years, are given in detail. Owing to some trouble from the sparrows destroying a small amount of the grain after being cut in the summer of 1895, the yields of grain from the different plots were not given for that year.

On an examination which was made of the comparative size of the kernels produced in the crop of 1896, it was found that the light seed produced the smallest grain, the hulled seed the next smallest, and the large plump seed the largest and heaviest grain. The seed which was hulled by the separator produced fairly good results in weight of grain per measured bushel and in yield of grain per acre; but the table shows that there was more than three times as large a number of the hulled seeds from this selection in the crop of 1896 as there was in the crop produced from the light seed, and about one and a half times as many as from the large black seed. In weight per measured bushel, the large black seed produced a crop in 1896 which weighed nearly four pounds per measured bushel more than that from the light seed.

The yield of grain per acre is very suggestive and should be carefully studied by those who are growing oats, as it will be seen that by sowing the best seed oats there was a production realized of over 43 bushels per acre, while the oats of a light character, of exactly the same variety, produced about 15 bushels per acre less in the crop of the past year.

Spring Grain—Different Dates of Seeding.

For five years in succession, barley, spring wheat and oats, and for four years in succession, peas have been sown on three different dates, each covering the time of the sowing of spring cereals fairly well. The first of these three dates of seeding has been April the 21st and April the 22nd, the second May the first, and the third May the 9th in each of the years mentioned. The experiments were conducted in duplicate in each case. The plots used for the experiment in 1896 were 1/100 of an acre in size, and the land was manured in the spring of 1895 at the rate of twenty tons of farm-yard manure per acre, and it produced a crop of roots the same season in which it was manured.

Dates of seeding.	Average weight per measured bushel.				Average yield of straw per acre				Average yield of grain per acre.			
	Barley 5 years.	Peas 4 years.	Spring wheat 5 years.	Oats 5 years.	Barley 5 years.	Peas 4 years.	Spring wheat 5 years.	Oats 5 years.	Barley 5 years.	Peas 4 years.	Spring wheat 5 years.	Oats 5 years.
	lbs.	lbs.	lbs.	lbs.	tons.	tons.	tons.	tons.	bus.	bus.	bus.	bus.
April 21-22	49.98	60.27	60.01	34.10	1.23	1.16	1.18	1.96	40.45	34.40	18.59	73.47
May 1	48.15	61.06	59.26	33.22	1.23	1.16	1.00	1.80	36.32	34.79	14.56	66.84
May 9	45.30	61.53	58.22	30.73	1.06	1.05	0.85	1.48	26.19	31.48	10.87	56.01

As this experiment has extended over a period of five years, the results should be of much value in providing information in regard to the sowing of the leading kinds of grain at different dates in the spring of the year, in a climate somewhat similar to that in the vicinity of Guelph. If the results from early sowing prove to be more satisfactory than those from later sowing, by increasing the yield and the quality of grain, in the County of Wellington, it is quite likely that the rule will hold good in other sections of the Province, although exactly the same dates might not be applicable in all cases.

In the case of barley, spring wheat and oats, the heaviest weight per measured bushel was obtained from the earliest date of seeding, in the average results of the number of years in which this experiment has been conducted. From the seeding of May the 9th, as compared with that of April the 21st and 22nd, it will be observed that there was a decrease of 1.79 pounds per measured bushel in the case of barley, 5.12 pounds in the case of spring wheat, and 3.37 pounds in the case of oats; and in a similar experiment with peas, it will be seen that the seeding of May the 9th produced a grain that weighed 1.29 pounds more than the seeding of April the 21st and 22nd. In yield of grain per acre the results are very interesting, as they show decidedly the best results from the first date of seeding, and decidedly the poorest results from the last date of seeding with all grains, with the exception of peas, which gave a little larger yield of grain per acre from the second than from the first date of seeding. The reader will observe that there was only about nineteen days from the first date until the last date of seeding, but there was a decrease of about fourteen bushels per acre of barley, three bushels per acre of peas, eight bushels per acre of spring wheat, and seventeen and a-half bushels per acre of oats, from the last date of seeding as compared with the first.

Spring Grain—Drilling versus Broadcasting.

For three years in succession, barley, peas, spring wheat and oats have been sown with the grain drill and also sown broadcast. The experiments were conducted in duplicate in each of these years, and seeding took place from the 18th of April to the 1st of May according to the years. The plots were 1/100 of an acre in size in every case. The following table contains a summary of results of all classes of grain tested in the three years:

Methods of seeding.	Yield of straw per acre.		Yield of grain per acre.	
	1896	Average for three years.	1896.	Average for three years.
	tons.	tons.	bus.	bus.
Broadcasted	1.23	1.72	45.02	47.95
Drilled	1.40	1.74	48.13	48.50

In the table which is here presented it should be clearly understood that the results represent four classes of grain grown on duplicate plots for three years in succession. The table, therefore, gives the average yields from at least forty eight plots. In average yield of straw per acre the broadcasted grain has given a little larger amount than that which was sown with the grain drill, the difference being about forty pounds of straw per acre in favor of the broadcasting. In yield of grain per acre, the average results are also very close. The drilled grain, however, gave a little more than one-half bushel per acre more than that which was sown broadcast. It must be remembered that seeding in nearly every case took place as early in the season as the ground was suitable, and that the grain which was sown broadcast had plenty of moisture for complete germination, and had full advantage of the warmth of the sun, by being placed near the surface of the soil, while the drilled grain which was sown at the same time as that which was broadcasted, would be placed in a soil which was of necessity somewhat colder at that particular season of the year. In the results given in the foregoing summary, the reader should examine the comparative results of sowing the different classes of grain by the drill and by hand at the six different dates, which were reported upon immediately after the reports of the results of the experiments with different varieties of grains.

EXPERIMENTS WITH POTATOES AND FIELD ROOTS.

Under the heading of "Roots," experiments were conducted with fall turnips, Swede turnips, mangels, sugar beets, carrots, and parsnips. The number of plots devoted to the root experiments was about equal to that used for experiments with potatoes. For the variety experiments, the plots were 1/100th of an acre in size; but for the experiments with different methods of cultivation, the plots varied somewhat according to the individual experiments. The land for these various crops was in a good state of cultivation. The germination of the seed in 1896 was much more satisfactory than in 1895. The results of the experiments for 1896, and also for the average of the different experiments for two, three, four, five and six years, as the case may be, will be found in the following pages.

Potatoes—Comparative Test of 195 Varieties

Although the number of varieties of potatoes now under experiment is large, still it seemed necessary to plant all the varieties given in this report, in order to find out which are the best. There is perhaps a greater number of varieties of potatoes than of any other farm crop, and we add to our list from year to year only those varieties which are made prominent by seed firms or by individuals. We sometimes find that varieties which are highly recommended to the general public prove of but little account, while others give good satisfaction in the comparative test.

The land upon which the varieties of potatoes were grown in 1896 was located in the northern part of the experimental grounds, and produced a crop of winter wheat in the summer of 1895. It was plowed in the autumn of 1895, and received a dressing of twenty tons of farm-yard manure per acre in the spring of 1896. The varieties of potatoes were planted side by side on plots 1/100 of an acre in size. There were, however, no paths between the different plots of potatoes, as exactly the same distance existed between the plots of the different varieties as between the rows of the individual plots. After the land was prepared for planting, it was ridged with a double mould-board plow, after which the potatoes were planted in rows $3\frac{1}{3}$ links (26 2-5 inches) apart. Exactly fifteen pounds of seed of each variety were used on each plot. The potatoes were cut into 198 pieces in every instance. The pieces were made about uniform in size and none of the eyes were thrown away. The pieces were placed one foot apart in the rows and were covered to a depth of four inches below the level. The planting took place on the 15th and 16th of May, and the ground was afterwards frequently stirred with a "Breed weeder" until the plants were several inches in height. This implement was operated with one horse and simply stirred the surface soil, thus preventing it from becoming hard. Flat cultivation was used throughout, and the application of Paris green solution was made 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 separated by a "Pease potato sorter." The potatoes were weighed very soon after being harvested, and the yields per acre were estimated from the actual results of the plots.

POTATOES—COMPARATIVE TEST OF 195 VARIETIES

Varieties.	Results for 1896.			Average for years grown.		
	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.
Grown for six years:		lbs.	bush.		lbs.	bush.
1 Empire State	93.14	13.50	188.33	94.42	12.90	201.94
2 Convoy	92.95	15.00	189.17	88.77	10.38	177.83
3 Thorburn	92.94	14.50	147.50	93.82	13.25	175.84
4 Summit	91.50	14.50	147.08	89.73	12.33	173.98
5 Tonhocks	88.42	13.00	158.33	80.93	8.33	173.35
6 Beauty of Hebron	92.67	15.00	193.33	90.51	10.07	172.88
7 Sweet St. Vernal	85.32	13.25	181.67	87.37	10.23	171.60
8 Rural New Yorker No. 2	93.35	14.00	206.67	92.41	11.83	171.40
9 Early Rochester	90.68	16.00	214.58	88.26	10.70	167.66
10 Late Rose	90.08	15.00	163.75	88.91	10.33	167.25
11 Woodbury White	88.98	16.00	147.50	86.31	10.12	165.08
12 Green Mountain	90.91	12.75	174.16	91.14	14.13	163.18
13 Advance	89.29	13.50	182.92	83.22	9.19	163.00
14 Rose's New Invincible	90.38	14.25	142.92	91.86	11.61	162.52
15 Badger State	87.66	12.25	165.42	87.43	10.53	162.29
16 Early Oxford	90.43	15.50	182.92	84.72	8.99	161.93
17 Early Sunrise	87.07	12.75	157.92	88.15	9.96	161.44
18 Thunderbolt	90.22	15.25	187.50	82.16	9.79	160.89
19 Silver King	85.38	14.00	193.75	81.33	9.58	160.37
20 Minister	91.48	13.25	166.25	93.57	11.59	159.58
21 Early Rose	89.22	13.00	166.25	85.90	9.88	157.63
22 Rural Blush	88.07	12.25	174.58	89.50	14.98	155.66
23 White Elephant	89.31	15.25	132.50	90.56	12.03	154.88
24 Pootaluck	85.36	14.50	150.83	86.15	10.13	154.15
25 Early Puritan	89.60	15.00	136.25	89.58	11.53	153.58
26 Daisy	88.56	14.00	127.50	86.91	9.53	149.83
27 Early Mane	87.97	12.75	110.83	84.05	9.20	149.69
28 Dakota Red	91.40	13.75	193.75	90.47	9.38	149.68
29 Crown Jewel	82.51	11.00	185.83	84.50	10.13	149.37
30 Kosh Konong	89.93	14.25	173.75	87.90	10.41	147.65
31 Hoffman	84.84	12.25	129.17	80.71	8.66	147.18
32 Ohio Junior	91.73	14.50	176.25	89.35	10.61	144.24
33 Early Dominion	93.43	15.50	171.25	85.66	9.99	143.84
34 Putnam	83.89	10.25	150.00	77.95	8.65	142.37
35 Halton's Seedling	84.59	12.00	137.92	79.21	8.73	138.47
36 Early Ohio	87.67	11.25	152.08	84.98	8.97	136.31
37 Queen of the Valley	79.70	12.25	164.17	85.57	10.08	130.65
38 Stray Beauty	84.89	9.00	201.25	82.02	6.67	130.54
39 Rosy Morn	87.82	12.50	160.83	83.04	8.36	130.30
Grown for five years:						
40 Burbank's Seedling	83.83	10.50	167.50	83.83	9.30	193.16
41 Morning Star	84.28	10.00	182.92	82.58	8.62	184.85
42 Early Everett	87.08	11.75	161.25	85.23	9.51	182.92
43 Hotel Favorite	83.92	10.00	176.25	83.42	9.36	181.33
44 The Ideal	75.14	9.25	216.25	78.52	7.70	177.51
45 Island MacDonald	78.67	11.50	156.25	87.08	11.26	175.74
46 The Dandy	79.26	9.25	456.67	80.90	8.86	175.67
47 Early Gem	91.79	12.75	142.08	90.30	10.96	175.66

POTATOES.—Comparative test of 195 varieties.—*Continued.*

Varieties.	Results for 1896. Per cent of whole crop marketable.	Weight of 30 largest potatoes on each plot.	Yield of potatoes per acre.	Average for years grown. Per cent. of whole crop marketable.	Weight of 30 largest potatoes on each plot.	Yield of potatoes per acre.
		lbs.	bush.		lbs.	bush.
48 King of the Roses........	81.98	9.75	164.17	81.48	9.36	**175.26**
49 Edwards	84.91	14.50	162.92	86.70	10.65	**173.69**
50 Vick's Perfection..................	76.41	10.75	213.75	84.80	8.92	**172.99**
51 St. Patrick......................	79.13	9.75	163.75	84.84	9.65	**172.49**
52 Landreth's State of Maine.......	84.83	8.50	148.33	80.40	8.06	**172.43**
53 Delaware.........................	89.27	11.00	159.17	88.25	9.51	**172.08**
54 State of Maine	88.66	11.25	165.42	91.00	9.51	**171.03**
55 Mammoth Pearl.....................	87.12	11.00	165.00	88.25	9.90	**170.76**
56 Watson's Seedling..................	82.04	10.00	155.42	80.41	8.70	**168.68**
57 Early May Flower...................	83.96	10.00	176.67	78.70	7.86	**167.77**
58 Dempsey's Seedling.................	81.28	10.75	182.50	82.78	9.05	**167.36**
59 Alexander's Prolific...............	88.92	13.00	150.42	86.46	10.22	**167.32**
60 New Queen.........................	85.81	10.00	120.42	84.24	11.65	**167.09**
61 Halo of Dakota....................	78.93	9.50	172.08	81.27	7.82	**166.65**
62 Wilson's First Choice.............	83.09	10.25	142.92	80.83	8.72	**165.60**
63 N. B. & G. Co's Grand Mogul...	91.72	11.00	120.83	92.00	9.67	**165.17**
64 Munro Co. Prize...................	81.69	12.00	172.92	83.47	10.51	**164.55**
65 May's Imperial....................	80.05	9.75	171.25	84 17	9.35	**163.75**
66 Polaris	80.86	10.75	135.00	80.92	8.91	**163.68**
67 Evorett's Seedling.................	80.60	9.75	111.67	79.70	8.31	**162.69**
68 Paris Rose....	75.29	10.00	141.67	73.90	8.02	**162.17**
69 Molly Star	84.98	11.25	122.08	81.93	9.41	**161.75**
70 Red Australian	83.98	11.25	161.25	87.84	9.06	**161.49**
71 Burpee's Extra Early..............	72.22	9.[illegible]0	127.50	76.15	7.37	**160.66**
72 Vick's Champion	87.97	11.00	166.25	89.48	10.26	**159.00**
73 Thorburn's Extra Early...........	82.92	10.00	100.00	77.84	8.35	**158.68**
74 Landreth's Alliance..............	82.19	13.25	152.08	[illegible]6.93	10 57	**158.26**
75 Mount Carbon......................	86.96	11.75	153.33	85.38	9.72	**156.33**
76 White Lily........................	80.50	11.25	134.58	82.64	9.46	**155.00**
77 White Star	92 54	10.50	83.75	90.96	12.31	**152.49**
78 Early Essex	79.19	10.00	124.17	80.35	8.56	**152.49**
79 P.E.I. Early Rose........... ...	84.80	11.50	137.08	88.34	9.86	**152.26**
80 Harbinger.........................	64.97	9.00	73.75	60.55	7.51	**150.56**
81 Early Market.....	75.20	12.25	105.83	88.11	9.86	**150.07**
82 Chicago Market	84.21	10.25	118.75	82.76	8.96	**148.77**
83 Chautauqua	75.14	8.75	73.75	86.75	9.26	**148.25**
84 Negro.............................	45.07	6.75	126.67	55.58	5.65	**147.18**
85 Hopeful	90.96	13.50	147.50	87.14	10.55	**146.94**
86 Bell A. C.........................	83.27	10.75	102.08	87.57	9.75	**145.51**
87 Garnets...........................	82.07	9.75	104.58	86.34	10.02	**144.08**
88 Boley's Northern Spy.............	92.34	12.00	97.92	87.81	10.20	**143.68**
89 Landreth's Garfield	66.53	8.00	99.58	74.32	7.65	**142.76**
90 Eureka............................	70.82	8.25	107.08	77.04	7.82	**142.66**
91 Extra Early Vermont....	70.34	7.50	98.33	81.01	8.86	**142.59**
92 Snowflake.........................	54.09	6.00	117.08	55.09	5.27	**140.86**
93 The Rosedale	82.11	11.50	79.17	82.92	8.97	**139.91**
94 Rose Seedling	88.89	12.25	105.00	92.35	11.51	**139.07**
95 Snow Queen.........................	75.39	9.00	109.33	73.78	7.26	**137.67**
96 Sunlit Star	77.98	9 50	90.83	75.74	8.26	**137.07**
97 Prince Albert.....................	64.87	7.25	61.67	76.84	7.95	**131.85**
98 Vaughan...........................	80.75	10 25	99 58	88.33	10.07	**131.85**
99 Lady Finger.......................	27.71	5.25	96.25	39.69	5.20	**129.85**
100 Chas. Downing	[illegible]2.25	9.75	170.00	57.84	5.92	**128.57**
101 McIntyre	73.53	10.25	99.17	82.19	9.52	**128.16**
102 Royal Adelaide	76.51	6 50	55.00	85.78	8.76	**127.04**
103 Pearce's Prize Winner...........	79.08	10.25	63.75	82.71	9.30	**87.21**

POTATOES.—Comparative test of 195 varieties.—*Continued.*

Varieties.	Results for 1896. Per cent. of whole crop marketable.	Results for 1896. Weight of 30 largest potatoes on each plot.	Results for 1896. Yield of potatoes per acre.	Average for years grown. Per cent. of whole crop marketable.	Average for years grown. Weight of 30 largest potatoes on each plot.	Average for years grown. Yield of potatoes per acre.
Grown for four years:		lbs.	bush.		lbs.	bush.
101 American Wonder	88.59	12.50	167.92	89.46	12.39	**223.53**
105 Pearl of Savoy	85.56	13.75	152.92	93.38	15.81	**220.00**
106 American Giant	83.02	11.75	157.08	90.57	13.38	**216.97**
107 Burpee's Superior	80.46	11.00	164.17	86.70	11.00	**212.62**
108 Bill Nye	76.02	9.50	163.33	85.40	10.25	**204.78**
109 Columbus	82.31	12.25	108.33	89 31	12.75	**204.59**
110 Early Harvest	62.95	7.50	183.33	82.00	9.25	**193.64**
111 Keiser	86.65	10.00	152.92	91.71	10 63	**191.55**
112 Scotch Regent	73.51	10.50	140.00	81.12	9.75	**188.96**
113 Early Pontiac	70.74	8.75	129.58	80.34	8.26	**186.37**
114 Early June Eating	82 15	10.75	118.75	88.08	12.57	**184.79**
115 Bruce's White Beauty	77.39	9.25	165.83	81.74	9.00	**181.88**
116 Granger	78 92	10.25	138.33	85.06	10.20	**180.31**
117 Montana Wonder	67 82	9.75	132.08	76.68	10.20	**180.10**
118 General Gordon	87.16	12.25	152.50	92.97	13.50	**179.75**
119 Early Six Weeks	82.05	10.25	130.00	83.90	10.00	**178.74**
120 Timpe's No. 4	77.42	8.50	155.00	86.34	11.01	**178.56**
121 Arizona	83.57	9.75	119.17	87.09	12.02	**176.44**
122 Golden Harvest	67.26	8.00	141.25	81.78	9.70	**173.55**
123 Rochester Rose	79.61	11.75	106.25	89.47	12.07	**172.72**
124 Steele's Earliest of all	55.79	6.75	147.92	78.37	8.31	**171.89**
125 Early Yorker	80.75	10.50	99.58	86.61	11.94	**171.56**
126 The Freeman	59.88	7.00	141.25	75.17	8.14	**170.53**
127 Improved Rose	72.91	9.25	84.58	85.65	10.56	**170.29**
128 North Pole	62.41	6 75	120.83	78.30	9.06	**169.59**
129 Six Weeks	82 37	8.25	130.00	90.11	10.56	**168.96**
130 Van Orman's Earliest	70.59	7.75	127.50	81.19	8.44	**168.86**
131 Reid's Eighty Six	69.14	8.00	145.83	80.28	9.82	**168.56**
132 Beauty of Beauties	84.84	9.00	129.17	87.61	10.13	**165.84**
133 Early Northern	68.00	7.50	125.00	85.35	10.45	**163.54**
134 Parson's Prolific	87.15	11.75	149.17	88.73	11.25	**162.29**
135 The Peoples	84.17	8.50	100.00	89.37	10.51	**158.84**
136 Nebula	67.81	8.25	133.33	79.75	11.64	**158.75**
137 Pride of Ireland	89.87	11 50	131.67	90.17	11.33	**154.70**
138 Manitoba Rose	89.17	11.00	130.83	89.10	10.57	**152.19**
139 Seneca Beauty	91.73	13.50	105.83	95.80	15 89	**151.36**
140 World's Fair	69.83	8.75	96.67	81.69	9.37	**148.76**
141 Potentate	91.33	10.50	72.08	89.97	12.32	**147.82**
142 Ontario	76.22	7.25	68.33	84.10	10.94	**140.11**
143 Great West	84.71	9.50	106.25	83.02	10.57	**138.34**
144 Howe's Premium	79.23	6.75	108.33	87.52	7.60	**135.52**
145 Maggie Murphy	86.27	11.25	75.83	92.26	12 81	**134.13**
146 Browell's Seedling	62.07	8.00	24.17	84.38	11.88	**130.33**
147 Columbian Peach Blow	61.54	1.00	10.83	73.40	6.50	**115.43**
148 New Satisfaction	73.79	7.75	60.42	72.88	8 20	**109.91**
149 Eyeless	30.00	4.75	29.17	57.55	6.75	**109.48**
Grown for three years:						
150 Great Divide	68.54	7.00	148 33	84.44	10.09	**210.14**
151 Troy Seedling	49.31	4.75	60 00	79.38	11.17	**218.20**
152 Adirondac	83.97	9.25	132.50	90.26	10.92	**205.83**
153 Irish Daisy	66.86	6.50	71.67	84.01	11.67	**200.14**
154 Hartzell's Seedling	82.74	8.25	94.17	91.01	12.42	**192.50**
155 Pride of the West	80.48	9.50	121.67	88.39	12.92	**191.67**
156 Pride of the Market	77.15	8.00	125.83	89 08	11.25	**191.67**
157 Clark's Nonsuch	86.63	9 50	130.83	92.88	13 59	**182.92**

POTATOES.—Comparative test of 195 varieties.—*Continued.*

Varieties.	Results for 1896.			Average for years grown.		
	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.	bush.		lbs.	bush.
158 Snow Drop	80.00	9.25	62.50	83.22	11.84	**179.73**
159 Pride of the Table	79.74	7.25	94.58	89.68	12.64	**175.00**
160 Clay Rose	76.76	7.75	77.08	88.58	14.67	**171.25**
161 Salzer's Prize Taker	72.98	8.25	103.33	83.81	10.67	**169.44**
162 Russell's Seedling	84.05	7.75	107.08	87.41	9.58	**168.61**
163 Victor Rose	86.94	10.00	102.08	92.53	15.75	**166.81**
164 Governor Rusk	59.66	5.75	99.17	77.63	9.25	**164.17**
165 Restaurant	77.17	6.50	105.83	87.62	11.33	**161.80**
166 Wilson's Stray Beauty	72.22	5.50	120.00	83.81	7.92	**154.93**
167 Bell's Stray Beauty	70.92	5.50	81.67	85.47	7.33	**148.19**
168 Vanguard	61.97	6.25	82.08	78.70	10.34	**148.05**
169 Vick's White Gem	61.39	6.50	65.83	79.46	10.59	**135.28**
170 Silver Dollar	66.67	6.50	57.50	79.40	8.33	**120.97**
Grown for two years:						
171 Governor Foraker	58.18	6.00	137.50	72.57	9.25	**201.25**
172 Rose of Erin	88.05	10.75	99.38	90.81	8.63	**172.61**
173 Fillbasket	77.46	7.25	44.38	84.76	11.63	**148.03**
174 Lee's Favourite	68.38	6.50	85.09	77.33	8.88	**144.17**
175 Burnaby Mammoth	71.88	7.50	60.00	81.28	10.88	**143.96**
176 Dreer's Standard	76.16	7.75	94.88	79.91	10.13	**142.82**
177 Early Pride	63.85	5.75	81.25	71.55	8.38	**140.00**
178 Early White Prize	76.92	6.50	65.00	80.84	9.00	**137.71**
179 Michigan Blues	87.12	7.75	82.50	90.32	10.25	**137.50**
180 Early Advancer	68.35	6.50	49.38	75.09	8.88	**127.82**
181 Rot Proof	52.38	5.75	52.50	71.65	10.25	**113.34**
182 Earliest Known	76.03	6.25	75.63	83.18	8.63	**106.78**
183 Irish Cups	41.46	3.50	25.63	61.60	6.00	**86.98**
Grown for one year:						
184 Manitoba Bluff	84.57	7.50	117.50	84.57	7.50	**117.50**
185 Mantana Bluff	72.79	6.25	91.88	72.79	6.25	**91.88**
186 Woodhull	63.01	6.25	91.25	63.01	6.25	**91.25**
187 Acme	71.03	5.75	90.63	71.03	5.75	**90.63**
188 Flower City	50.00	5.75	90.00	50.00	5.75	**90.00**
189 Brown's Prolific	61.97	6.00	88.75	61.97	6.00	**88.75**
190 Manhattan	79.10	6.50	68.75	79.10	6.50	**68.75**
191 Brown Elephant	70.64	6.50	68.13	70.64	6.50	**68.13**
192 Weld's Orange	25.23	3.25	66.88	25.23	3.25	**66.88**
193 English Bumpers	75.26	5.75	60.63	75.26	5.75	**60.63**
194 Napoleon	59.57	5.75	58.75	59.57	5.75	**58.75**
195 California Red	49.15	4.75	36.88	49.15	4.75	**36.88**

Although the average yield per acre of the different varieties for 1896 is not large, still the comparative results are perhaps fully as valuable as though the average yield was as high as on some former occasions. It will be seen from the foregoing table that there were only five varieties which produced upwards of two hundred bushels per acre. The early varieties gave much higher comparative results in 1896 than in several of the past years It will be noticed that the Stray Beauty produced a little over two hundred bushels per acre in 1896, which is an exceptionally large yield for this variety, as it is one of the earliest potatoes which we have grown, and usually produces a somewhat small yield per acre.

It will be seen that the Empire State occupies the first place among thirty-nine varieties which have been grown for six years in succession. This is a good substantial potato for the producer, as the potatoes are usually large and of a good quality, and the yield is one of the very best among those which have been grown in the experimental department. It will be seen from the table that the Empire State produced an average of twenty-four bushels per acre more than the variety coming next to it in the average of six years' experiments. This is a point worthy of special notice. There were 178,965 acres devoted to the potato crop throughout Ontario in 1896, according to the report of the Ontario Bureau of Industries. It will be seen that the difference of twenty-four bushels per acre over the entire Province for one year, would make a difference of over four million bushels of potatoes in the total yield in the province. The Burbanks Seedling variety heads the list in average yield per acre among the varieties which have been grown for not more than five years. This gave an average of one hundred and ninety three bushels per acre. The percentage of marketable potatoes is much less than that of the Empire State variety, and the average weight of the thirty best potatoes is also considerably less, which shows that the individual potatoes of the Burbanks Seedling variety are usually smaller in size than those of the Empire State. It will also be seen from the results of the varieties which have not been grown for more than four years that there is a large average yield of potatoes per acre. It must be remembered, however, that the average yield of potatoes for the past four years, was larger than that for the two previous years, hence the averages for those grown for only four years would be relatively larger than those which were grown in the experiments for five and six years. The American Wonder, the Pearl of Savoy, and the American Giant, have given large average yields and are all late varieties of potatoes. Much has been said of late in regard to the American Wonder as being a variety of great promise. We have found it a good strong growing late variety which usually yields well, and is of a fair quality, but evidently not quite equal to the Empire State in point of quality.

It will be remembered that our potato crop in 1895 possessed a large amount of scab. This may be partly accounted for by the potatoes being grown as the first cultivated crop on new land. The percentage of scab of each variety was given in the table of results for 1895, to show which were the most injured and which were the least injured by the scab. The seed of the different varieties was not treated in any way before planting in the spring of the present year, as we desired to study the different varieties very carefully in regard to the manner in which they would continue to become much or little affected by this blight. There was, however, but very little scab in the crop of the present season. The potatoes, however, were grown upon land which has been under cultivation for a considerable number of years. The varieties which were the most affected by scab in 1896, were Early Rochester, Alexander's Prolific, Extra Early Vermont, Negro, Governor Foraker, Dreer's Standard, and Manitoba Bluff. An experiment was conducted by treating the potatoes differently for the prevention of scab, and the results of this experiment will be found in this report.

Mention should be made at this time of some of the early varieties of potatoes, but as a special experiment was conducted with twelve of the earliest kinds which have been tested in the past years, the reader is referred to the results of this experiment, which will give information regarding the comparative yields of the early varieties.

Potatoes—Comparative Test of Twelve Early Varieties.

As there is usually much interest taken in early potatoes, it was thought advisable to select the twelve varieties which has proven to be the earliest in our experiments of the past years, and test them under different conditions. The twelve early varieties were planted on May the 4th on good soil, which was situated on the lower portion of the experimental field. The land produced a grain crop in 1895, and was manured at the rate of twenty tons of farm-yard manure per acre in the spring of 1896. These twelve early varieties were again planted in the regular variety tests on the 15th and 16th of May, on an elevated portion of the experimental field. The following table gives the average result of the two experiments.

The first column of figures to the left in the following table represents the average percentage of the potatoes of each variety which were over one inch in diameter in the experiment of the first date of seeding and over one-and-a-half inches in diameter in the second date. Each variety of potatoes that was planted on May the 4th was dug at three different dates, namely, nine weeks, twelve weeks, and fifteen weeks after the planting took place. The average percentage of the crop which was over one inch in diameter was 84 per cent. from the first digging, 87 per cent. from the second, and 94 per cent. from the third. There seemed to be a large increase in the percentage of potatoes over one inch in diameter, and also in the yield per acre between the twelfth week and the fifteenth week after planting. This experiment will likely be conducted in the future, and we hope to bring out some important results in regard to various points of interest relating to the growing of early potatoes.

Varieties of early potatoes.	Average percentage of potatoes of over 1 or $1\frac{1}{2}$ in. diameter.	Average yield of potatoes per acre.
		bus.
Stray Beauty	88.0	211.3
Early Rose	92.3	192.5
Charles Downing	77.6	181.3
Early Dominion	94.3	175.0
Early Ohio	91.1	167.3
Howe's Premium	85.5	151.7
Steele's Earliest of All	75.9	151.5
Early Sunrise	93.5	144.6
Snowflake	72.7	143.5
Tonhocks	91.7	139.2
Burpee's Extra Early	84.0	129.1
Thorburn's Extra Early	88.5	125.0

It will be seen that in the average yield per acre in 1896, the Stray Beauty potato stood highest, producing nearly twenty bushels per acre more than the Early Rose, which stands second in yield of potatoes. The largest sized potatoes were produced by the Early Dominion variety, and the smallest by the Snow Flake.

Potatoes—Different Depths of Planting Seed Tubers.

For six years in succession, potatoes have been planted one, three, five, and seven inches deep in the experimental grounds. The Vick's American Wonder, Great Divide, Tonhocks, and Stray Beauty varieties of potatoes were used in this experiment, in 1896, each one of which was planted at the four different depths mentioned The experiment was conducted with four varieties in 1895 and in 1894, and with two varieties in each of the years 1893, 1892 and 1891. There has been no less than eighteen separate tests and seventy-two plots used in this experiment. In 1896 each variety consisted of one row four rods in length. The nature of the soil and the method of preparation were the same as for the variety test. The potatoes in this experiment were all planted on May the 22nd, 1896. The following table gives the average results for 1896, and also for the six years in which this experiment has been conducted :

Depths of planting.	Results for 1896.			Average yield per acre 6 years 1891-2-3-4-5-6. (18 tests.)
	Depth of new potatoes in the soil.	Number of potatoes exposed to the sun per 100 hills.	Yield of whole crop per acre.	
	inches.		bush.	bush.
One inch	1.55	48.2	155.31	192.73
Three inches	2.75	1.7	148.75	198.42
Five inches	3.47	.0	134.38	203.66
Seven inches	4.86	.0	79.38	190.38

In 1896 the potatoes planted only one inch deep gave the best yield per acre for the first time within the past six years. It will be noticed that as the depth increased the yield decreased in the results for the past season. As the past summer was a favorable one as regards showers, there was no period in which the potatoes severely suffered from a continuous drouth. The potatoes, therefore, which were planted near the surface had a sufficient amount of moisture and seemed to thrive exceedingly well. It will, however, be observed that in the average of the six years' experiments the greatest yield has been realized from the potatoes planted to a depth of five inches, and those which were planted at a depth of three inches stand second in yield per acre. The potatoes which were planted one inch deep and seven inches deep gave the poorest results in average yield of crop.

It is of interest to note that the crop of potatoes produced from the deepest planting was nearly five inches under the surface of the soil when the crop was matured, while those produced from the seed of the shallowest planting were less than two inches below the surface. While it is objectionable to grow potatoes nearly five inches deep in the soil and thus cause greater labor at the time of harvesting, it is also objectionable to grow them too near the surface, as many of them are liable to be injured by exposure to the direct rays of the sun. The planting of five inches below the surface has given very satisfactory results throughout.

Potatoes—Different Methods of Preparing Seed.

An experiment has been conducted for five years in succession by preparing seed potatoes for planting in different ways, in order to find out which methods will give the best satisfaction. The experiment was conducted in duplicate in 1892 and 1893, and in triplicate in each of the past three years. In 1894, 1895 and 1896 three varieties of potatoes were used each season. The Empire State, Pearl of Savoy, and Rural New Yorker No. 2 were the ones employed in this experiment in 1896. The quantity of seed per acre varied, according to the manner of preparing the seed. The quality and preparation of the soil were the same as for the comparative tests of the different varieties previously mentioned. Each plot consisted of one row one rod long. The rows were three-and-a-third links apart, or a little less than 27 inches. The potatoes were planted on May the 23rd in 1896. Great care was taken in the selection of the potatoes for the various plots in this experiment. The yields per acre have been calculated from the actual results of the plots.

Preparations.	Percentage of whole crop marketable.		Yield of whole crop per acre.		Yield per acre, less seed used.	
	1896.	Average 5 years, 1892-3-4-5-6.	1896.	Average 5 years, 1892-3-4-5-6.	1896.	Average 5 years, 1892-3-4-5-6.
			bush.	bush.	bush.	bush.
Large whole, one foot apart	71.06	79.91	322.50	336.67	34.17	107.88
Large whole, two feet apart	73.96	84.58	230.42	247.42	52.09	131.07
Large whole, three feet apart	78.42	87.18	179.58	199.60	60.69	124.43
Medium whole, one foot apart	75.70	82.97	240.00	270.98	120.00	176.11
Medium whole, two feet apart	82.08	88.44	183.75	210.85	124.57	163.57
Small whole, one foot apart	85.44	88.54	154.58	197.60	131.55	172.01
Medium cut in two, one foot apart	78.55	84.10	205.83	198.50	145.81	150.14
Medium, two eyes in a piece, without seed ends, one foot apart	87.18	91.46	146.25	143.94	122.72	125.29
Medium, one eye in a piece, without seed ends, one foot apart	92.16	92.29	106.25	91.67	93.73	80.99
Medium, seed ends, one foot apart	86.93	87.25	108.33	95.63	100.30	89.08

The preceding table furnishes some important data in reference to the preparation of potatoes for planting. It will be observed that decidedly the best yield per acre in 1896, and in the average of five years, has been produced by large whole potatoes one foot apart, and the second largest yield from medium-sized whole potatoes one foot apart. In percentage of marketable potatoes it will be seen that the pieces of potatoes containing two eyes each, got from medium-sized potatoes, gave the best satisfaction in this respect in the results of 1896, and also in those for the average of five years. The largest amount of small potatoes was produced from the large whole potatoes which were planted one foot apart.

Special attention is directed to the last column, at the right of the foregoing table, as this column gives the average yield per acre produced by the different preparations of the seed, after the amount of seed used has been subtracted from the crop produced. In looking over this table it will be seen that the best yield is from the medium-sized potatoes planted one foot apart in the row. Although it was previously stated that large whole potatoes planted one foot apart had produced the largest yield per acre, still it will be seen that owing to the large amount of seed required in this case, the average yield per acre, after the seed has been deducted, is quite low in comparison with other preparations of seed.

Potatoes—Selection of Seed for Three Years in Succession.

In 1894 an experiment was conducted similar to the one described under the heading of "Potatoes—Different Methods of Preparing Seed." In this experiment large, medium, and small whole potatoes were planted side by side, and the crop was carefully harvested and stored in a cool cellar. In 1895 large, medium, and small whole potatoes were selected from the potatoes produced by the large, medium and small whole 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 similar selections were again made from the produce of the potatoes of 1895. The term "small potatoes" in this experiment means those about one and a half inches in diameter, and the term "very small potatoes" means those of an average of about three quarters of an inch in diameter. The potatoes for this experiment were all planted on May the 29th, 1896. The yields per acre have been determined from the yields of the plots.

Seed selected.	Amount of seed.	Results for 1896.			
		Percentage of whole crop marketable.	Weight of 30 largest potatoes on each plot.	Yield per acre.	
				Whole crop.	Whole crop less seed used.
	bus.		lbs.	bus.	bus.
Large whole potatoes	53.8	79.3	7.8	168.8	115.0
Medium whole potatoes	80.9	79.1	7.4	143.8	112.9
Small whole marketable potatoes	10.3	79.9	6.9	105.6	95.3
Very small whole unmarketable potatoes	4.3	80.8	6.5	65.0	60.7

Although the plot which was planted with large whole potatoes required 53.8 bushels per acre of seed, it will be noticed that there was still remaining the largest yield of potatoes per acre after deducting the amount of seed used from the whole crop produced upon the plot. The results are quite regular throughout, the largest yields being produced from the largest potatoes and the smallest yields from the smallest potatoes which were planted. In regard to the percentage of marketable potatoes, it will be noticed that the small sized seed produced the largest percentage of marketable potatoes. This, no doubt, is caused by the small yield produced by the small potatoes. It will also be observed that the largest potatoes were produced from the largest seed, and as the seed decreased in size, the weight of the largest potatoes in the crop produced also decreased in regular order.

Potatoes—Planting Sets of Different Sizes With One Eye in Each Set.

In 1895 and in 1896 an experiment was conducted in which potato sets one-sixteenth, one-eighth, one-quarter, one-half, 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 sets on the crop produced. The experiment has been conducted in duplicate in each of the two years past. The varieties used in 1896 were the Empire State and the Pearl of Savoy, which were planted on the 27th of May, in rows four rods long and three-and-a-third links apart. The potato sets were planted to a depth of about four inches, and flat cultivation was used throughout the season. The soil was the same as that for the variety tests. The yields per acre have been calculated from the actual yields of the plots.

Weights of potato sets planted	Percentage of whole crop marketable.		Weight of 30 largest potatoes on each plot.		Yield of potatoes per acre.	
	1896.	Average 2 years 1895-6.	1896.	Average 2 years 1895-6.	1896.	Average 2 years 1895-6.
			lbs.	lbs.	bus.	bus.
Each set containing 1-16 ounce and 1 eye	87.5		8.50		60.00	31.25
" " 1-8 " 1 "	94.6	89.0	9.88	8.69	105.00	54.38
" " 1-4 " 1 "	94.6	89 8	11.13	9.82	138.13	75.32
" " 1-2 " 1 "	94.0	90 6	11.00	10.00	145.00	99.38
" " 1 " 1 "	92.0	91.0	10.25	10.50	165.00	129 38
" " 2 ounces and 1 eye	89.3	90.5	9.50	11.07	181.88	170.32

The results in the above table are very interesting and show the great influence which the size of the potato sets have upon the amount of the crop produced. The smallest-sized pieces produced decidedly the smallest yield, and there was a gradual increase according to the increase in the size of the seed tubers. In the average experiments for two years, the potato sets which weighed two ounces each produced the largest potatoes; and as the potato sets decreased in size, the comparatives weights of the largest potatoes in the crops produced became gradually less.

Potatoes—Planting Sets of Equal Size With a Varying Number of Eyes in Each Set.

An experiment has been conducted for two years in succession, to obtain some information in regard to the influence of the number of eyes on pieces of potatoes as affecting the succeeding crop. Potato sets of one ounce in size were used throughout the experiment, and on number one plot the sets contained one eye in each piece; on number two plot, two eyes; on number three plot, three eyes; on number four plot, four eyes; and on number five plot, five eyes. The Empire State and Pearl of Savoy varieties were used for this experiment in 1896. The land was similar in character, and the cultivation was of the same nature as that for the variety test. The potatoes were planted on May the 27th.

The following table gives the results of this experiment:

Number of eyes in the seed of potatoes.	Average yield of potatoes from each — Set. Average 2 years, 1895 6.	Average yield of potatoes from each — Eye. Average 2 years, 1895-6.	Yield of potatoes per acre, 1896.
	ozs.	ozs.	bus.
Each potato set containing 1 ounce and 1 eye........	7.28	7.28	158.13
" 1 " 2 "	8.00	4.00	176.25
" 1 " 3 "	7.88	2.64	181.88
" 1 " 4 "	7.74	1.72	186.25
" 1 " 5 "	8.63	1.75	197.50

In the foregoing table it will be observed in this first column of figures to the left, that the average amount of potatoes from large seed was fairly uniform, regardless of the number of eyes in each set. It will be seen that the results of this experiment and those of the preceding experiments point very strongly to the conclusion that much more depends upon the comparative size of the potato sets which are planted than upon the comparative number of eyes on the sets.

Potatoes—Influence of Plaster and Lime when Sprinkled on Freshly Cut Potatoes.

The writer has frequently observed that seedsmen usually sprinkle potato eyes with plaster or a somewhat similar substance when sending potato eyes by mail. This seems to preserve the pieces of potato. It has also been stated by practical men that they believe it is an advantage to sprinkle potatoes with plaster or lime immediately after being cut for seed. In order to obtain data which would form a serviceable guide in regard to this matter an experiment was started in the spring of 1894, and has been conducted for three years in succession, in which freshly cut potatoes have been sprinkled with plaster or with lime, or have been left untreated before planting. In order to obtain as accurate results as possible, two varieties of potatoes were used for this experiment in 1896. Three lots of each variety were cut on May the 29th, one of which was immediately sprinkled with lime, another with plaster, and the third was left untreated. Three lots of each variety were again cut on June the 2nd and treated in a way similar to those already described. The twelve lots of seed were planted on June the 2nd on plots side by side.

Preparation of sets.	Percentage of crop marketable, average 2 years.	Weight of 30 largest potatoes per plot, average 3 years.	Yield of whole crop per acre. 1896.	Yield of whole crop per acre. Average 3 years.
		lbs.	bus.	bus.
Potatoes sprinkled with plaster.....	75.89	15.23	170.63	251.43
Potatoes sprinkled with lime.......	76 89	14 96	158.44	243.44
Potatoes not sprinkled............	75.19	13.73	145.00	208.61

The yields per acre from this experiment have been quite uniform in the three years in which it has been conducted. The potatoes which were sprinkled with plaster gave the best results, and those which were sprinkled with lime gave the second highest yield in each of the past three years. It will be observed that, in the average yield of potatoes per acre, the seed which was sprinkled with plaster gave about forty-three bushels per acre, and that which was sprinkled with lime about thirty-five bushels per acre more than the seed which was not sprinkled with either plaster or lime.

Potatoes—Planting Seed on the Same Date as Cut, and Four Days After Cutting.

This experiment was conducted in 1896, and occupied the same plots as the experiment which precedes it. There were in all twelve plots which were planted with potatoes on June the 2nd. The seed for six of these plots was cut on May the 29th, and that for the other six on June the 2nd. The yields per acre have been determined from the actual results of the plots.

Dates of cutting.	Percentage of whole crop marketable.	Yield of whole crop per acre.
		bus.
Potatoes cut on May 29 and planted on June 2	61.35	146.67
Potatoes cut on June 2 and planted on June 2	66.29	169.38

The average yield per acre of all the tests with potatoes cut on the date of planting was 22.7 bushels per acre more than the average of those which were cut four days before planting. In 1895, the potatoes which were planted on the same date that they were cut gave an average of about 25 bushels per acre more than those which were cut three days previously. These results confirm the results of other experiments previously conducted, and point very emphatically to the advantage of planting potatoes immediately after cutting, and the disadvantage of preparing the seed several days before planting, which is the custom of some potato growers.

Potatoes—Planting Single Eyes from Different Parts of the Seed Tubers.

An experiment has been conducted for three years in succession, to determine whether the individual eyes in the seed end of the potato are of as much value for planting as the individual eyes from the other parts of the potato. To determine this, uniform potatoes were selected and single eyes were cut from the seed end, from the middle and from the stem end of the tubers. One eye was left in each of the pieces, and the pieces were all made exactly the same weight. The experiment is therefore, purely a test of the comparative value of the eyes, and is not influenced by the difference in the size of the pieces planted. The potato sets were planted one foot apart in the rows, and were covered to a depth of four inches. Flat cultivation was used throughout, as in the case of the other potato experiments.

Parts of potatoes from which the eyes were taken.	Percentage of crop marketable, average two years 1895-6.	Weight of 30 largest potatoes per plot, average 3 years 1894, 1895, 1896.	Yield of whole crop per acre, average three years 1894, 1895, 1896.
		lbs.	bus.
Middle of potato	85.7	14.9	192.0
Seed end of potato	86.2	15.1	190.5
Stem end of potato	84.2	14.4	186.1

In the average of this experiment, which has been conducted in duplicate for three years in succession, we find that the eyes taken from the middle portion of the potato have given a little the highest average yield per acre, but this yield is very close to the yield from the eyes taken from the seed end of the potato. The selection of the eyes from the large end of the potatoes, give the lowest average results in percentage of crop marketable, in yield of whole crop per acre, and in the weight of the best developed potatoes. There is, however, only a small difference in the results of the eyes selected from the different parts of the potatoes.

Potatoes—Submitting Seed to Different Exposures Three Weeks Previous to Planting.

For three years in succession an experiment has been conducted in which potatoes were carefully and evenly divided into different lots and placed in different degrees of light and heat for three weeks before they were planted; some being placed in the dark cellar, others in the cellar in front of a window, others on the barn floor, others in the green house immediately below the glass, and others in the open air. Those placed in the dark cellar grew long tender light colored sprouts, while those placed in a warm temperature produced short green colored sprouts. Part of the potatoes kept in the dark cellar were planted with the sprouts removed, and part with the sprouts still attached to the tubers. The potatoes were distributed to their respective places on May the 29th, and the planting took place on June the 18th. The yields per acre have been estimated from the actual results of the plots.

Places where the potatoes were kept for 21 days before planting.	Percentage of crop marketable.		Weight of 30 largest potatoes.		Yield of whole crop per acre.	
	1896.	Average 3 years.	1896	Average 3 years.	1896.	Average 3 years.
			lbs.	lbs.	bus.	bus.
Potatoes in barn in light, sprouts on...	78.51	80.59	7.25	11 71	142.50	278.33
Potatoes in root cellar in dark, sprouts on	76.96	78.57	7.50	11.46	127.50	250 01
Potatoes in root cellar in light, sprouts on	78.58	81.57	7.75	10.63	131.25	244.58
Potatoes in green house in light, sprouts on	65.05	72.36	6.25	9.13	128.75	225.84
Potatoes in root cellar in dark, sprouts off	67.69	69.74	4.75	7.63	81.25	198.75
Potatoes in open air, sprouts on	60.29	60 96	4.75	8.08	88.13	72.09

In each year in which this experiment has been conducted, the average results of the duplicate plots show that the potatoes which were placed in the barn where the light was admitted by glass windows gave the largest yield per acre. It should be mentioned, however, in this connection, that the potatoes were not placed in a position where the sun could shine directly upon them. The potatoes which were placed in the root cellar, and from which the sprouts were not removed, gave the second largest yield per acre; but at the same time, produced 28 bushels per acre less than the potatoes which were placed on the barn floor where the temperature would be considerably higher. It will be observed that the potatoes which were placed in the dark in the root cellar, and from which the sprouts were removed, gave very poor results. This is a point worthy of special notice, as it is thoughtlessly practised in many instances. Seed potatoes are frequently kept in a dark cellar, which is allowed to receive a sufficient amount of heat to cause the potatoes to sprout considerably before planting.

These sprouts which are then removed from the potatoes seem to take a considerable amount of the nourishment away, and the result is that small yields of potatoes per acre are almost sure to follow.

Potatoes—Methods of Cultivation.

In 1896, an experiment was conducted for the first time by planting potatoes in rows twenty-six and two-fifth inches apart, with the potato sets one foot apart in the row, and also by planting the sets thirty-three inches apart. Another feature in connection with the experiment was that part of the potatoes which where planted thirty-three inches apart were cultivated on the flat and part were hilled up. This experiment was conducted in duplicate on plots of exactly the same shape and size, each plot being 1/100 of an acre. The preparation of the soil was similar to that for the variety test of potatoes.

The following table gives the average results of the duplicate experiment conducted in 1896.

Distance between rows.	Distance between plants in the rows.	Kind of cultivation.	Percentage of crop unmarketable.	Yield of whole crop per acre.
				bus.
26 2-5 inches	12 inches	Flat	81.04	184.63
33 "	33 "	"	79.76	176.00
33 "	33 "	Hills	80.99	169.63

Exactly similar quantities of seed were used in the different plots of this experiment. It will be seen from the foregoing results that the drills which were 26 2-5 inches apart with the potatoes 12 inches apart in the drill gave the best average yield per acre, and also the greatest percentage of marketable potatoes from the whole crop. Plots which were left flat produced an average of over six bushels per acre more than the plots which were hilled. This is the first time that we have conducted an experiment in planting potatoes in hills as compared with flat cultivation, but from the results which we have obtained in planting roots and rape on flat and ridged soil, we are not at all surprised that the potatoes which were not hilled gave a larger yield than those which were hilled. This experiment will likely be repeated for several years.

Potatoes—Application of Fertilizers.

For five years in succession an experiment has been conducted by using thirteen different fertilizers with the potato crop. In 1892 and 1893 the potatoes were grown in the field to the south-east of the College building, and it was rather low in aspect. In 1894, 1895 and 1896 this experiment was conducted in the grounds which are now especially devoted to experimental work. This experiment has not been conducted on the same land for more than one season. The land where the experiments have been conducted during the last three years is more elevated than that which was used in 1892 and 1893.

Fertilizers.	Average percentage of crop marketable, 3 years.	Average weight of 30 best developed potatoes on each plot, 3 years.	Yield of whole crop per acre	
			1896	Average 5 years, 1892-3-4-5-6.
		lbs.	bus.	bus.
Royal Canadian	87.51	12.58	188.54	**162.40**
Potato Manure	86.63	11.83	166.88	**146.52**
Bone and Potash	87.12	12.67	186.67	**146.33**
Sure Growth	82.95	12.92	194.58	**146.10**
Superphosphate (animal)	85.55	12.25	177.50	**143.60**
Reliance	86.51	12.83	207.71	**142.87**
Superphosphate (mineral)	86.09	12.13	184.58	**141.61**
Muriate of Potash	89.01	12.55	193.54	**140.49**
Victor	87.07	12.59	204.58	**136.68**
Pure Bone Meal	82.54	12.25	176.25	**132.44**
Capelton	81.32	12.09	198.11	**130.38**
Wood Ashes	87.09	13.30	184.79	**130.33**
No Fertilizer	85.70	12.84	166.67	**121.69**
Nitrate of Soda	78.84	11.54	168.54	**117.12**

In 1896 the experiment was conducted in duplicate, the Irish Daisy variety of potatoes being used for one set and the Empire State variety for the other. There were, therefore, in all twenty-eight plots used for this experiment in 1896, as one plot was left unfertilized in each set for the purpose of comparison. The size of the plots used was 1/100 of an acre, and the potatoes were planted in rows three and a third links (26 2-5 inches) apart. There were three rows four rods long in each plot. One row was planted between each two plots and was left unfertilized, in order to keep the fertilized plots well separated. Fifteen pounds of potatoes were planted upon each plot on June the 19th. The potato sets were placed one foot apart in the drills. The fertilizers were sown broadcast on the land after the potatoes had been dropped but before they were covered. Nitrate of soda and muriate of potash were used at the rate of 160 pounds per acre, unleached ashes at the rate of 800 pounds per acre, and all the other fertilizers at the rate of 320 pounds per acre.

By examining the first column of figures to the left of the table it will be observed that the Muriate of Potash has produced the highest percentage of marketable potatoes in the average results of three years. The Royal Canadian fertilizer stands second in this respect, but the Nitrate of Soda has given very unsatisfactory results, as no less than 80 per cent. of the potatoes produced from the plots which received Nitrate of Soda were of sufficient size to be classed as marketable. A point in connection with the application of Nitrate of Soda, however, should be mentioned. It has been previously stated that all the fertilizers were applied at the time the potatoes were planted. As the Nitrate of Soda is a very soluble fertilizer, it is possible that a considerable amount of the fertilizer had become dissolved and had passed beyond the reach of the potatoes before they had developed a sufficient amount of roots to make use of the it.

In yield per acre in 1896 the "Reliance" and the "Victor" fertilizers gave the largest average yields per acre. These are two complete fertilizers which we obtained from the Province of Quebec. Special attention is directed to the column of figures at the right of the table, as this column presents the average yields per acre of the potatoes produced from the plots which received different fertilizers for five years in succession. On examination of this table, we find that the Royal Canadian fertilizer heads the list with an average of 162 4 bushels per acre. Royal Canadian is the name given to a complete fertilizer which was obtained from the same firm as the "Reliance" and the "Victor," and is sold at about $38 per ton. The second highest average yield per acre has been produced from the Potato Manure, which was obtained in Hamilton, Ontario. It will be seen that the Potato Manure, the Bone Potash, and the Sure Growth gave practically the same results. The Superphosphate manufactured from bones gave an average of two bushels per acre more than that manufactured from the mineral phosphate. The unfertilized land has given an average of 40.7 bushels per acre less than the Royal Canadian fertilizer in five years' experiments. The crop of potatoes was increased 98.8 per cent. in 1892, 57.1 per cent. in 1893, 17 per cent. in 1894, 8.8 per cent. in 1895, and 13 per cent. in 1896 by the application of 320 pounds of the Royal Canadian fertilizer.

Potatoes—Rural Trench System.

Potatoes have been grown in very large yields in some parts of the United States by what is known as the "Rural Trench System." By this method trenches are made from ten to twelve inches in width, and about a foot in depth, by completly removing the soil. The soil is then returned to the trenches from which it was removed, and the potatoes are planted in the soil thus returned. A test with this system in comparsion with our usual method of cultivation was made on duplicate plots in 1894, on triplicate plots in 1895, and on quadruplicate plots in 1896. Each trench was dug to a depth in of one foot, and was made ten inches in width. The trenches were made immediately before the potatoes were planted in each of the years mentioned. The rows were four rods long and three feet apart, and the potatoes were planted from four to six inches below the surface of the soil. In 1896 two plots received farm yard manure at the rate of twenty tons per acre, two plots received fertilizer at the rate of thousand pounds per acre, and two other plots a combination of farm-yard manure and fertilizer. The manure and fertilizer were mixed through the entire lot of soil, which had been removed from the trenches. Two plots of potatoes were left unfertilized, and the remaining plots were planted according to our ordinary method in planting our varieties. The potato fertilizer was used in two sets, and the Sure Growth fertilizer in the other two sets. The average of these four sets of experiments for 1896 is given in the following table, also the average results of the experiment conducted for the three years in succession.

Conditions.	Amount of fertilizer used per acre.	Percentage of seed that grew.	Yield of whole crop per acre.	
			1896.	Average 3 years 1894, 5 and 6.
			bus.	bus.
Farm-yard manure	20 tons	96.6	131.08	290.79
Ordinary method		96.6	135.90	283.58
Commercial fertilizer and manure	1,000 lbs. F. and 20 tons M.	86.7	99.92	265.85
Commercial fertilizer	1,000 lbs	98.1	134.06	254.55
No fertilizer		91.3	105 65	245.62

It will be seen in the preceding table that the potatoes planted according to our ordinary method gave the largest average yield per acre, and the potatoes which received the heaviest manuring gave the lowest yields in 1896. In the average results for three years in succession, the farm-yard manure with the trench system has given the largest yield per acre, and the rural trench system without the application of either manure or fertilizer has given the lowest yield per acre. Had the trenches for this experiment been dug in the autumn of the year in order that the frosts could have acted upon the soil the results might have been considerably different. From the results which have been already obtained, there appears to be but little advantage from the loosening of the soil as described in this experiment immediately before the potatoes are planted.

Potatoes—Treatment for Scab.

183 varieties of potatoes were grown upon new land in the summer of 1895. These varieties were all more or less affected with the scab. As can be seen by reference to the report of 1895, two varieties which possessed a very large amount of scab, and two varieties which possessed a small amount of scab, were selected to be treated in different ways in order to obtain some information regarding the comparative values of different methods of preventing injuries from the scab on the following crop. A quantity of each variety was taken and divided into four equal parts, one portion being treated with corrosive sublimate, another with flour of sulphur, another with Bordeaux mixture, and the other was left untreated. The methods by which the potatoes were treated with these applications were those which have been recommeded as the best for the purpose. The potatoes after being treated were planted in sixteen plots of land which had been under cultivation for a number of years. The potatoes were planted the same way as those in the variety experiment, in the first week in June. The following table gives the average results from the four methods of treatment of the potatoes.

Treatment for scab.	Amount of scab in crop produced.	Yield of potatoes per acre.
		bush.
Corrosive sublimate	68	149.4
Flour of sulphur	66	135.0
Untreated	100	126.9
Bordeaux mixture	85	123.8

There was only a small amount of scab on any of the potatoes which were grown in 1896. The potatoes grown in this experiment were all very carefully examined by two judges, and the result of their judgment is as indicated by the figures given in the centre column of the table. It will be seen that there was the largest amount of scab on the potatoes which were not treated, the amount of scab being represented by 100. The potatoes which were treated with the Bordeaux mixture had about 15 per cent. less scab than those which were untreated, and by the flour of sulphur and corrosive sublimate about one-third less scab than the untreated potatoes. It has been claimed that the treatment by the corrosive sublimate method has a tendency not only to reduce the amount of scab, but also to increase the yield of potatoes per acre, which has been the case this year in the experiment under consideration, as the potatoes treated with corrosive sublimate gave an average of over twenty bushels per acre more than those which were not treated. There was also about eight bushels per acre increase from the potatoes treated with the flour of sulphur as compared with those which were not treated. The flour of sulphur was thoroughly spread over the potatoes before they were planted. It will be remembered that the yield of potatoes was considerably increased by sprinkling lime or plaster on potato sets in the experiment, of which the results are given in a previous part of this report. It is possible that the flour of sulphur might have had a similar effect in slightly increasing the yield in this experiment. As this test has been conducted for only one year, the results should be received as only suggestive until it is repeated for several years in succession under varying conditions.

Swede Turnips—Comparative Test of Seventy-Four Varieties.

No less than seventy-four varieties of Swede turnips were grown in plots side by side in the experimental department in 1896. Twenty-nine of these varieties have now been tested for six years in succession, six for five years, eleven for four years, thirteen for three years, five for two years, and ten varieties were grown in 1896 for the first time. This experiment was conducted upon new land, which was plowed in the spring of 1894 for the first time. The stumps were completely removed from the land in the summer of 1895, and the land was cultivated in the summer and autumn of that year and in the spring of 1896. The turnips were sown on June the 16th and 17th, in rows three and a third links (26 2-5 inches) apart. The rows were four rods long and there were three rows of each variety. When the plants had reached a height of about two inches, they were thinned to a distance of ten inches apart in the rows. The yields per acre have been calculated from the actual yields of the plots.

In the following table it will be noticed that the yield of tops per acre, the average weight per root and the yield of roots per acre for each of the varieties are given for 1896, and also for the number of years in which the different varieties have been grown in the experimental department. The yield of roots per acre in 1896 is about the same as the average yield for the past six years. It will be observed that there is quite a variation in the amount of tops produced by Swede turnips of different varieties; for instance, the White Swede, the Highland Prize Purple Top and the White Sweet Russian varieties produced upwards of ten tons of tops per acre in 1896. In comparison with these it will be observed that the Budlong White and Dreer's Improved Purple Top produced less than five tons of tops per acre. There seems to be but little connection between the comparative yields of the tops and of the roots per acre. There were only three varieties of Swede turnips that produced average roots which weighed upwards of two pounds in 1896, these being the Improved Long Island, the Improved Purple Top Yellow and Sutton's Magnum Bonum. In yield of roots per acre it will be seen that the three varieties which produced the largest yields in 1896 were among six that were grown in our experimental grounds in 1896 for the first time. They were the Improved Purple Top Yellow, Sutton's Magnum Bonum and Lord Derby Green Top.

SWEDE TURNIPS—COMPARATIVE TEST OF 74 VARIETIES.

Varieties.	Results for 1896.			Average results for number of years grown.		
	Yields f tops per acre.	Average weigh per root.	Yield of roots per acre.	Yield of tops per acre.	Average weight per root.	Yield of roots per acre.
Grown for six years:	tons.	lbs.	tons.	tons.	lbs.	tons.
1 Hartley's Bronze Top	5.15	1.54	17.20	6.01	2.19	**20.69**
2 White Swede	11 15	1.64	18.25	7.36	2.15	**19.95**
3 Skirving's Swede	8.70	1.68	18.55	6.33	2.08	**19.46**
4 Carter's Imperial Hardy	9.20	1.83	18.30	6.57	2.13	**19.35**
5 P. W. & Go's. Imperial Prize Purple Top	7.65	1.51	16.50	6.48	2.17	**19.33**
6 Knowfield	7.50	1.78	19.90	5.70	2.08	**19.28**
7 Our Selected Purple Top	8 00	1.54	17.20	5.45	2.13	**19.24**
8 Carter's Prize Winner	7.70	1.60	17.75	6.19	2.04	**19.19**
9 Sharp's Improved	9.65	1.72	17.75	5.83	2.00	**19.13**
10 Westbury's Improved	6.50	1.90	19.45	6 37	2.11	**19.13**
11 Sutton's Champion	6.40	1.73	18.80	5.43	2.15	**19.03**
12 Hazard's Improved	6 55	1.74	16.70	5.53	2.17	**18.66**
13 Bangholm	7.50	1.68	16.25	6 23	2.08	**18.49**
14 Green Top	7 38	1.78	18.25	6.80	2 06	**18.42**
15 Marshall's Purple Top	6 95	1.45	14.50	5.71	2.14	**18.16**
16 East Lothian	8.80	1.77	17.20	6 09	2.03	**18.14**
17 Highland Prize Purple Top	11.40	1.40	14.50	7.06	1.98	**18.08**
18 Drummond's Imperial	5.50	1.51	16.05	5.67	2.00	**18.08**
19 Hall's Westbury	5.75	1.42	14 25	5.07	1.98	**18.06**
20 King of Swedes	6.75	1.71	16.55	5.87	2.01	**18.01**
21 Laing's Improved	6.75	1.49	15 00	5.96	1.88	**17.57**
22 Carter's Elephant	7.35	1.53	14.65	6.12	2.02	**17.42**
23 White Sweet Russian	10.85	1.81	19.40	7.13	1.85	**17.34**
24 Maston's Purple Top	7.35	1.59	15 05	5.79	1.91	**17.28**
25 Budlong White	4.85	1.51	16.30	4.33	1.76	**19.26**
26 Royal Norfolk Purple Top	7.70	1.66	17.25	5.36	1.92	**17.16**
27 Marquis of Lorne Purple Top	7 85	1.49	14.95	5.90	1.97	**17.15**
28 White Rock	7.40	1.57	16.75	5.27	1.80	**16.68**
29 Ashcroft's Purple Top	5.75	1.86	14.10	4.85	1.99	**15.40**
Grown for five years:						
30 Queen of Swedes	7.10	1.66	18.60	5.99	2.00	**19.86**
31 Laidlaw's Improved	7.25	1.75	20.80	5.95	1.93	**19.23**
32 Crimson King	6.95	1.58	16.25	6.14	1.99	**19.07**
33 Shamrock Swede	6.50	1.70	18.25	6.12	1.96	**18.98**
34 Rennie's Prize Purple Top	7.30	1.74	18.40	6.31	2.06	**18.80**
35 Aroostook Ruta Baga	7.10	1.54	17.10	6.16	1.75	**17.51**
Grown for four years:						
36 Kangaroo	7.50	1.84	18.9	6.72	2.19	**21.23**
37 Improved Long Island	6.90	2.18	23.9	5.89	2.06	**19.95**
38 Jarman's Improved King of the West Purple Top	7.70	1.88	19.90	6.79	2.08	**19.70**
39 N. B. & G. Co's. Prize Winner	6.65	1.75	18.00	6.45	2.07	**19.54**
40 Scottish Champion	6.85	1.79	19.90	6.59	1.95	**19.53**
41 Bloomsdale	7.75	1.64	17.30	6.74	1.93	**18.63**
42 Maule's Heavy Cropping	6.90	1.79	19.75	6.26	1.94	**18.60**
43 Jumbo or Monarch	6.80	1.61	16.55	6.62	1.99	**18.45**
44 Hurst's Monarch	6.45	1.47	15.10	6.20	1.94	**18.03**
45 Thorp's Improved Shipping	5.85	1.79	17.95	5.43	1.77	**16.95**
46 White French	7.75	1.57	16.90	7.12	1.74	**16.49**
Grown for three years:						
47 Buckbee's Giant	5.60	1.75	15.80	7.10	2.21	**20.59**
48 New American Yellow	6.90	1.62	16.65	6.12	2.00	**18.17**
49 Dreer's Improved Purple Top	4.70	1.72	17.50	4.75	1.85	**18.08**
50 Keith's Green Top	7.35	1.87	17.00	6.84	2.04	**17.92**

SWEDE TURNIPS—COMPARATIVE TEST OF 74 VARIETIES.—*Continued.*

Varieties.	Results for 1896.			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 three years:	tons.	lbs.	tons.	tons.	lbs.	tons.
51 Halewood's Bronze Top	5.60	1.40	13 35	5.56	1.85	**17.57**
52 Improved American Purple Top	6.60	1.86	18.50	6.33	1.95	**17.50**
53 Mammoth Russian	6.80	1.71	19.00	5.72	1.74	**17.25**
54 Crosse's Improved	6.60	1.54	15.45	7.37	1.79	**16.94**
55 Shirving's Liverpool	9.25	1.81	17.95	6 87	1.88	**16.84**
56 Burpee's Breadstone	6 50	1.61	16.85	5.57	1.69	**16.31**
57 Sweet German	10 15	1.75	18 60	5.54	1.50	**14.69**
58 American Breadstone	5.10	1.31	13.80	4.26	1.44	**13.13**
59 Burpee's Improved Purple Top	4.85	1.78	19.50	6.20	1.31	**12.98**
Grown for two years:						
60 White Giant Purple Top	7.70	1.83	19.95	6 87	1.71	**17.50**
61 Perfection Purple Top	6.90	1.92	20.03	5.97	1.73	**16.96**
62 Simmers' Champion Purple Top	6.25	1.74	17.70	6.15	1.67	**16.80**
63 Pearce's Standard	6.45	1.58	15.50	6.03	1.54	**15.14**
64 Mammoth Siberian	5.00	1 67	17.50	5.10	1.59	**14.98**
Grown for one year:						
65 Improved Purple Top Yellow	5.90	2.28	24.25	5.90	2.28	**24.25**
66 Sutton's Magnum Bonum	7.45	2.23	23.60	7.45	2.23	**23.60**
67 Lord Derby Green Top	6.25	2.00	22.25	6.22	2.00	**22.25**
68 Gloucester White Fleshed Green Top	8.50	1.83	21.95	8.50	1.83	**21.95**
69 Evans' New Ontario Purple Top	6.75	1.88	20.85	6 75	1.88	**20.85**
70 Mammoth Clyde Purple Top	6.85	1.88	20.35	6.85	1.88	**20.35**
71 Evans' Improved Monarch or Elephant	7.80	1.84	19.65	7.80	1.84	**19.65**
72 Shepherd's Golden Globe	6.50	1.75	19.20	6.50	1.75	**19.20**
73 Fettercairn Green Top	8.90	1.75	18.15	8.90	1.75	**18.15**
74 Waite's Eclipse Hybird	....	....	....	5.35	1.47	**9.58**

The reader's attention is specially directed to the column of figures at the right hand side of the table, as this gives the average yield of roots for the number of years that each variety has been grown in the experimental department. From this column it will be seen that the Hartley's Bronze Top heads the list with an average of 20.69 tons of roots per acre. As there have been twenty-nine varieties tested for that length of time, the Hartley's Bronze Top certainly occupies a very high place as a large yielder. A few varieties have given an average of only about three quarters as large a yield per acre as the Hartley's Bronze Top; and the varieties standing next to it have produced about three-quarters of a ton per acre less than the Hartley's Bronze Top in the average of six years.

SWEDE TURNIPS—THINNING PLANTS IN THE DRILL.

For five years in succession an experiment has been conducted in which Swede turnips have been thinned to four, eight, twelve, sixteen and twenty inches between the plants in the drills. The experiment has been conducted in duplicate in each of the five years. In 1896, as in each of the other years, the plots were 1/100 of an acre in size. The soil used for this experiment in the past season was plowed in the spring of

1894 for the first time, and has never received any manure. Slight ridges were made with a double mould board plow and the seed was sown on the 22nd of June. The plants were thinned when about two inches high, and were left at the distance required. The yields per acre have been calculated from the actual results of the plots.

Distance between roots in the drill.	Yield of tops per acre.		Average weight per root.		Yield of roots per acre.	
	1896.	Average 5 years.	1896.	Average 5 years.	1896.	Average 5 years.
	tons.	tons.	lbs.	lbs.	tons.	tons.
4 inches	6.58	....	.80	....	19.65	....
8 inches	5.60	5.44	1.48	1.49	19.85	18.31
12 inches	4.98	5.12	1.95	1.92	18.43	16.42
16 inches	4.35	4.20	2.45	2.41	17.70	16.08
20 inches	3.90	4.33	2.66	2.64	15.30	14.23

The preceding table gives the results of thinning Swede turnips at different distances in the drill for 1896, and also for the average of five years in which this experiment has been conducted. It will be seen that the largest yield of roots per acre was produced from the plants which were left eight inches apart in the drills, and the smallest yield per acre was from the plants which were twenty inches apart. As the distance between the plants in the drills was increased, the average weight per root was also increased, and the yield of roots per acre was decreased, with but a slight exception in regard to the yield per acre, the plants being left eight inches apart producing a little larger yield of roots per acre than those which were left four inches apart.

Swede Turnips—Different Distances Between the Drills.

Swede turnips have been sown in drills twenty, twenty-six, and thirty-two inches apart for five years in succession. An experiment has been conducted in duplicate during each of these five years. The plants have been thinned to a distance of ten inches apart in the row. The land on which this experiment was conducted was similar to that mentioned in the experiment with thinning plants in the drills. There were ten rows in each plot, the rows being four rods in length. The yields have been calculated from the actual yields of the plots.

Distance between drills.	Yields of tops per acre.		Average weight per root.		Yield of roots per acre.	
	1896.	Average 5 years.	1896.	Average 5 years.	1896.	Average 5 years.
	tont.	tons.	lbs.	lbs.	tons.	tons.
20 inches	5.51	5.37	1.69	1.54	23.96	18 31
26 inches	5.37	5.22	2.14	1.88	22.56	16.96
32 inches	5.88	5.10	2.39	2.07	21.43	15.73

In the average yield of roots per acre for the five years in which this experiment has been conducted, the drills situated twenty inches apart gave the best yield, those situated twenty-six inches apart the next, and those thirty-two inches apart the smallest yield of roots per acre. By having the rows twenty inches apart, about two and a half tons per acre were obtained as an increase over the yield produced from the drills thirty-two inches apart. It will be noticed that were the yield was the largest, the average size of the roots was the smallest, and where the average yield was the smallest, the average size of the roots was the largest. The results of this table should be considered in conjunction with those in the last table where the drills were the same distance apart, but there was a difference in the thinning of the plants in the drill.

Fall Turnips—Comparative Test of Forty-eight Varieties.

There were forty-eight varieties of fall turnips (which are also sometimes called soft turnips or white and yellow fleshed turnips) grown in the experimental department in 1896. These were grown on land similar to that described for the varieties of Swede turnips. The plots were 1/100 of an acre in size, each plot consisting of six rows two rods in length, the rows being three and a third links (26 2-5 inches) apart. The land was slightly ridged with a double mould-board plow. The seed was sown on June the 18th, immediately after the land was thoroughly cultivated. When the plants were about two inches high, they were thinned to a distance of ten inches apart in the drills. At the time of harvest, the roots were carefully counted and were weighed immediately after being pulled. The yields per acre have been calculated from the actual yields of the plots.

Fall Turnips—Comparative Test of Forty-eight Varieties.

Varieties.	Color of flesh.	Results for 1896.			Average results for number of years grown.		
		Yield of tops per acre.	Average per root.	Yi'ld of roots per acre.	Yield of tops per acre.	Average per root.	Yi'ld of roots per acre.
Grown for six years:		tons.	lbs.	tons.	tons.	lbs.	tons.
1 Jersey Navet	White..	9.30	2.09	23.60	6.85	2.51	**23.85**
2 Early American Purple Top	"	5.55	2.05	24.65	5.79	2.30	**23.11**
3 Purple Top Mammoth	"	9.40	2.35	26.00	7.03	2.42	**21.92**
4 Early Purple Top Munich	"	1.30	2.02	24.20	3.52	2.21	**21.80**
5 Greystone Improved	"	9.50	2.52	26.50	7.88	2.51	**21.69**
6 Pomeranian White Globe	"	11.00	2.04	23.50	8.28	2 21	**20.78**
7 Red Globe Norfolk	"	11.10	2.00	22.05	7.57	2.22	**20.68**
8 Red Top Strap Leaf	"	4.60	2.05	24.00	4.63	2.09	**20.06**
9 White Stone	"	5.00	1.91	22.50	4.75	2.13	**18.54**
10 Orange Jelly	Yellow.	5.15	1.41	15.40	4 53	1.80	**15.41**
11 Golden Ball	"	4.90	1.24	13.75	5.10	1.67	**14.02**
12 Yellow Aberdeen Purple Top	"	7.15	1.36	13.65	6.36	1.59	**13.80**
13 Yellow Aberdeen Green Top	"	6.00	.98	9.50	5.59	1.53	**12.12**
Grown for five years:							
14 Imperial Green Globe	White..	11.75	1.47	16.35	[illegible].48	1.71	**14.78**
15 Purple Top Hybrid	Yellow.	5.40	1.73	17.78	5.33	1.53	**12.67**
Grown for four years:							
16 Green Barrel	White..	6.45	2.16	23.85	6.60	2.12	**21.45**
17 Yellow Stone	Yellow.	6.50	2.28	26.15	4.97	2.12	**20.72**
18 White Flat Dutch Strap Leaf	White..	2.70	1.85	21.25	4.90	1.94	**20.47**
19 Sutton's Imperial Green Globe	"	6.98	2.43	26.45	5 50	2.03	**20.15**
20 Cow Horn	"	10.05	1.69	16.20	6.26	2.20	**19.64**
21 Jarman's Selected Green Globe	"	8.60	2.01	21.50	6.08	1.95	**19.47**
22 White Six-Weeks	"	6.10	2.29	26.20	6.15	1.94	**19.43**
23 Jersey Lily	"	7.05	2.27	25.20	7.58	2.18	**19.18**
24 Yellow Montgomery	Yellow.	5.75	1.68	19.35	7.18	1.85	**18.95**

FALL TURNIPS—COMPARATIVE TEST OF FORTY-EIGHT VARIETIES.—*Continued.*

Varieties.	Color of flesh.	Results for 1896.			Average results for number of years grown.		
		Yield of tops per acre.	Average per root.	Yi'ld of roots per acre.	Yield of tops per acre.	Average per root.	Yi'ld of roots per acre.
Grown for four years:		tons.	lbs.	tons.	tons.	lbs.	tons.
25 Extra Early Milan	White..	6.00	1.81	21.15	3.11	1.85	**18.73**
26 Early White Model	"	4.85	1.89	18.70	4.76	2.02	**18.23**
27 Jarman's Improved Green Top Scotch Yellow	Yellow.	8.00	1.25	12.85	6.91	1.87	**17.72**
28 Amber Globe	"	6.60	1.83	18.85	5.81	1.73	**15.10**
29 Dale's Hybrid	"	10.10	1.47	15.35	8.74	1.60	**14.23**
30 Early Maltese	"	3.45	1.62	15.25	3.87	1.49	**13.74**
31 Fosterton Hybrid	"	5.30	1.06	9.00	6.25	1.40	**12.50**
32 Carter's Champion Green Top Scotch or Aberdeen Hybrid	"	6.65	1.60	13.25	6.45	1.29	**11.19**
33 Seven Top	White..	14 75	1.41	14.00	8.79	.94	**9.12**
Grown for three years:							
34 White Egg	White..	7.10	2.68	30.00	7.73	2.89	**29.45**
35 Milk Globe	"	9.20	2.64	27.60	10.90	3.09	**24.10**
36 Early La Crosse	"	3.80	2.47	28.75	7.71	2.23	**23.30**
37 White Lily	"	10.20	2.31	23.75	8.35	2.32	**23.08**
38 All Gold	Yellow.	6.80	1.77	16.90	7.43	1.86	**16.73**
39 Orange Sweet	"	4.18	1.38	10.10	6.33	1.71	**13.35**
40 Small Berlin	White..	.03	.23	.55	.26	.28	**1.83**
Grown for two years:							
41 Red Top White Globe	White..	5.00	3.17	35.65	4.43	2.78	**29.83**
42 Yellow Globe	Yellow.	6.50	2.84	32.00	5.43	2.38	**25.19**
43 Our Selected White Globe	White..	6.55	1.84	16.10	8.42	2.10	**18.97**
Grown for one year:							
44 Long Tankard	....	13.00	2.08	22.25	13.00	2.08	**22.25**
45 Sutton's Favorite Purple Top Yellow Hybrid	....	6.00	1.84	20.10	6.00	1.84	**20 10**
46 Yellow Finland	....	3.70	1.68	19.25	3.70	1.68	**19.25**
47 Sutton's Perfection Green Top Hybrid	....	4.88	1.74	18.45	4.88	1.74	**18.45**
48 Waite's Eclipse Hybrid	....	9.00	1.68	16.50	9.00	1.68	**16.50**

The white varieties of fall turnips gave larger yields than the yellow varieties in nearly all cases. The Yellow Stone variety, however, which has been grown for four years in succession, has made a very good record, yielding 26.15 tons per acre in 1896, and an average of 20.72 tons in the experiments for four years. This is a higher record than several of the white-fleshed varieties grown for the same length of time. The highest record in the average of the experiments for six years has been made by the Jersey Navet variety. This, however, has been followed closely by the Early American Purple Top, there being a difference of about three-quarters of a ton per acre in favor of the Jersey Navet. Some of the new varieties are giving promising results. The largest yield per acre produced in 1896 was that of the Red Top White Globe which has been grown for only two years, and which gave over thirty-five tons per acre in 1896. The Imperial Green Globe, Sutton's Imperial Green Globe, and Jarman's Selected Green Globe are varieties which grow rapidly; and as they are quite round in shape and smooth in the skin, these varieties have been pronounced very suitable for early shipment to some of the American markets, where good prices are frequently paid for early turnips from Canada.

Fall Turnips—Thinning Plants in the Drills.

This experiment has been conducted for five years in succession, and consists in sowing fall turnips in drills of an equal distance apart, and after the plants are about two inches in height thinning to four, eight, twelve, sixteen, and twenty inches apart in the drills. The experiment has been conducted in duplicate in each of the five years. The land used for this test was plowed in the spring of 1894 for the first time, and has never received any farm-yard manure or commercial fertilizers. The plots were exactly 1/100 of an acre in size, there being three rows four rods in length in each plot. The seeding took place on the 22nd of June. The yields per acre have been calculated from the actual yields of the plots.

Distance between plants in the drill.	Yield of tops per acre.		Average weight per root.		Yield of roots per acre.	
	1896.	Average 5 years.	1896.	Average 5 years.	896.	Average 5 years.
	tons.	tons.	lbs.	lbs.	tons.	tons.
4 inches	7 98	7.76	1.05	1.04	27.00	24.50
8 "	5.45	6.87	1.76	1.85	23.61	23.74
12 "	4.80	6.54	2.39	2.62	22.85	22 58
16 "	5.28	6.46	3 07	3.28	22.83	21.98
20 "	5.20	6.05	3.59	3.61	21.65	19.83

As this experiment has now been conducted for five years in succession, some important data are presented in the above table. Not only is the yield of roots given for 1896 and for the average of the years in which this experiment has been conducted, but all the roots on each plot have been counted each year, and the average weight per root is given for each thinning in the experiment of 1896, and also for the five years of this experiment. It will be seen that the average root produced from the plants which were left four inches apart in the rows was 1.04 pounds. As the distance between the plants in the rows was increased to twenty inches, the average weight per root also gradually increased until it reached 3 61 pounds. The average yield per acre, however, runs in the opposite direction from the size of the roots, as the plants which were the closest together produced the largest yield, and those which were the widest apart in the drills produced the smallest average yield, the difference being nearly five tons per acre. The reader will observe the regularity that there is running through this experiment. The results go to show that both the size of the roots and the yield per acre can be regulated fairly well by the distances apart that the plants are allowed to remain on the land. If the farmer has plenty of land and a small amount of help, it might pay him best to grow the large roots, even should he obtain a small yield. If, however, he has a fair amount of help and wishes to crop his land heavily, he will obtain a larger yield of roots per acre and a larger percentage of dry matter, by having them closer together on the land, providing he keeps within the limits of this experiment.

Fall Turnips—Different Distances Between Drills.

An experiment in sowing fall turnips on drills twenty, twenty-six, and thirty-two inches apart, has been conducted for only three years, and not for five years in succession as in the case of a somewhat similar experiment conducted with Swede turnips. In 1896 the fall turnips for this experiment were sown on drills which were slightly ridged by means of a double mould-board plow. Seeding took place on June the 20th. The character of the soil and method of cultivation were similar to those described for the different varieties of fall turnips. When the plants were about two inches high they were thinned to a distance of ten inches apart in the drills. The yields per acre have been calculated from the actual yields of the plots.

Distance between drills.	Yield of tops per acre.		Average weight per root.		Yield of roots per acre.	
	1896.	Average for years 1894-5-6.	1896.	Average for years 1894-5-6.	1896.	Average for years 1894-5-6.
	tons.	tons.	lbs.	lbs.	tons.	tons.
20 inches.....	6.91	6.80	2.09	2.08	29.53	24.84
26 "	6.15	6.50	2.64	2.43	30.46	24.13
32 "	7.04	6.87	3.25	2.83	30.14	22.97

This experiment, which has been conducted in duplicate for three years in succession, shows that in drills twenty inches apart the average yield of roots was 24.84 tons; in drills twenty-six inches apart it was 24.13 tons; and in drills thirty-two inches apart it was 22.97 tons. The average weight per root was 2.08 pounds from the narrowest drills as compared with 2.83 from the widest drills. It will be observed that as the drills increased in width the average size of the individual roots increased, but the average yield of roots per acre decreased quite regularly.

MANGELS—COMPARATIVE TEST OF 58 VARIETIES.

Varieties.	Results for 1896.			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 six years:	tons.	lbs.	tons.	tons.	lbs.	tons.
1 Evans' Improved Mammoth Saw Log (long red)	1.60	1.40	16.60	4.40	2.28	**24.85**
2 Simmers' Improved Mammoth Long Red	1.90	1.73	20.10	4.06	2.16	**23.98**
3 Carter's Champion Yellow Intermediate	.90	1.56	16.65	3.10	2.16	**23.13**
4 Steele Bros. Long Red Selected	2.05	1.85	22.20	3.82	2.11	**23.03**
5 Elvetham Long Red	1.80	1.65	17.85	4.18	1.94	**22.47**
6 Norbitan Giant (long red)	1.80	1.59	18.60	3.87	2.07	**22.33**
7 Eiffel Tower (long red)	2.60	2.37	27.05	3.55	2.00	**21.59**
8 Yellow Obendorf (intermediate)	1.45	2.05	23.15	2.99	1.90	**21.49**
9 Carter' Mammoth Long Red	1.80	1.76	19.50	4.00	1.95	**21.13**
10 Colossal Long Red	2.15	1.93	22.50	3.34	1.89	**20.37**
11 May's Mammoth Long Red	2.53	1.73	20.30	3.90	1.80	**20.17**
12 Yellow Oval Shaped Giant	2.25	2.83	34.00	1.99	1.82	**20.07**
13 Giant Holstein (long red)	2.03	1.78	20.95	3.47	1.84	**20.06**
14 Mammoth Red Intermediate	1.13	1.89	16.40	2.89	1.86	**19.82**
15 New Monarch (long red)	1.80	1.55	18.25	3.24	1.74	**19.78**
16 Oblong Giant Yellow	1.80	2.19	26.00	2.37	1.82	**19.50**
17 Chirk Castle (long red)	2.88	1.71	19.50	3.11	1.71	**19.11**
18 Mammoth Golden Giant (yellow intermediate)..	2.40	2.29	26.80	2.72	1.64	**17.57**
19 Carter's Warden Orange (oval)	1.25	1.53	18.65	2.61	1.52	**16.90**
20 Red Globe	2.05	1.82	22.00	2.32	1.53	**16.32**
21 Yellow Globe..	.90	1.48	17.50	2.38	1.73	**15.63**
22 Golden Tankard	1.28	1.68	20.35	1.82	1.41	**15.43**
23 Clark's Devon Orange Globe	1.95	1.72	20.60	1.91	1.46	**15.38**
24 Kinver Yellow Globe............................	1.88	1.90	22.50	1.99	1.32	**14.08**
25 Long Yellow..	2.55	1.63	19.10	2.17	1.69	**13.99**
26 Fisher Hobbs' Orange Globe	1.45	1.28	15.15	1.84	1.35	**13.92**
27 Oblong Giant Red	1.65	1.53	17.60	1.78	1.70	**13.38**
Grown for five years:						
28 Sutton's Mammoth Long Red	2.25	1.80	20.75	3.11	1.53	**16.34**
29 Berkshire Prize Yellow Globe..................	1.30	2.06	23.50	1.50	1.41	**14.88**
30 Canadian Giant (long red)	2.15	1.75	19.90	2.73	1.37	**14.51**
31 Beck's Champion Globe (yellow)......	1.20	1.80	21.25	1.86	1.34	**14.81**
32 Gate Post (long red)................................	2.95	1.76	20.35	2.71	1.36	**14.01**
33 Sutton's Yellow Intermediate..................	1.10	1.85	21.40	1.44	1.27	**13.57**
34 Sutton's Golden Tankard	1.25	1.66	18.50	1.81	1.27	**13.32**

MANGELS—COMPARATIVE TEST OF 58 VARIETIES—*Continued.*

Varieties.	Results for 1896.			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 four years:						
35 Ward's Oval (yellow)	2.55	2.66	31.30	2.13	1.62	**18.06**
36 Giant Yellow Intermediate	1.90	2.07	23.75	2.37	1.67	**17.82**
37 New Eschendorf (yellow oval)	1.90	2.16	24.90	1.89	1.58	**17.07**
38 Yellow Leviathan (intermediate)	1.75	1.84	20.75	2.25	1.60	**16.90**
39 English Prize (long red)	2.40	1.94	22.67	2.76	1.55	**16.79**
40 Sutton's Yellow Globe	1.25	2.21	25.15	1.55	1.78	**16.50**
41 Jarman's Giant Intermediate (yellow)	1.25	2.65	28.25	1.22	1.56	**15.92**
42 Jarman's Giant Long Red	2.15	2.03	22.50	2.71	1.46	**15.50**
43 Yellow Ovoid	1.50	1.71	18.20	2.24	1.45	**15.16**
44 Olive Shaped Red	1.90	2.28	22.00	2.02	1.52	**15.15**
45 Jarman's Selected Golden Tankard	1.60	2.51	25.65	1.65	1.69	**14.93**
46 Jarman's Model Yellow Globe	1.15	1.92	20.95	1.53	1.40	**13.28**
Grown for three years:						
47 Thorp's Own Yard Long	2.25	2.03	23.80	3.54	1.80	**19.59**
48 Jumbo (long red)	1.50	1.79	20.00	2.37	1.66	**17.58**
49 Carter's Warden Prize Yellow Globe	1.15	1.99	23.10	1.74	1.58	**17.07**
50 Dignity (long red)	2.60	1.84	21.40	2.97	1 57	**16.99**
51 Thorp's Own Champion Yellow Intermediate	1.25	1.91	21.75	1.68	1.57	**16.50**
52 Webb's New Kinver Yellow Globe	1.00	1.80	20.75	1.15	1.43	**15.71**
Grown for two years:						
53 Long White	2.15	2.31	27.50	2.64	1.79	**20.72**
54 Effurt Model (yellow intermediate)	1.00	2.09	23.25	1.90	1.70	**19.13**
Grown for one year:						
55 Surprise (long red)	1.90	2.09	23.00	1.90	2.09	**23.00**
56 Sutton's Crimson Tankard (red)	1.15	1.72	18.50	1.15	1.72	**18.50**
57 Cornish Giant Yellow Globe	.85	1.36	17.50	.85	1.36	**17.50**
58 Red Tankard	.80	1.40	14.85	.80	1.40	**14.85**

Four varieties of mangels were added to the list in 1896, making a total of fifty-eight varieties which have been grown in the experimental department in the past year. As thirty-four of these varieties have been grown for five or six years in succession, the results are becoming useful as a basis of comparing the relative value of the different varieties of mangels in regard to their yield of roots per acre. The land in which the mangel seed was sown was situated in the western part of the experimental grounds. The soil was rather low lying, and it received a dressing of twenty tons of farmyard manure per acre in the spring of 1896.

The plots used for the mangels were 1/100 of an acre in size in every instance. Each plot consisted of three drills three-and-a-third links (26 2-5 inches) apart, and four rods in length. We sowed one drill of each variety on April the 30th, and two drills of each variety on May the first, thus making the dates of seeding for all the varieties exactly uniform. The germination of the seed was very good, and there was no frost to interfere with the young plants as in 1895. When the plants were two or three inches high they were thinned to a distance of ten inches apart in the drills.

There were in all over twenty strains of the long red varieties of mangels. Some people may wonder why such a large number of varieties or strains of the same variety have been tested in our experimental grounds. The varieties enumerated in the above list have all been made prominent by seedsmen and others and are offered to the general public for sale. We consider it a matter of importance to test thoroughly all the different kinds of farm crops which are offered for sale to the farmers of Ontario, in order that a guide can be placed before them regarding the comparative values of the roots which are offered under different names.

The Evans' Improved Mammoth Saw Log mangel occupies first place in average yield per acre among the twenty-seven varieties which have been grown for six years in succession. This variety has given an average of nearly one ton per acre more than the Simmers' Mammoth Long Red, which comes next to it in yield of roots per acre. The latter variety, however, gave the largest yield per acre in the crop of 1896. It will be noticed by looking over the reports for mangels of the past six years that there is quite a variation in the comparative results of the different varieties from year to year. There seems to be about as little stability in the comparative yield of mangels one year with another as in the case of any class of farm crops. The Carter's Champion Yellow Intermediate has made an excellent record in most of the years in which it has been grown, but it will be observed that a large number of other varieties have surpassed it in yield per acre in 1896. It will, however, be observed that in the average yield per acre for six years it occupies a higher place than a large number of the long red varieties, even though it is a yellow intermediate mangel.

Mangels—Thinning Plants in the Drills.

For five years in succession, mangels have been sown in drills of equal distances apart; and the plants have been thinned when two or three inches high, to four, eight, twelve, sixteen, and twenty inches apart in the drills. In 1895, however, the severe frosts which occured about the middle of May, so injured the crop of that season that the results were not recorded. In 1896 an experiment was made in duplicate on land which had produced a grain crop in 1895. The drills were exactly 1/100 of an acre in size, there being six rows three-and-a-third links (twenty-six two fifth inches) apart and two rods long in each plot. The land was manured at the rate of twenty tons of farmyard manure per acre in the spring of 1896, before the mangels were sown. The seeding took place on the 9th of May, and the germination was quite satisfactory. The plants were divided to their respective distances when from two to three inches in height.

Distance between roots in drills.	Yield of tops per acre.		Average weight per root.		Yield of roots per acre.	
	1896.	Average 4 years, 1892, 3, 4, 6.	1896.	Average years, 1892, 3, 4, 6.	1896.	Average 4 years, 1892, 3, 4, 6.
	tons.	tons.	lbs.	lbs.	tons.	tons.
4 inches	8.06	....	1.41	....	40.18	....
8 inches	5.24	5.83	2.53	1.83	36.91	27.23
12 inches	4.88	5.16	3.89	2.50	37.68	26.03
16 inches	4.25	4.75	4.85	3.03	35.39	24.14
20 inches	3.53	4.16	5.72	3.45	32.05	22.07

We have presented in the foregoing table the results of this experiment for 1896, and also the average results of the experiment for 1892, 1893, 1894 and 1896. As the results from the mangels which were thinned to four inches apart in the drills was missed in one year, the average results from this part of the experiment is not inserted. In 1896, the largest yield per acre was produced from plants which were thinned to a distance of only four inches, the yield being 40.18 tons, while from the plants which were thinned to twenty inches apart, the yield was about eight tons less. The yield from the roots left twelve inches apart in the drill was a little larger than that from the plants left eight inches apart in the drill in 1896, but in the average of four years the yield from the latter was larger than that from the former by one and a fifth tons per acre.

Mangels—Different Distances Between Drills.

An experiment has been conducted in duplicate in each of the last five years by sowing the mangels on drills twenty, twenty-six and thirty-two inches apart. In 1896 the mangel seed was sown on May 11th, and the plants were thinned to ten inches apart when they were two or three inches in height. The yields per acre have been estimated from the actual results of the plots.

Distance between drills.	Yield of tops per acre.		Average weight per root.		Yield of roots per acre.	
	1896.	Average 5 years.	1896.	Average 5 years.	1896.	Average 5 years.
20 inches............. ...	2.61	3.55	1.69	1.71	21.42	20.63
26 inches...........	2.09	3.55	2.22	2.03	20.87	19.12
32 inches.................	2.10	3.66	2.31	2.38	18.22	18.13

The average yield of roots per acre and the average weight of the individual roots in 1896 from the plots twenty, twenty-six and thirty-two inches apart are in the same comparative order as the average yields, and the average weight of the individual roots for the five years that this experiment has been conducted. The drills which were thirty-two inches apart grew roots which averaged two-thirds of a pound more than those which were grown on the drills twenty inches apart, but the average yields per acre of whole crop was 2.75 tons more from the latter than from the former.

Carrots—Comparative Tests of 45 Varieties.

The average yield of carrots per acre in 1896 was about equal to the average of the varieties grown for five years in succession.

The same number of varieties of carrots were grown in the experimental department in 1896 as in 1895. Although four varieties were grown during the past summer for the first time on the experimental plots, still four of the varieties which were reported upon in 1895 have been dropped from the list. The plots on which the carrots were grown were ten links wide by one hundred links long, making each plot 1/100 of an acre in size. The seed was sown on drills three and a third links (26 2/5 inches) apart. The seeding took place on May the 8th and the germination was quite satisfactory. When the plants were about three inches in height they were thinned to an average of about four inches apart in the rows. The thinning was done very carefully, the number of roots being counted in every instance. The yields per acre have been determined from the actual results of the plots.

CARROTS—COMPARATIVE TESTS OF 45 VARIETIES.

No.	Varieties.	Results for 1896. Yield of tops per acre.	Results for 1896. Average weight per root.	Results for 1896. Yield of roots per acre.	Average results for number of years grown. Yield of tops per acre.	Average results for number of years grown. Average weight per acre.	Average results for number of years grown. Yield of roots per acre.
		tons.	ozs.	tons.	tons.	ozs.	tons.
	Grown for five years:						
1	Pearce's Improved Half-long (white)	4.85	17.76	28.75	7.23	15.61	**29.34**
2	Steele Bros.' Improved Short (white)	5.90	16.93	29.00	7.40	15.47	**28.79**
3	Mastadon (white intermediate)	4.35	16.89	27.50	6.18	14.43	**27.02**
4	White Green Top Orthe (intermediate)	4.15	13.21	22.25	6.33	14.24	**26.22**
5	Large White Vosges (intermediate)	4.50	14.87	26.40	5.79	13.68	**26.13**
6	Simmers' Short White Vosges	3.80	14.89	24.90	5.31	13.10	**24.52**
7	Sutton's Yellow Intermediate	4.35	13.38	23.50	5.74	12.67	**23.31**
8	Large White Belgian (intermediate)	3.75	16.77	20.65	5.62	12.71	**22.11**
9	Danver's Orange (short red)	3.40	11.81	19.75	4.04	10.59	**21.13**
10	Giant Wiltshire (long white)	4.55	13.78	22.30	6.33	11.08	**21.10**
11	Mitchell's Perfected (red intermediate)	3.60	11.81	20.00	3.74	10.54	**19.94**
12	Guerande (short red)	2.80	10.98	20.25	3.25	8.82	**19.90**
13	Carter's Orange Giant (long)	3.75	10.61	15.25	4.17	11.92	**18.07**
14	French Intermediate	2.70	8.76	14.20	4.04	8.32	**17.32**
15	Half Long, stump rooted (red)	2.75	9.71	17.60	2.65	8.32	**17.26**
16	James' Scarlet Itermediate	2.80	8.83	16.00	3.27	8.03	**16.26**
17	Sutton's Improved Intermediate (red)	2.65	9.59	16.90	2.88	7.73	**15.00**
18	Long Red Surrey	4.20	8.57	14.20	4.10	7.99	**14.82**
19	Yellow Belgian (long)	3.05	9.20	13.00	4.28	8.46	**14.54**
20	Long Orange	3.90	7.97	12.65	5.40	7.35	**13.77**
21	Improved large long Red Altringham	2.00	7.35	10.20	3.76	7.01	**12.42**
	Grown for four years:						
22	Nichol's Improved Large Orange	3.55	9.88	18.80	3.71	9.22	**17.34**
23	Rubicon Half Long (red)	2.44	11.25	18.50	3.21	9.29	**17.32**
24	Chantenay (short red)	2.40	10.45	18.15	2.60	9.55	**16.36**
25	Nante's Half Long Stump-rooted (red)	1.85	8.48	16.85	2.85	8.65	**16.16**
26	Half Long Scarlet	3.30	8.36	16.85	3.24	7.72	**15.95**
27	Long Red St. Valley	1.90	10.40	12.40	3.06	9.28	**15.75**
28	Red Parisian Forcing (short)	1.60	8.30	15.30	1.87	6.88	**13.90**
29	New Long Red Coreless	1.00	4.73	7.50	1.97	5.99	**11.41**
30	Small French Forcing (short red)	1.25	6.90	9.70	1.42	5.95	**10.30**
31	Jarman's Selected Green Top (long red)	3.80	13.26	15.00	2.29	12.29	**8.92**
	Grown for three years:						
32	Mammoth Intermediate Smooth (white)	4.70	17.25	29.00	5.40	16.99	**27.60**
33	Iverson's Champion White (intermediate)	6.30	13.87	25.75	6.22	16.18	**25.68**
34	Improved White Belgian (long)	4.60	13.26	20.55	4.65	12.65	**21.25**
35	Yellow Intermediate	4.15	12.74	21.65	6.40	14.09	**20.30**
36	Midsummer (short red)	1.60	8.08	13.00	2.49	9.58	**16.85**
37	Victoria (long red)	2.85	9.33	16.45	3.34	9.22	**16.35**
38	Yellow Giant	3.00	9.93	16.45	3.63	10.38	**16.15**
39	Early Half Long Carentian	1.15	5.07	9.35	1.30	5.66	**10.74**
	Grown for two years:						
40	Thorp's Own Short White	5.00	13.19	22.25	3.85	11.39	**19.77**
41	Henderson's Intermediate (red)	3.80	10.03	18.25	3.78	10.08	**17.20**
	Grown for one year						
42	Intermediate Red	5.00	10.81	19.50	5.00	10.81	**19.50**
43	California Mammoth Orange	4.80	10.27	17.75	4.80	10.27	**17.75**
44	New Vallery (long red)	4.50	10.29	16.95	4.50	10.29	**16.95**
45	Carter's Gate Post Orange (long)	4.75	20.42	15.25	4.75	20.42	**15.25**

It will be observed that twenty-one varieties of carrots have been grown for five years in succession, and both the yield of roots per acre, the yield of tops, and the average weight per root are given in the foregoing table, not only for 1896, but also for the average of the five years. When the yield per acre is given and also the average weight per root, very definite information is secured. As stated before, the roots are counted very carefully at the time of thinning, and they are again counted later in the season, after the plants have become larger and the surplus roots are removed. All the roots of every variety are again counted at the time of harvesting, and the average weight per root as given in the table is obtained by dividing the total weight of the roots of each variety by the actual number grown upon the plots. There are a number of intermediate white carrots, very similar in all general characteristics and which have given good satisfaction. There is, however, some difference in the yielding power of these crops, which are somewhat similar in general appearance. It will be seen that the Pearce's Improved Half Long White heads the list in yield per acre in the average of five years' experiments. This variety is followed by seven other intermediate carrots, under different names and which present a variation in yield of over seven tons per acre. The largest yields per acre in 1896 were produced by Steele Brothers' Improved Short White, Mammoth Intermediate Smooth, and Pearce's Improved Half Long White.

Carrots—Thinning Plants in the Drill.

For five years in succession an experiment was started by thinning carrots to distances of two, four, six, eight and ten inches apart in the drill. Owing to the severe frosts, however, and the very unfavorable weather in the early part of May, 1895, this experiment was ruined for that season. We, therefore, have the results for only four years. In 1896 the experiment was conducted on rather low-lying land, situated in the western portion of the experimental grounds. This land produced a crop of grain in 1895 and was manured at the rate of twenty tons of farm-yard manure per acre in the spring of 1896. Slight ridges were made with a double mould-board plow and the carrot seed was sown on May the 9th. The plots were exactly 1/100 of an acre in size, there being six drills, each two rods in length, in each plot. The experiment was conducted in duplicate in 1896 as in each of the years previously.

Distance between plants in the drills.	Yield of tops per acre.		Average weight per root.		Yield of roots per acre.	
	1896.	Average 4 years.	1896.	Average 4 years.	1896.	Average 4 years.
	tons.	tons.	lbs.	lbs.	tons.	tons.
2 inches	8.03	7.78	.57	.62	33.03	28.20
4 inches	6.83	6.76	1.04	.91	28.93	25.59
6 inches	4.45	5.51	1.65	1.21	22.78	21.82
8 inches	4.95	5.12	1.67	1.37	23.81	20.37
10 inches	4.31	....	1.93	....	21.40	....

The plants left closest together in the drill have given the best average yield per acre for 1896, and also in the average results of four years, during which time this experiment has been conducted. The plants which were left six inches apart in the drill produced roots double the size of those which were left only two inches apart, but the yield was nearly six and a half tons per acre less.

Carrots—Different Distances Between Drills.

This experiment was conducted in duplicate in 1896, as in each of the past five years. The seeding of the past season took place on May the 11th and the plants were very carefully thinned to a distance of four inches apart when from two to three inches in height. There were ten drills used in each plot.

Distance between drills.	Yield of tops per acre.		Average weight per root.		Yield of roots per acre.	
	1896.	Average 5 years.	1896.	Average 5 years.	1896.	Average 5 years.
	tons.	tons.	lbs.	lbs.	tons.	tons.
20 inches	3.90	5.96	.80	.77	23.74	27.73
26 inches	3.99	5.81	.97	.91	21.31	26.05
32 inches	4.22	5.32	1.10	.97	20.32	22.28

It will be seen that there is a difference of about five and a half tons per acre in favor of the close drills in the average yield per acre for five years. The results are fairly uniform throughout and should be considered along with those of the previous experiment, in which carrots were thinned to different distances apart in the drill.

Sugar Beets—Comparative Test of 13 Varieties.

Inquiries are frequently received from farmers throughout Ontario regarding sugar beets as food for stock. As there are several varieties on the market, it was thought advisable to give the different varieties which are offered for sale a careful test in our trial grounds, to find out which kinds are likely to give the best satisfaction for field cultivation. Nine varieties have now been grown for five years in succession, three for three years, and one for two years. The soil on which this experiment was conducted in 1896 was quite similar to that described for the experiment with the varieties of mangels. Three rows, each four rods long, were devoted to each variety. The rows were three and a third links (26 2/5 inches apart) apart, and the plants were thinned to ten inches apart in the rows. The seeding took place on May the 2nd.

Varieties.	Color of roots.	Results for 1896.			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 five years:		tons.	lbs.	tons.	tons.	lbs.	tons.
1. White Silesian	White	2.15	1.44	17.25	4.77	1.52	**17.83**
2. Red Top	Reddish	1.75	1.52	18.50	3.63	1.50	**17.67**
3. Lane's Improved	White	2.00	1.30	19.20	2.55	1.38	**17.23**
4. Champion	Reddish	1.15	1.70	20.50	3.42	1.36	**15.92**
5. White French	White	1.90	1.22	14.35	3.88	1.39	**15.90**
6. Austria Electorial Wohanka	"	1.95	1.40	16.50	4.49	1.31	**15.62**
7. Kleinwanzelben	"	1.75	1.22	14.20	4.41	1.22	**14.05**
8. Red Skinned	Reddish	1.50	1.36	16.00	2.90	1.13	**13.14**
9. Improved Imperial	White	2.25	1.34	15.85	3.43	1.66	**11.63**
Grown for three years:							
10. Jersey	Reddish	.50	1.33	16.00	3.00	1.40	**18.09**
11. New Danish Island	"	1.00	1.40	16.50	2.29	1.45	**17.99**
12. French Yellow	Yellowish	1.50	1.31	16.00	2.82	1.25	**16.00**
Grown for one year:							
13. Green Top White	White	3.25	1.42	16.45	3.30	1.31	**15.23**

Although the White Silesian was surpassed in yield of roots per acre in 1896 by three other varieties, still, in the average of five years' experiments, it still occupies head place with an average of 17.83 tons per acre. This variety, however, is followed closely by the Red Top, which produced an average of only about one-sixth of a ton per acre less than the White Silesian; and the Lane's Improved does not come far below the Red Top in the yield of roots. In 1896 the White Silesian sugar beet was sent out with four varieties of mangels for a comparative test over Ontario, in connection with the co-operative experimental work, and in the average results of thirteen carefully conducted experiments, it was surpassed in yield per acre by each of the varieties of mangels, two of which were long red varieties, one yellow intermediate variety, and the other a yellow globe variety.

Parsnips—Comparative Test of 4 Varieties.

Four varieties of parsnips have now been tested for two years in succession. The growing of parsnips as a field crop in our experimental work has also resulted from several inquiries which have been made regarding the comparative yield of parsnips along with other roots as a food for live stock. The soil on which the parsnips were grown was quite similar in every respect to that used for the mangels and sugar beets. The seeding took place on May the 2nd. The plots were 1/100 of an acre in size, and there were three rows, four rods long, in each plot. When the plants were about three inches in height, they were thinned to a distance of ten inches apart in the drill.

Varieties.	Yield of tops per acre.		Average weight per root.		Yield of roots per acre.	
	1896.	Average 2 years.	1896.	Average 2 years.	1896.	Average 2 years.
	tons.	tons.	lbs.	lbs.	tons.	tons.
1. Improved Half Long	3.30	3.08	1.12	.84	12.50	12.84
2. Improved Long Smooth	2.60	2.93	.82	.69	9.70	11.44
3. New Ideal Hollow Crown	2.75	2.73	1.01	.74	11.00	11.00
4. Magnum Bonum	2.85	2.53	.99	.71	10.50	9.93

Although the yield of the Improved Half Long and the Improved Long Smooth were quite similar in 1895, there was quite a variation in the results of these two varieties in the experiment of the past year. In the two years' experiments it will be seen that the Improved Half Long heads the list with an average yield of 12.84 tons of roots per acre. This is nearly three tons per acre more than the quantity produced by the Magnum Bonum variety, which came at the bottom of the list.

Mangels and Carrots—Selection of Seed.

An experiment was carefully conducted in 1896 for the purpose of ascertaining the relative value of seeds of different sizes taken from ordinary stocks as sold by leading seedsmen. Large plump seed, medium-sized seed, and small-sized seed were selected of both mangels and carrots. Four plots were used with each selection of each class of roots, thus making in all twenty-four plots in this experiment. In selecting the seed, great care was taken to use nothing but seed which was apparently sound in every respect, but of different sizes. The seeding took place in the second week of May.

Selection.	Yield of roots per acre.		
	Mangels.	Carrots.	Average of mangels and carrots.
	tons.	tons.	tons.
Large plump seed	59.29	30.51	44.90
Medium-sized seed	49.77	22.32	36.05
Small-sized seed	30.83	11.21	21.02

The results of the foregoing table are certainly very suggestive of the value of the different samples of seed of both mangels and carrots. The results of course have been influenced to a certain extent by the difference in the germination of the seed composing the different selections. In two sets of the experiment with each class of roots, five seeds were placed in the soil wherever a root was desired; and in the other two sets of the experiment with each class of roots, one seed was placed in the soil wherever a root was desired. In the case of the small size seeds, but very little thinning could be done; but on the plots that had received large plump seed, there were several plants to be removed, wherever five seeds had been placed. The results, therefore, given in the above table do not show a comparison quite so striking as it should be from the different selections made. These results certainly point to the importance of sowing good seed of both mangels and carrots, even should it be necessary to sift the seed after it is bought.

Swede Turnips and Fall Turnips—Different Depths of Planting.

An experiment was conducted in 1895 by planting the seed of Swede turnips one inch, two inches, three inches, and four inches deep in the soil. A similar experiment was conducted in 1896, with both Swede turnips and fall turnips. The land used for this experiment in 1896 was considerably elevated, and was in a good state of fertility, being what might be termed a good average clay loam. The seed was placed in the soil with great care. The yields per acre have been determined from the actual results of the plots.

Depth of planting seed.	Yield of roots per acre.			
	Swede turnips.		Fall turnips.	Average results for two years.
	1895	1896.	1896.	1895-6.
	tons.	tons.	tons.	tons.
1 inch deep	10.7	25.5	27.8	21.3
2 inches deep	9.9	22.3	30.2	20.8
3 inches deep	4.5	5.5	18.8	9.6
4 inches deep	1.7	2.5	2.1	2.1

It will be seen that the seed which was planted one inch deep gave the best results in yield of Swede turnips per acre in both 1895 and 1896. The seed which was planted two inches deep, however, gave the best results with the fall turnips in the experiment of the past season. The yield from the seed which was placed in the ground three inches below the level, gave comparatively low results, and that which was placed four inches below the level gave almost no results at all.

Swede Turnips and Fall Turnips.—Thinning Different Sized Plants.

An experiment was conducted in 1896 for the first time in thinning Swede turnips and fall turnips when the plants were about one-and-a-half to two inches in height, as compared with thinning the plants when they had reached an average of eight to ten inches in height. It may be said by some that turnips are never allowed to reach eight or ten inches in height before they are thinned; but the writer has on several occasions seen turnips thinned when they had reached fully that height. When turnip plants are rather thick in the drills, they run up very rapidly, and reach the height mentioned before the fact is realized. This experiment was conducted on new land in the past season. The seeding took place on the 23rd of June. The plots were 1/100 of an acre in size, and the test was made in duplicate. The plants when thinned were allowed to remain eight inches apart in the drill. The following table gives the average results for this experiment.

Height of plants when thinned.	Yield of roots per acre.		
	Swede turnips.	Fall turnips.	Average for both classes of roots.
	tons.	tons.	tons.
Plants thinned when $1\frac{1}{2}$ to 2 inches high......	21.10	32.05	26.58
Plants thinned when 8 to 10 inches high.......	16.35	17.95	17.15

It will be seen from the foregoing table that the Swede turnip plants which were thinned when young gave about five tons per acre more than those which were thinned at a later stage. The difference is even more marked in the case of the fall turnips, as the plants thinned when young gave nearly double the yield per acre as compared with those which were allowed to grow for some time before thinning.

Swede Turnips, Fall Turnips, and Mangels—Grown on the Flat and on Ridges

In 1896 an experiment was conducted with Swede turnips, fall turnips and mangels by sowing the seed of each class on flat rows and also on ridges made with a double mould-board plow. The experiment was conducted in duplicate, thus making twelve plots used for this experiment in the one year. The mangels were sown on May the 12th and the turnips on June the 23rd. The rows were three-and-a-third links (26 2.5 inches) apart. The cultivation was similar for the different plots throughout. The yields per acre of the duplicate plots were averaged, and the yields per acre have been calculated from the actual yields of the plots

Method of culti-tion.	Average weight per root.				Average yield per acre.			
	Swede turnips.	Fall turnips.	Mangels.	Average of 3 classes of roots.	Swede turnips.	Fall turnips.	Mangels.	Average of 3 classes of roots.
	lbs.	lbs.	lbs.	lbs.	tons.	tons.	tons.	tons.
Flat cultivation..	4.11	2.27	3.08	3.15	17.90	24.96	24.41	22.42
Ridged " ..	3.84	2.29	2.99	3.04	16.53	24.58	22.80	21.30

It will be noticed that in every instance the roots which were sown on the level gave a larger average yield per acre than those which were sown on the ridges. The greatest difference was in the case of the mangels and the least in the case of the fall turnips. There was a little over one ton of roots per acre more from the seed which was sown on the level than from that which was sown on the ridges in the average of the whole experiment in 1896.

Swede Turnips and Fall Turnips—Application of Fertilizers.

Duplicate experiments were conducted in 1896 in using commercial fertilizers with Swede turnips and fall turnips. The fertilizers used in this experiment were nitrate of soda, muriate of potash, superphosphate, mixture and land plaster. There was one plot in each set of the experiment which was left without any fertilizer, as a basis of comparison. One hundred and sixty pounds of nitrate of soda and also of muriate of potash were used per acre, and 300 pounds of superphosphate. The mixture was composed of these three fertilizers, one-third of the above quantity of each being used. Four hundred pounds of salt and 400 pounds of land plaster per acre were applied in this experiment. The test was conducted on land which had not received any manure for four years, and which had produced a crop of roots in 1895. The land was slightly ridged with a double mould-board plow, and the fertilizers were applied on the drills before the seed was sown. The seeding of both the

Swede and the fall turnips took place on the 25th of June. One row was left unfertilized between each two plots. The plants were thinned to ten inches apart in the drills. The yields per acre have been calculated from the actual yields of the plots.

Fertilizers.	Average weight per root.			Yield of roots per acre.		
	Swede turnips.	Fall turnips.	Average.	Swede turnips.	Fall turnips.	Average.
	lbs.	lbs.	lbs.	tons.	tons.	tons.
Nitrate of soda	2.00	2.56	2.28	21.25	29.90	25.58
Salt	1.79	2.29	2.04	20.73	27.05	23.89
Muriate of potash	1.86	2.38	2.12	19.50	27.50	23.50
Mixture	1.74	2.22	1.98	19.60	26.60	23.10
Superphosphate	1.65	2.27	1.96	18.48	25.40	21.94
Land plaster	1.55	2.04	1.80	17.55	24.23	20.89
No fertilizer	1 57	2.00	1.79	18.15	23.35	20.75

It will be seen on examination of the above table that the nitrate of soda gave the largest average yield of roots per acre, both of the Swede turnips and the fall turnips. The comparative results of the different fertilizers are fairly uniform throughout for the two classes of roots. This experiment will likely be repeated for several years in succession.

SILAGE AND FORAGE CROPS.

Several experiments have been made with corn, millet, rape, sunflowers, grasses, clovers, sugar cane, etc., within the past two years. These crops are receiving more and more attention by the farmers of Ontario, and especially by those who are raising or handling a number of farm animals. We have conducted some very interesting experiments with several of the classes of crops under this heading, which should give valuable information regarding the comparative value of the different classes of crops, of different varieties in the same classes, and of methods of cultivation, selection of seed, etc., of the same varieties.

Corn for Fodder, Silage and Grain—Comparative Test of 136 Varieties.

One-hundred-and-thirty-six varieties of corn have been grown in the experimental department in 1896. Of this number, fifty-three have been grown for six years, seven for five years, fifteen for four years, twenty-six for three years, twenty-five for two years, and ten grown in 1896 for the first time. These varieties have been obtained from the United States and Canada, and include a number of varieties which are offered for sale as seed in the Northern States and the Dominion of Canada. It will be seen by refering to Bulletin 59 issued by the Ontario Bureau of Industries, that nearly five hundred thousand acres of land were devoted to the growing of corn in 1896. The corn crop, therefore, is becoming an important one in this Province. Great care, therefore, should be taken by those who wish to grow corn for either grain or dry fodder or silage, to select the varieties which are likely to give the best satisfaction in the locality in which they are grown. A farmer living in any part of Ontario should be enabled to glean some very valuable information from the results of the experiments which are here recorded. The land on which the different varieties of corn were grown in 1896 produced a crop of roots in 1895, and was sod the previous year. No manure was applied to the land before either the roots or the corn. All the varieties were grown on duplicate plots in 1896. The corn was planted in hills five links (39.6 inches) apart both ways. Four plants were allowed to remain in each hill. The first set of varieties were harvested about the middle of September, and the last set about one week later. The green corn was weighed immediately on being cut. It was then husked and the weight of ears was immediately taken. Planting of all the varieties took place on May the 20th. The yields per acre have been calculated from the actual results of the plots.

Corn—Test of 136 Varieties for Silage, Fodder or Grain.

Varieties.	Kinds of corn.	Average results for 1896. Condition of grain when harvested.	Height of plants.	Number of ears per plot.	Yield of ears per acre.	Yield of whole crop per acre.	Average for years grown. Yield of ears per acre.	Yield of whole crop per acre.
Grown for six years:			ins.		tons.	tons.	tons.	tons.
1 Chester County Mammoth....	White Dent......	Early Milk.	79	143	2.93	18.58	1.57	**20.94**
2 Barzilian Flour...............	do	Water	85	165	.75	18.03	.50	**20.56**
3 Mammoth White Surprise	do	"	92	155	1.09	16.63	.94	**19.93**
4 Thoroughbred White Flint....	do	Milk........	84	165	2.87	14.38	2.10	**19.79**
5 Cloud's Early Yellow.........	Yellow Dent	"	85	157	2.68	15.90	3.21	**19.51**
6 Blunt's Prolific...............	White Dent......	Water	87	130	.92	14.50	1.18	**19.44**
7 Mastadon Dent	Yellow Dent.....	Milk........	88	156	3.32	15.85	3.05	**19.33**
8 Virginia Horsetooth	White Dent.....	Water	89	160	.88	15.05	.91	**18.68**
9 Red Cob Ensilage	do	Early Milk.	90	178	1.84	17.60	1.83	**18.53**
10 Mammoth Sweet Fodder	Sweet	Milk........	75	155	2.59	14.93	2.52	**18.49**
11 Giant Prolific Sweet Ensilage .	White Dent......	"	89	165	2.86	16.18	2.39	**18.46**
12 Mammoth Southern Sweet....	do	Water	88	155	1.38	16.53	1.57	**18.31**
13 Mammoth White Cob Ensilage	do	Late Milk..	88	165	2.70	15.10	1.81	**18.24**
14 Golden Beauty	Yellow Dent.....	" ..	86	152	2.26	14 80	2.23	**18.05**
15 Hickory King	White Dent......	Milk........	86	156	1.45	15.40	1.09	**17.86**
16 Sheeps' Tooth	do	"	84	168	1.68	14.53	1.64	**17.81**
17 Salzer's Superior Fodder Ensilage	do	Early Milk.	85	160	1.69	15.50	1.69	**17.75**
18 Mammoth Cuban..............	Yellow Dent.....	Firm Dough	82	147	3.20	13.70	3.51	**17.32**
19 Horse Tooth	do	Late Milk..	89	158	2.23	15.03	2.80	**17.28**
20 Improved Leaming	do	Dough	83	158	2.68	13.98	3.00	**17.22**
21 Centennial White	White Dent......	Late Milk..	87	151	2.61	15.05	2.85	**16.91**
22 Egyptian Sweet	Sweet	Dough	81	167	2.28	14.13	2.11	**16.90**
23 Evergreen Sweet	do	Late Milk..	78	173	3.52	14.13	2.65	**16.38**
24 Hickox Sweet	do	Dough	72	160	3.77	13.18	2.85	**16.24**
25 Sweet Fodder	do	Late Milk..	79	80	2.44	13.98	1.82	**16.15**
26 Large White Flint	White Flint......	Early Milk.	88	185	2.75	18.33	3.14	**16.06**
27 Salzer's North Dakota	do	Firm Dough	76	162	3.07	11.00	3.05	**15.98**
28 Tuscarora	do	"	70	118	2.73	11.15	3.11	**15.71**
29 Wisconsin Earliest White Dent	White Dent......	Dough	83	157	2.33	13.48	3.54	**15.46**
30 Stowell's Evergreen Sweet	Sweet	Late Milk..	71	163	2.49	13.43	2.34	**15.38**
31 Salzer's South Dakota	Yellow Flint.....	Ripe	69	166	2.82	10.17	2.86	**15.37**
32 Clark's County Champion	White Dent......	Firm Dough	85	152	3.19	12.43	2.89	**15.22**
33 Late Mammoth Sweet	Sweet	Late Milk..	76	194	3.81	14.18	2.58	**15.03**
34 Pride of the North............	Yellow Dent......	Firm Dough	85	164	3.26	11.70	2.99	**14.36**
35 Compton's Early	Yellow Flint	Ripe	83	163	3.28	11.90	3.32	**14.34**
36 Angel of Midnight....	do	"	72	172	2.51	13.68	2.80	**14.27**
37 Longfellow	do	"	71	169	3.19	10.90	2.95	**13.99**
38 Early Butler	Yellow Dent......	Firm Dough	82	151	3.30	11 18	3.09	**13.94**
39 Golden Dent	do	Late Milk..	89	162	2.88	14.73	2.86	**13.68**
40 Old Colony	Sweet	Firm Dough	67	63	1.21	4.35	2 61	**13.46**
41 100-Day Corn	Yellow Flint......	Ripe	73	177	2.78	9.75	2.91	**13.06**
42 Queen of the North	Yellow Dent	Firm Dough	85	162	3.13	12.15	2.94	**12.64**
43 Waugkakum	Yellow Flint	"	71	168	2.89	10.85	2.91	**12.62**
44 Canada Yellow	do	Ripe	72	168	3.30	10.60	3.05	**12.55**
45 Early White Flint............	White Flint	"	73	162	3.20	9.10	3.07	**12.46**
46 Dakota Dent	Yellow Dent.....	Firm Dough	76	150	3.11	9.08	3.09	**12.27**
47 King of the Earlies	do	"	82	156	3.68	11.25	2.99	**12.00**
48 Pearce's Prolific	Yellow Flint	Ripe	78	171	2.94	10.23	2.44	**11.91**
49 Minnesota King.....	Yellow Dent.....	"	73	160	3.28	9.30	3.15	**11.78**
50 Early Adams or Burlington...	White Dent......	"	57	158	2.53	5.50	2.66	**11.68**
51 Self Husking	Reddish Flint	"	68	133	2.21	8.13	2.54	**11.61**
52 Crosby	Sweet	Firm Dough	60	179	2.72	7.85	2.74	**11.09**
53 Rideout or Mercier	Yellow Flint.....	Ripe	71	157	3.18	8.53	2.91	**10.66**
Grown for five years:								
54 Giant Beauty	Yellow Dent.....	Milk	94	139	3.10	16 30	3.32	**19.95**
55 Dr. Woodhull	do	Late Milk..	94	135	3.09	15.90	3.01	**19.48**

CORN—TEST OF 136 VARIETIES FOR SILAGE, FODDER OR GRAIN—*Continued.*

Varieties.	Kinds of corn.	Average results for 1896. Condition of grain when harvested.	Height of plants.	Number of ears per plot.	Yield of ears per acre.	Yield of whole crop per acre.	Average for years grown. Yield of ears per acre.	Yield of whole crop per acre.
Grown for 5 years – *Con.*			ins.		tons.	tons.	tons.	tons.
56 N. B. G. & Co's Giant Fodder	White Dent	Milk	96	190	1.45	14.85	1.77	**19.16**
57 Pride of Kansas	Yellow Dent	Early Milk.	95	145	2 13	16.65	1.82	**17.55**
58 New Leaming	do	Dough	91	154	3.46	14.45	3.31	**17.35**
59 True Leaming	do	Firm Dough	91	150	3.57	13.95	3.42	**16.83**
60 Silver Flint	White Flint	"	84	171	3.36	13.15	3.18	**12.59**
Grown for four years:								
61 Kansas King	White Dent	Late Milk	98	160	2.03	16.55	1.80	**18.55**
62 Boone County White	do	"	97	154	2.93	15.40	2 68	**18.48**
63 Peach Blossom Mam. Field	Pinkish Dent	"	101	91	2.73	13.20	2.77	**18.45**
64 Legal Tender	Yellow Dent	"	94	168	3.09	15.65	2.85	**18.37**
65 Giant White Southern	White Dent	Dough	95	171	3 63	15 90	2.80	**18.17**
66 Champion White Pearl	do	Late Milk	94	152	2.89	12.68	3.19	**17.68**
67 Elephant Fodder	Yellow Dent	Firm Dough	86	161	3.80	16.08	3.23	**17.65**
68 Big Buckeye	do	Dough	94	151	3 10	13.38	2.84	**17.20**
69 Iowa Gold Mine	do	Firm Dough	90	155	3.64	13.98	3.15	**16.04**
70 Queen of the Field	do	"	87	152	3.38	11.78	3.60	**15.28**
71 Red Blazed	Reddish Dent	Ripe	80	160	3.43	11.50	3.36	**14.41**
72 Farmer's Favorite	Yellow Dent	Dough	92	131	2.84	13.70	2.27	**13.85**
73 N. B. & G. Co's Rustler White Dent	White Dent	Ripe	55	151	2.02	4.33	3.36	**12.74**
74 Dakota Queen	Yellow Dent	"	86	160	3.13	9.38	3.33	**12.28**
75 Extra Early Huron Dent	do	"	85	160	3.28	10.00	3.28	**12.26**
Grown for three years:								
76 Nebraska White Prize	White Dent	Dough	92	170	3.61	16.08	3.17	**17.85**
77 Perfect Mammoth Ensilage	do	Late Milk	95	164	2.51	15.48	2.68	**17.51**
78 Paragon White Ensilage	do	"	97	147	2.86	15.20	2.35	**17.11**
79 Golden Superb	Yellow Dent	Dough	96	139	2.98	15.68	2 66	**16.38**
80 Riley's Favorite	White Dent	"	95	153	2 78	13.65	2.75	**16.08**
81 White Prolific	do	"	93	152	3.65	14.80	3.00	**15.95**
82 Champaign County Prolific	do	Late Milk	89	147	2.36	14.75	2.17	**15.93**
83 High Mixed	Yellow Dent	Dough	96	139	2.89	13.75	3.06	**15.92**
84 Waterloo Extra Early Dent	do	"	90	153	3.21	15.33	2.61	**15.84**
85 Early California	do	"	89	150	2.86	14.95	2.55	**15.75**
86 Salzer's Early Giant White Dent	White Dent	"	89	149	3.08	15.90	3.58	**15.75**
87 Yellow Western Horsetooth	Yellow Dent	Late Milk	91	160	2.19	13.68	2.53	**15.39**
88 90 Days Leaming	do	Firm Dough	91	160	2.97	13.13	2.83	**15.00**
89 Nebraska Mammoth Red	Red Dent	Dough	84	151	2.84	11.63	2.91	**13.96**
90 Early White Cap Dent	White Dent	Firm Dough	86	155	3 07	11.20	2.92	**13.92**
91 Wisconsin White Flint	White Flint	"	81	160	2.94	12.03	2.76	**13.63**
92 Sanford	do	"	75	156	2.91	11.45	2.74	**13.58**
93 King Phillip	Reddish Flint	Ripe	80	169	3.40	12.05	3.43	**13.00**
94 Canadian Dent	Yellow Dent	"	83	155	2.78	8.83	2.84	**12.94**
95 North Star Yellow Dent	do	Firm Dough	86	155	3.31	10.25	3.28	**12.40**
96 Pride of Canada	Yellow Flint	Ripe	73	163	2.78	9.85	2.71	**12.06**
97 Gold Medal Dent	Yellow Dent	Firm Dough	84	155	3.00	10.55	3.17	**12.00**
98 Smoky Dent	Reddish Dent	"	81	150	3.29	10.75	3.62	**12.00**
99 Squaw	Variegated Flint	Ripe	60	165	2 83	6.90	3.00	**10.16**
100 Dakota Gold Coin	Yellow Dent	"	74	157	2.98	8 08	2.91	**9.86**
101 Excelsior Yellow Dent	do	Firm Dough	82	154	3.06	11.48	2.45	**7.99**
Grown for two years:								
102 Mexican June			86	none	none	22.88	none	**21.89**
103 Sale Mammoth	Sweet	Milk	75	135	2.57	13.88	2.60	**15.89**

CORN—TEST OF 136 VARIETIES FOR SILAGE, FODDER OR GRAIN—*Continued.*

Varieties.	Kinds of corn.	Average results for 1896.					Average for years grown.	
		Condition of grain when harvested.	Height of plants.	Number of ears per plot.	Yield of ears per acre.	Yield of whole crop per acre.	Yield of ears per acre.	Yield of whole crop per acre.
Grown for two years—*Con*			ins.		tons.	tons.	tons.	**tons.**
104 Dungan's White Profilic	White Dent	Water	93	145	2.26	14.70	2.23	**15.80**
105 Primitive	Yellow Flint	Milk	74	183	2.76	13.38	2.59	**15.62**
106 Old Cabin Home	White Dent	Early Milk.	89	135	.99	13.05	.87	**15.13**
107 Riley's Yellow Dent	Yellow Dent	Dough	92	148	2.86	14.30	2.42	**15.00**
108 Golden Row	do	“	85	156	3.43	11.70	3.36	**14.63**
109 Montgomery Golden King	do	“	91	130	2.59	13.05	2.50	**14.63**
110 Great Western	do	“	88	160	3.26	14.50	2.05	**14.45**
111 Pride of Columbia	do	Firm Dough	86	157	3.31	13.40	3.07	**14.25**
112 Conqueror	do	Milk	87	129	1.91	13.58	1.73	**14.14**
113 Connecticut Giant Golden	White Flint	Firm Dough	77	157	2.68	11.38	2.86	**13.44**
114 Terrebonne	do	Ripe	48	134	1.72	4.25	2.09	**13.28**
115 Maumee Valley Yellow Dent	Yellow Dent	Firm Dough	89	153	3.41	12.13	3.13	**13.24**
116 Golden Prolific	do	“	85	154	3.26	12.43	2.79	**13.07**
117 Langworth	White Dent	Ripe	84	153	3.60	12.05	3.60	**13.03**
118 Golden Dew Drop	Yellow Flint	“	78	160	2.94	11.80	3.10	**12.84**
119 Indian White Flour (white cob)	White Flint	“	67	160	3.87	10.30	3.81	**12.48**
120 Hathaway's Yellow Dent	Yellow Dent	“	84	154	4.06	11.80	3.66	**12.48**
121 Dakota Sweet	Sweet	Firm Dough	72	182	3.55	11.20	3.44	**12.28**
122 Indian White Flour (red cob)	White Flint	Ripe	71	153	3.62	10.18	3.75	**12.24**
123 Wisconsin Yellow Dent	Yellow Dent	Firm Dough	82	148	3.39	12.25	3.13	**11.68**
124 Indian Blue	Variegated Flint	Ripe	52	180	2.69	6.80	3.02	**8.58**
125 McColl	Black Flint	“	37	170	1.59	2.70	2.1[illegible]	**6.50**
126 Will's Jehu 70 Day	Yellow Flint	“	49	159	1.94	4.28	2.2[illegible]	**5.57**
Grown for one year:								
127 Seven Eared Fodder	White Flint	Water	88	108	.63	17.93	.63	**17.93**
128 Mammoth White Ensilage	White Dent	Milk	90	170	2.81	15.75	2.81	**15.75**
129 New Delaware Dent	Yellow Dent	Late Milk.	91	148	2.83	15.43	2.83	**15.43**
130 Black Hills	White Flint	Firm Dough	76	178	4.28	15.33	4.28	**15.33**
131 Southern Queen	Yellow Dent	Dough	90	152	3.23	14.73	3.23	**14.73**
132 Golden Triumph	do	“	83	152	2.59	13.18	2.59	**13.18**
133 Minnesota White Flint	White Flint	Ripe	82	155	2.97	11.28	2.97	**11.28**
134 Dakota Gold Dollar	Yellow Flint	“	75	160	3.04	10.05	3.04	**10.05**
135 Bailey's Mahogany	Red Flint	“	78	156	3.11	8.88	3.11	**8.88**
136 Rainy River	Variegated Flint	“	37	180	1.67	3.30	1.67	**3.30**

In selecting corn for any part of Ontario, the variety should be chosen which will produce the largest total yield per acre, the largest yield of grain per acre, and that will mature in the locality before the time of severe frosts in the autumn of the year. When these three things are taken into consideration, it is evident that no one variety will give the best satisfaction throughout Ontario. Great care, however, has been taken in presenting the results in such a way that any person in Ontario can glean the desired information regarding the different varieties simply by a study of the foregoing table, as not only is the yield of whole crop per acre given, but also the average weight of ears per acre, the average number of ears per plot, and the comparative stage of maturity reached by the corn at the time it was harvested about the middle of September. It will also be observed that a concise description of each variety is given under the heading of "Kinds of Corn." White dent indicates that the color of the grain is white, and that the variety comes in the class known as dent corn. The dent corns usually grow higher and possess larger stalks than the flint varieties. There are also no suckers produced by the dent corns, as in the case of the flint and the sweet varieties. The grain of the dent corn is longer, flatter, and a little softer than that of the flint varieties.

The varieties of corn have been arranged in the table according to their average yield per acre for the number years in which they have been tested in the experimental department. Therefore, among the fifty-three varieties which have been grown for six years in succession, it will be seen that the Chester County Mammoth comes first, Brazilian Flour second, and the Mammoth White Surprise third in average yield per acre. From a glance at another column, however, it will be seen that these are very late varieties. Two of them, in fact, producing corn the grains of which had not even reached the milk condition but was in what we term the water stage. As we glance down the list we find that the Cloud's Early Yellow reached the milk stage at the time of harvesting, and has produced an average of 3.2 tons of ears per acre in the last six years. It also stands fifth in yield of total crop per acre among fifty-three varieties grown for that length of time. Special attention is also directed to the Mammoth Cuban, Salzer's North Dakota, Wisconsin Earliest White Dent, and Crompton's Early varieties, which have given very satisfactory results among those which have been grown for six years in succession. The largest of these varieties of corn would only be suited for the southern part of Ontario, and the smaller kinds, as Salzer's North Dakota and the Compton's Early, would be better suited for the northern section. The Black Hills variety of corn which was grown in 1896 for the first time is a very promising sort, as the grain reached a firm dough condition at the time of harvesting, and there was the largest yield of ears produced by this variety in each of the experiments, when compared with that of other kinds.

Fodder Corn—Different Distances Between Drills, and Between Plants.

For five years in succession an experiment has been conducted with fodder corn, with the object of determining as nearly as possible the proper distance between the rows, and between plants in the rows, to give the most satisfactory results. For this experiment an early, a medium, and a late variety were selected. The Mammoth Southern Sweet, the Wisconsin Earliest White Dent, and the Compton's Early being the varieties used in each of the past five years. Each variety was sown on drills thirty, thirty-six and forty-two inches apart, and the corn in each set of the drills was planted four, eight and twelve inches apart. Two grains of seed were planted where only one plant was desired; and when the plants were about four inches in height, one of them was removed where the two were growing. This experiment was conducted in duplicate for one or two years, and in triplicate for each of the other years.

The soil on which this experiment was conducted in 1896 produced a crop of roots in 1895 after being plowed from sod the previous year. Planting took place on May the 21st and 22nd. As the germination of the seed was somwhat uneven in 1895, the results of the experiments for that year were not given in the annual report. The following table, therefore, gives the average results from the three sets of experiments conducted in 1896, and also for the four years during which this experiment has been successfully conducted. The yields per acre have been determined from the actual yields of the plots.

In examining the average results for four years on the table, we find that in every instance the largest total yield of green crop per acre was produced from the plants which were four inches apart in the drill, the second from those which were eight inches apart, and the lowest from those which were twelve inches apart. This applies to the medium and the late varieties of corn, and also to the rows which were thirty, thirty-six and forty-two inches apart in the case of each variety. In regard to the average weight per ear, exactly the opposite of this is the case, as the largest ears in every instance were produced from the plants which were twelve inches apart in the drills, the second largest from those which were eight inches apart in the drills, and the smallest from the plants which were four inches apart in the drill. This holds good with the three varieties, and for the different distances apart of each variety.

Fodder Corn—Different Distances Between Drills and Between Plants.

Distance between drills.	Distance between plants in drills	Average weight per ear. 1896.	Average weight per ear. Average 4 years.	Yield of ears per acre. 1896.	Yield of ears per acre. Average 4 years.	Yield of whole crop per acre. 1896.	Yield of whole crop per acre. Average 4 years.
	inches.	ozs.	ozs.	tons.	tons.	tons.	tons.
Mammoth Southern Sweet.							
30 inches	4	2.53	2.70	2.07	1.73	22.39	22.98
	8	3.58	3.14	2.18	1.74	18.41	19.31
	12	4.37	3.88	2.07	1.85	15.66	16.85
36 inches	4	2.95	2.88	2.05	1.57	20.77	20.16
	8	4.22	3.96	2.35	1.94	18.84	18.[illegible]2
	12	5.33	5.14	2.44	2.01	16.45	16.11
42 inches	4	3.25	....	2.30	2.00	20.17	20.14
	8	4.84	....	2.62	2.20	17.54	17.49
	12	5.72	....	2.31	2.06	14.98	15.97
Wis. Earliest White Dent.							
30 inches	4	2.73	3.39	2.09	3.17	16.26	18.38
	8	4.83	5.35	3.19	3.51	15.94	15.67
	12	6.48	7.67	3.03	3.55	13.13	14.11
36 inches	4	4.13	3.98	3.37	3.15	18.02	16.72
	8	6.01	6.94	3.42	3.69	14.55	15.17
	12	8.01	8.18	3.27	3.35	12.67	13.20
42 inches	4	4.95	4.67	3.91	3.75	19.08	17.49
	8	7.95	7.49	4.26	3.78	16.49	15.32
	12	9.00	9.11	3.34	3.45	12.91	13.23
Compton's Early.							
30 inches	4	3.25	3.48	2.72	3.24	16.20	17.87
	8	4.30	4.98	2.94	3.50	13.80	15.29
	12	5.86	6.36	3.31	3.33	13.31	14.14
36 inches	4	3.76	3.56	3.05	2.99	16.24	15.21
	8	6.05	5.95	3.82	3.66	15.58	14.56
	12	6.82	6.90	3.00	3.06	12.14	12.37
42 inches	4	3.39	3.75	2.71	3.05	13.63	13.69
	8	5.71	6.18	3.06	3.23	12.18	12.75
	12	6.55	0.02	2.60	2.91	10.63	12.00
Average of three varieties.							
30 inches	4	2.84	3.19	2.29	2.71	18.28	19.74
	8	4.24	4.49	2.77	2.92	16.05	16.76
	12	5.57	5.97	2.80	2.91	14.03	15.03
36 inches	4	3.61	3.47	2.82	2.57	18.34	17.36
	8	5.43	5.62	3.20	3.10	16.32	15.98
	12	6.72	6.74	2.90	2.81	13.75	13.89
42 inches	4	3.86	....	2.97	2.93	17.63	17.11
	8	6.17	....	3.31	3.07	15.40	15.19
	12	7.09	....	2.75	2.81	12.84	13.73

The husked grain from each plot of each variety was very carefully examined by three judges, and the greatest number of points for the grain produced from the Mammoth Southern Sweet was from the plants which were twelve inches apart in the drills, and the drills forty-two inches apart; the greatest number of points for the Wisconsin Earliest White Dent was from the plants which were eight inches apart in the drill, and the drills forty-two inches apart; and the largest number of points for the Compton's Early was from the plants which were eight inches in the drill, and the drills forty-two and thirty-six inches apart. The results in the table should be studied very carefully, as they should prove of value to every person in Ontario who is growing corn extensively, as it gives some important information in regard to the best distances to plant early, medium and late varieties of corn for the production of both stalks and ears.

Fodder Corn—Seed Selected from Different Parts of the Ear.

An experiment has now been conducted for three years in succession in which corn has been taken from the small end of the ear, from the large end of the ear, from the middle of the ear, and from the whole ear, and has been sown upon plots situated side by side. This experiment has been conducted in duplicate during each of these years. The corn was planted in hills 39.6 inches apart both ways, and four plants were allowed to remain in each hill. The condition of the soil, cultivation, etc., were similar to those of the variety tests. The planting all took place on the same date, and the corn for the different plots was out at the same time. The green crop was weighed immediately on being cut and the grain was then husked, after which the ears were weighed.

Sections of the ears from which the seed corn was taken.	Yield of ears per acre.		Yield of whole crop per acre.	
	1896.	Average 3 years.	1896.	Average 3 years.
	tons.	tons.	tons.	tons.
Small end of ear	3.05	3.14	11.05	12.90
Large end of ear	3.46	3.22	11.73	12.55
Whole ear	3.37	2.98	11.80	12.07
Middle of ear	3.30	3 09	11.15	11.82

It will, no doubt, be surprising to many when they examine the above table and observe that the grains from the small end of the ear produced a larger yield of green crop per acre than the grains from any of the other parts of the ear, in the average results of three seasons. In average weight of ears per acre, however, the seed which was taken from the large end of the ear produced the greatest yield in 1896, and also in the average of the three years in which this experiment has been conducted.

Fodder Corn—Different Depths of Planting.

For two years in succession an experiment has been conducted on duplicate plots by planting corn one, two and three inches below the surface of the soil. The corn was planted in hills 39.6 inches apart both ways, four grains were planted in each hill, and no thinning of the plants took place. The soil was what might be termed an average clay loam, and the seeding took place on the third week in May. The corn was cut about the middle of September, at which time the whole crop was weighed.

Depths of planting.	Yield of ears per acre.		Yield of whole corp per acre.	
	1896.	Average 2 years, 1895-6.	1896.	Average 2 years, 1895-6.
	tons.	tons.	tons.	tons.
1 inch deep	3.18	3.97	14.72	16.81
2 inches deep	3.54	4.25	15.53	17.92
3 inches deep	3.28	3.98	14.83	17.42

The corn which was planted to a depth of two inches below the surface of the soil gave the best results in 1895, and in 1896, in total yield of green crop per acre, and also in the yield of ears per acre. This experiment will likely be continued for several years.

Fodder Corn—Seed Grown in Ontario and in the United States.

In 1894 and in 1896 an experiment was conducted by planting corn which was grown in Ontario in comparison with seed secured from the United States. In the experiment conducted in 1894 the seed had been grown in Lambton county, in the Niagara Peninsula, and at the Agricultural College; and in the experiment conducted in 1896 the seed had been grown at Bow Park Farm, near Brantford, in the Niagara Peninsula, and at the

Agricultural College. The seed corn of the same varieties was obtained from the southern and middle States for the experiment of 1894 and also for the experiment in 1896. The plots used for the tests were 1/100 of an acre in size, and the date of seeding, nature of soil, etc., were quite similar to those described for the variety experiments with corn. The corn was planted in hills 39.6 inches apart both ways. Eight kernels were planted in each hill; and after the plants were about four inches high they were thinned to four plants per hill. The corn was all cut on the same day.

Where seed was grown.	Yield of ears per acre.		Yield of whole crop per acre.	
	1896.	Average 2 years, 1894-6.	1896.	Average 2 years, 1894-6.
	tons.	tons.	tons.	tons.
Ontario	3.68	3 90	14 68	15.26
United States	3.90	3.91	14.88	15.26

The seed from Ontario gave the largest average yield of green corn per acre in the experiment of 1894, and the seed obtained from the United States produced a little the largest average yield of green crop in the experiment of 1896. When the results of the two years are averaged the yields are the same. Remarks almost similar to these might be made in regard to the yield of the ears per acre.

MILLET—COMPARATIVE TEST OF 18 VARIETIES.

Varieties.	Average height 1896.	Yield of crop per acre when first cut.	
		1896.	Average for years grown.
Grown for five years:	ins.	tons.	tons.
1 German or Golden	34	12.20	**8.94**
2 Golden Wonder	26	9.80	**8.12**
3 Salzer's Dakota	36	7.80	**7.74**
4 East India Pearl	30	10.25	**6.97**
5 Common	35	6.80	**5.38**
6 White French	33	6.50	**5.05**
7 Red French	25	5.70	**4.36**
Grown for four years:			
8 Hungarian	33	6.85	**5.82**
Grown for three years:			
9 Canadian	28	10.00	**8.00**
10 Magic	32	6.75	**7.19**
11 California	32	4.90	**4.34**
12 Russian	36	5.33	**3.79**
Grown for two years:			
13 Holy Terror Gold Mine	33	11.25	**11.95**
14 Japanese (Milleacum)	38	11.70	**11.09**
15 Japanese (Italicum)	32	11.50	**10.91**
16 Japanese (Crus Galli)	32	10.75	**10.65**
17 Canary	29	8.60	**9.10**
18 Manitoba	45	7.70	**5.81**

In 1896 eighteen varieties of millet were grown in the experimental department. Of this number seven have now been grown for five years in succession, one variety for four years, four varieties for three years, and six for two years in succession. The experiment was conducted in duplicate in 1896, thus making thirty-six plots devoted to the testing of millet. The plots were exactly 1-100 of an acre in size in both sets. The seed was sown broadcast. The germination of the different varieties was quite satisfactory, the plants being quite even over the plots. The crop was cut just as the different varieties came nicely into head, and was weighed immediately.

From the foregoing table it will be seen that the German or Golden millet gave the largest average yield of green crop per acre. The second and third varieties in yield per acre in 1896 were two millets which have been imported from Japan. It will be noticed that there are three varieties of millet which were imported from Japan. When the term "Japanese millet" is applied to any one of these varieties, the information given is very obscure, as the three varieties from Japan are entirely distinct from each other. They are all productive varieties, and require thin seeding in order to get the best results. The results obtained from Salzer's Dakota in the past two years have not been nearly so satisfactory as those for the first three years that this variety was grown in the trial grounds. From a careful selection, however, of plants produced from seed obtained in 1892, we hope to secure a millet which will surpass any variety which is reported on in the table.

Sugar Cane, Kaffir Corn, Jerusalem Corn, Etc.

Seventeen varieties of sugar cane, Kaffir corn, Jerusalem corn, broom corn, etc., were grown in the Experimental Department in 1896. Ten of these varieties have now been grown for three years in succession. There were five rows of each variety, the rows being forty links (26.4 feet) long. The plants were left eight inches apart in the drills, and all varieties were sown in the same manner.

Varieties.	Kind of crop.	Average height.		Yield of heads per acre.		Yield of whole crop per acre.	
		1896.	Average results for number of years tested.	1896.	Average results for number of years tested.	1896.	Average results for number of years tested.
		inches.	inches.	tons.	tons.	tons.	tons.
Grown for three years:							
1 Fodder	Sugar Cane	68	74.7	.0	.04	17.83	**17.84**
2 Early Orange	"	88	76.0	.10	.09	17.83	**17.62**
3 Early Amber	"	76	76.3	.0	.29	16.20	**16.69**
4 White African	"	58	59.3	.0	.0	14.10	**15.12**
5 California Golden	Broom Corn	95	75.7	.92	1.14	11.83	**10.83**
6 Kaffir Corn	Kaffir Corn	58	53.0	.0	.0	13.60	**10.63**
7 Yellow Millo Maize	Millo Maize	64	57.0	.64	.81	13.75	**10.38**
8 Dwarf	Broom Corn	50	55.7	.90	1.21	13.58	**9.95**
9 Improved Evergreen	"	....	....	.63	1.34	7.85	**7.62**
10 Jerusalem Corn	Jerusalem Corn	63	56.0	.65	.95	6.93	**5.91**
Grown for two years:							
11 Early Minnesota	Sugar Cane	83	85.5	.24	.46	15.00	**14.13**
12 Early Japanese	Broom Corn	83	79.0	1.28	1.49	10.00	**8.78**
13 Branching Doura	Branchi'g Doura	62	57.0	.60	.77	8.25	**8.04**
Grown for one year:							
14 Kansas Orange Cane	Sugar Cane	72	72	.0	.0	18.85	**18.85**
15 Sorghum Saccharatum	....	72	72	.21	.21	16.88	**16.88**
16 White Millo Maize	Millo Maize	61	61	.0	.0	13.13	**13.13**
17 Sorghum Vulgare	....	82	82	.35	.35	9.00	**9.00**

Inquiries have been received on several occasions regarding sugar cane and Kaffir corn as a fodder crop. As there seemed to be a desire on the part of some farmers to obtain more information regarding these crops, a systematic experiment was arranged by which a considerable number of these different fodder crops could be grown side by side under similar conditions. Many visitors had an opportunity of examining these crops when they were growing in the summer, and can thus judge for themselves as to their comparative value as indicated by the general appearance of the different crops. The above table gives the average height and the yield of the whole crop per acre, both for 1896 and for the number of years that each variety has been grown in the Experimental department. It also gives the comparative yields of each variety. This indicates to a certain extent the relative stage of maturity of the different varieties, and also gives some practical information in regard to the broom corns. The fodder sugar cane occupies first place in average yield per acre among all the varieties that have been grown for three years in succession. Although there is an occasional boom of the Kaffir corn, we see by the above table that it has produced a yield of less than eleven tons per acre in the average of three years' experiments, and is so late that when grown at Guelph it is very rarely that a single head makes its appearance before the crop is cut in the latter part of September.

Mixed Grains—Grown for Fodder.

Inquiries are frequently received from farmers throughout Ontario regarding the best kinds of fodder crops to feed during the periods in the summer when pasture becomes scarce. To answer these inquiries satisfactorily, experiments have been conducted with a large number of crops which may be used as a green food as required in the summer months for stock. Grains grown in mixtures have occupied no small place in this experiment. During the past five years we have sown oats, peas, barley and spring wheat separatively 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 during each of the five years. In each of the years the grains were sown separately and in various combinations, with two and three kinds of grain in each combination, and also in a mixture of all four kinds together. This has required fifteen plots in each set, or thirty plots in the duplicate experiment. Therefore, one hundred and fifty plots have been devoted to this experiment within the past five years. The plots in all instances have been 1/100 of an acre in size. In 1896 the seed for this experiment was sown on April the 21st on land which produced a crop of roots in 1895, having been manured at the rate of twenty tons per acre in the spring of that year. The following table gives the average results of the grain grown singly and in the various combinations for 1896, and for the average of the five years during which this experiment has been in progress.

Crops.	Average height of mixtures 1896.	Yield per acre of green crop grown separately.		Yield per acre of green crop grown in mixtures.	
		1896.	Average 4 years 1893, 4, 5, 6.	1896.	Average 5 years 1892, 3, 4, 5, 6.
	inches.	tons.	tons.	tons.	tons.
1. Peas and Oats	36	7.38	7.34	7.78	7.96
2. Barley and Peas	32	6.59	6.53	7.58	7.22
3. Barley, Peas and Oats	35	6.63	6 63	7.38	7.07
4. Barley and Oats	34	5.94	6.03	6.65	6.75
5. Peas, Wheat and Oats	34	6.03	6.17	6.25	6.63
6. Barley, Peas, Wheat and Oats	34	5.81	5.93	6.88	6.46
7. Wheat and Oats	36	5.04	5.33	5.18	6.03
8. Barley, Wheat and Oats	31	5.08	5.29	5.18	6.02
9. Peas and Wheat	34	5.69	5.83	5.95	5.98
10. Barley, Peas and Wheat	32	6.63	5.90	6.43	5.85
11. Wheat and Barley	30	4.25	4.50	4.88	5.14

By an examination of the foregoing table it will be seen that the peas and oats, when sown together, have given the largest yield of green crop per acre of all the mixtures used, and the wheat and barley have given the smallest yield per acre among all the various mixtures. Not only has peas and oats given the largest average yield of green crop per acre when sown in combination, but this mixture has produced a food of good quality, the peas being rich in albuminoids and the oats in carbohydrates, making a well balanced ration when grown together as in the experiment under consideration. Upon a closer examination of the table it will be seen that the grain which was grown in mixtures gave larger yields per acre than the same kinds of grain sown separately, with but one slight exception, as in the case of barley, peas and wheat. These grains, when grown singly, produced an average yield of 5.90 tons of green crop per acre, and when sown in combination 5.85 tons of green crop upon a similar area. These results, however, are so near equal that they may be looked upon as practically the same. The question is sometimes asked whether oats and tares, or oats, peas and tares would not give better results than oats and peas. Tares have been used in connection with our experiments but have never given so good satisfaction as peas when mixed with oats. In 1896 a co-operative experiment was conducted with these crops on several farms throughout Ontario. Three plots were used for each test, peas and oats being grown on one plot, tares and oats on another, and peas, tares and oats on a third. The average results over Ontario show that the mixture of peas and oats gave the largest yield of green fodder per acre; peas, tares and oats the second largest, and the tares and oats the smallest. The mixture of peas and oats was the most popular mixture with the experimenters.

Peas and Oats—Sown in Different Quantities for Green Food.

This experiment was conducted in duplicate plots in 1896, and has been carried on for five years in succession. Nine plots have been used for each set in each of the five years. There have been, therefore, ninety plots in all used in this experiment since it was first started. Different proportions of peas and oats have been mixed together in such a way that some valuable information should be gleaned in regard to the best combinations for fodder purposes. The seed was sown broadcast on plots 1/100 of an acre in size. The land was rather low lying and produced a crop of potatoes in 1895. The yields, therefore, in 1896 have been comparatively high.

Crops.	Results for 1896. Average height.	Average percentage lodged.	Yield of green crop per acre.	Average yield of green crop per acre, 5 years.
	inches.	per cent.	tons.	tons.
Oats 2 bushels and Peas 3 bushels	42	18	11.93	9.30
" 2 " " 1 "	42	4	11.70	9.22
" 1½ " " 2 "	41	16	11.20	8.95
" 1½ " " 3 "	41	45	11.40	8.91
" 2 " " 2 "	43	10	12.05	8.87
" 1 " " 3 "	38	55	9.43	8.82
" 1½ " " 1 "	39	9	9.00	8.52
" 1 " " 1 "	39	13	8.45	8.28
" 1 " " 2 "	37	33	8.53	8.18

A mixture of two bushels of oats and three bushels of peas per acre has given the largest yield of green crop in five years' experiments. As a considerable quantity of the crop for this mixture, however, becomes lodged, and as a large amount of seed is required per acre, we wish to draw special attention to the second mixture given in the table, namely, two bushels of oats and one bushel of peas per acre. This mixture has given a yield of green crop nearly equal to that from the first mixture, and it contains two bushels per acre less seed. A very important point in connection with this mixture is that the crop usually stands up well, providing a suitable variety of oats and a suitable variety of peas is selected for the mixture. It will be seen in the results given for 1896 that only four per cent. of the crop produced by this mixture was lodged. This was the smallest percentage lodged of all the mixtures used. The Prussian Blue peas mixed with either the Siberian, Banner, or Egyptian oats makes a very good combination for the production of green fodder.

Sunflowers—Comparative Test of Six Varieties.

Seven varieties of sunflowers were planted on plots 1/100 of an acre in size in the spring of 1896. The land was cultivated similarly to that for a corn crop, and the seed was sown in rows five links apart.

Varieties.	Average height.		Average yield per acre 2 years, 1894-5.	
	1896.	Average 3 years.	Heads.	Total crop.
	ins.	ins.	tons.	tons.
Helianthus Globosus	60	63.3	4.65	10.63
Texas Silver Queen	56	57.3	2.72	.82
Black Giant	64	60.0	3.97	7.75
Mammoth Russian Giant	54	57.0	3.19	9.13
Double California	48	44.3	3.37	5.42
Silver and Gold	30	....	2.04	4.87

The experiment was unsatisfactory in 1896, owing to the unevenness of the germination of the sunflower seed of nearly all the varieties. Notes were taken of the various varieties under experiment. It is, however, considered best not to give the results for 1896, except of the comparative height of the different varieties tested. In the average results for the two years in which the six varieties were successfully grown, the Helianthus Globosus gave a yield of 10.6 tons of total crop per acre, and a yield of over 4.5 tons of heads per acre.

Fodder Crops.

Eight kinds of fodder crops have been grown under experiment for two years in succession. 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 experiment was conducted in duplicate each year. 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 yield of green crop per acre.

Varieties.	Average height of crop.		Average yield per acre.	
	1896.	Average 2 years, 1895 and 1896.	1896.	Average 2 years, 1895 and 1896.
	inches.	inches.	tons.	tons.
Rape	23.5	20.3	18.28	17.67
Egyptian Peas	18.5	17.7	9.25	10.08
Grass Peas	44.0	41.5	7 88	9.16
Yellow Soy Beans	25.0	23.9	6.85	9.06
Prussian Blue Peas	53.0	49.8	5.10	7.73
Tares or Vetches	29.5	29.3	3.30	6.73
Crimson Clover	9.0	11 5	5.60	6.59
Horse Beans	33.5	30.5	4.35	5.87

The rape has a large lead over all of the other crops in yield of green crop per acre. In 1896 the yield of rape was nearly double that of any of the other varieties of fodder crops included in this experiment. The lowest average yield per acre was produced by the horse beans in 1895 and 1896. In our experiments with horse beans during the past five years we have been unable to obtain satisfactory results with any of the five or six varieties which we have had under experiment. The crimson clover stands second to the last in average yield of green crop per acre, and the tares or vetches are third last on the list, producing an average of 6.7 tons of green crop per acre.

Varieties of Rape, Kale and Mustard.

In 1896 an experiment was made by sowing two varieties of rape, three varieties of kale, three varieties of mustard and one variety of Brussels sprouts upon plots of uniform size, to obtain some information regarding the comparative yields of these crops. This experiment was conducted on new land which was cropped in 1895 for the first time. The plots were 1/100 of an acre in size. The varieties which were the most rapid growers were cut before the rest of the varieties in this experiment. The crop from each plot was weighed immediately on being cut.

Varieties.	Yield of green crop per acre.
	tons.
1. Dwarf Essex Rape	24.18
2. Dwarf Victoria Rape	18.60
3. Thousand Headed Kale	15.60
4. Dwarf Green Kale	14.10
5. Tall Green Curled Kale	13.50
6. Creole Curled Mustard	13.15
7. Brussels Sprouts	12.96
8. Giant Southern Curled Mustard	12.60
9. Bloomsdale Long-Leafed Mustard	11.75

The Dwarf Essex rape stands at the head of the list in the yield of green crop per acre. The Dwarf Victoria variety of rape which stands next to the Dwarf Essex yielded only about three-quarters as much green fodder. The three varieties of mustard and the Brussels sprouts gave yields per acre less than those of either of the varieties of rape or of kale. A few other varieties of kale were also sown which would have given results of much interest, had we been successful with the crops. Mr. Wm. Davies of Toronto very kindly supplied a small quantity of the seed of the Jersey tree cabbage and Irish evergreen cabbage, which he obtained in Jersey Island while visiting there two years ago. We were unable, however, to get any of the Jersey cabbage to germinate, and only secured a few of the plants of the Irish evergreen, although both varieties were sown in the green house and also in the field. A plot was sown with Jersey kale, obtained by Prof. H. H. Dean of the Ontario Agricultural College when visiting the Island of Jersey in 1895. This plot, however, was destroyed by being badly washed through the influence of a heavy rain. We hope, however, to receive fresh supplies of these seeds in order to test the crops in comparison with those which we have already had under experiment.

Rape—Selection of Seed.

As in the case with nearly all kinds of farm crops, an experiment has been conducted with rape by selecting different sized seed, to find out which will produce the most satisfactory results. The experiment has now been conducted for two years in succession by selecting large plump seed, medium-sized seed, and small-sized seed from ordinary seed purchased in the spring of each year. The seed in all cases was sound and whole, and was carefully sifted and hand picked to make the samples as desired for the three separate classes. The experiment was conducted in duplicate each year. The following table gives the results of the experiment for 1896, and of the average for two years in which this experiment has been conducted.

Selections.	Yield of green rape per acre.	
	1896	Average 2 years, 1895-6.
	tons.	tons.
Large plump seed	27.53	20.32
Medium sized seed	26.48	17.86
Small sound seed	26.48	14.88

In the average results for two years, it will be seen that the large plump seed gave about five and a half tons of green crop per acre more than that which was produced by the small-sized seed. The medium-sized seed produced a crop intermediate in quantity in the average results for two years. The comparative yields in 1896 were not so marked as those of 1895.

Rape—Thinning Plants to Different Distances in the Drills.

In order to get some information regarding the respective distances to which the plants of rape should be thinned in the drill, an experiment has been conducted for two years in succession in which the plants were left two, four, eight, and twelve inches apart in the drills. The drills of course were the same distance apart in every instance. The experiment was conducted in duplicate during each of the past two years.

Distance between the plants in the row.	Yield per acre of green rape. Average for two years, 1895-96.
	tons.
Two inches	16.62
Four inches	16.72
Eight inches	15.55
Twelve inches	14.62

In the average results of the experiments conducted for two years in succession, the plants which were left four inches apart in the drill gave the largest yield per acre, and the plants which were left two inches apart in the drill gave results practically the same as those left four inches apart. It is somewhat surprising to notice that the plants when left twelve inches apart in the drill produced over fourteen-and-a-half tons per acre. The plants grew very strong and thrifty, in the case of the thinnest seeding. If the rape seed is of good quality, it is advisable not to sow a very large quantity per acre. From one to one-and-a-half pounds is usually quite sufficient when the rape is sown in rows.

Rape—Methods of Cultivation.

An experiment was conducted with rape in 1896 by sowing the seed broadcast and in rows, without the use of the subsoil plow, and also by sowing it in rows immediately after the land had been subsoiled. The rape which was sown in rows received cultivation throughout the season, while that which was sown broadcast received no cultivation whatever. The crop was weighed immediately on being cut.

Method of soil preparation.	Yield of green rape per acre.	
	1896.	Average two years, 1895-96.
	tons.	tons.
Land subsoiled and rape sown in rows	18.25	12.48
Land not subsoiled and rape sown in rows	17.39	11.50
Land not subsoiled and rape sown broadcast	15.38	10.34

The land which was subsoiled produced the largest average yield per acre of green rape in 1895 and in 1896. The smallest yield per acre was produced from the broadcast sowing in each of these two years. The rape which was sown in rows and not subsoiled produced an average of nearly one and one-fifth tons per acre more than that which was sown broadcast. Not only is there a direct advantage from sowing rape in drills by the increase in the crop produced, but the cultivation which is given between the rows keeps the weeds from growing and leaves the land in excellent condition for future crops.

Rape—Different Depths of Planting Seed.

An experiment was conducted in 1896 for the first time by planting rape seed one, two, three, and four inches below the level of the land. This seed was planted with great care, to obtain some information regarding the depth of planting rape seed with a view to obtain the best satisfaction from the crop. The experiment was made in duplicate in 1896 and will likely be repeated for several years.

One inch deep, 19.0 tons; two inches deep, 22.3 tons; three inches deep, 21.0 tons; four inches deep, 17.7 tons.

The seed which was planted to a depth of two inches below the surface of the soil gave the largest average yield of green crop per acre. It will be remembered that corn planted to a depth of two inches also gave the best results for the past two years in succession. The seed of the fall turnips gave the best results in 1896, when planted to a depth of two inches, and that of Swede turnips in the experiments of 1895 and in 1896 produced the largest yields from the seeding of only one inch in depth. Although the seed which was planted four inches below the surface gave nearly five tons per acre less than that which was planted two inches below the surface, still this difference is not nearly so marked as it was with the turnips, the yield being very low from the seeding of four inches deep in the case of the latter crop.

RAPE—APPLICATION OF FERTILIZERS.

In 1891 an experiment was conducted by applying different commercial fertilizers to land on which rape was sown. A somewhat similar experiment was conducted in 1896. The plots were 1/100 of an acre in size in the experiment of the past season. One half of the amount of the different fertilizers was used in 1896, as previously mentioned in connection with the experiment with fertilizers and potatoes. The fertilizers were applied at the time the rape seed was sown.

Fertilizers.	Yield of green weight per acre.		
	1891.	1896.	Average.
	tons.	tons.	tons.
Nitrate of soda	15.8	14.7	15.3
Mixture	14.8	10.6	12.7
Salt	15.1	10.1	12.6
Superphosphate	12.6	10.4	11.5
Muriate of potash	12.2	10.4	11.3
No fertilizer	13.2	....	....
Land plaster	....	10.1	....

In the experiment for 1891 land plaster was not used, and in the experiment of 1896 the weight of the green crop produced on the unfertilized plot was unfortunately not recorded. As this experiment will likely be repeated in future years, we hope to be able to give a more complete record from the land receiving land plaster and also from land left unfertilized. It will be observed that the nitrate of soda produced decidedly the best results in 1891 and in 1896. For five years in succession rape has been grown with nitrate of soda and without any fertilizer in connection with the co-operative experiments conducted throughout Ontario during each of these five years. The nitrate of soda has given a larger average yield of rape per acre than the plot which was left unfertilized, the largest yield per acre being 2.1 tons more from the nitrate of soda than from the unfertilized plots. For the co-operative experiments nitrate of soda was used at the rate of eighty pounds per acre, which cost about $2.20.

CLOVERS—COMPARATIVE TESTS OF 8 VARIETIES.

In the spring of 1894 a number of varieties of clover were sown in the experimental department. The clover seed was sown with a light seeding of barley, one bushel per acre of the latter being used. The seeding took place on May the 12th, 1894. No protection has been afforded the plots in either of the past winters. The table gives the results for 1896 and also for the average of the past two years.

Varieties.	Uniformity of plants over the plots.	Height of plants.		Weight of green crop per acre.	
	1895.	1896.	Average 2 years, 1895-6.	1896.	Average 2 years, 1895-6.
		inches.	inches.	tons.	tons.
Lucerne or Alfalfa	Good	19	16	19.88	**11.62**
Sainfoin	"	31	23	11.70	**7.01**
Long Red Rawdon	Medium	31	21	10.64	**6.36**
Mammoth Red	"	32	21	7.12	**4.30**
Perennial	"	32	22	7.28	**4.16**
Alsike	Good	18	14	4.80	**3.84**
Yellow Trefoil	"	21	14	4.60	**3.18**
Common Red	Medium	20	16	3.36	**2.40**

The Lucerne or Alfalfa furnished four cuttings in the summer of 1896. The yields of green crop of Lucerne or Alfalfa for the four different cuttings were as follows: April 30th, 2 9 tons; June 30th, 8.6 tons; August 13th, 3.4 tons; and October 3rd, 4.9 tons per acre. There were two cuttings of Sainfoin, the first occurring on July the 7th, giving an average yield of 8.45 tons of green clover per acre, and the second on August 13th, giving a yield of 3.25 tons per acre. The rest of the varieties did not produce a second crop sufficiently large for cutting in 1896. The average yield of green crop per acre from the eight varieties of clovers reported in the foregoing table was 8.67 tons, and the average of two years the yield was 5.36 tons of green clover. It will be interesting to know that the average ton of green clover in the experiment of 1896 produced 676 pounds of hay when properly cured for hauling into the barn.

The clovers under the names of Long Red Rawdon, Mammoth Red and Perennial Red are very similar in all characteristics. The Lucerne or Alfalfa gave more than double the average yield per acre of all the other varieties.

Crimson or Scarlet Clover—(*Trifolium Incarnatum*)

A somewhat lengthy description of this clover and our experience with it in the experimental department for four years in succession was given in the report of the Experimentalist in 1895. In the past year various experiments have been conducted with this clover. A quantity was sown in August of 1895, which obtained a good growth before the winter set in. It was, however, badly killed during the winter season, there being only about one-fifth of the plants living in the spring of the present year. Crimson Clover was sown in the spring of 1896 with both oats and barley, and the experiment was made in duplicate. The crop was carefully examined just before the grain was ready to harvest, and the crimson clover plants were found to be very spindly and a few were coming into bloom. After the grain was harvested the plants thrived a little better, but the results were unsatisfactory as regards the crop produced.

This clover was also sown with red clover and with Lucerne or Alfalfa. It was thought that in this way it might be of value, as neither the red clover nor the Lucerne produced very large yields during the first season, and that is the time in which the crimson clover is valuable, if at any time. But both the red clover and the Lucerne seemed to give fully as large crops as the crimson clover. From our experience with crimson clover during the past five years, I must say that the results are not very favorable to the cultivation of the crop in Ontario, unless it is to be grown in special localities or under special conditions.

Grasses—Comparative Test of 21 Varieties.

On May the 15th, 1894, thirty-one varieties of grasses were sown on the experimental grounds. During the winter of 1894-5, however, ten of these varieties were killed out so badly that the land was afterwards devoted to other purposes. Twenty-one varieties came through the winter fairly well, and we now have the results from these grasses for two years in succession. Prof. C. E. Thorne, Director of the Ohio Agricultural Experiment Station, after examining these plots in the autumn of 1896, made the remark that they were the finest plots of grasses that he had ever seen in his life.

It will be observed that there is a great variation in the yield produced by the different varieties under experiment. The Lyme grass gives an average of 7.4 tons of green crop per acre in the average of two years, and the Wild Timothy an average of only about one half ton of green crop per acre. The varieties under the numbers 1, 2, 3, 4, 5 and 21 are natives of Canada, and were very kindly supplied to us by Mr. S. A. Bedford, Superintendent Experimental Farm, Manitoba.

GRASSES—COMPARATIVE TEST OF 21 VARIETIES.

Names of varieties of grasses. Common name.	Scientific name.	Uniformity of the plant on the plot in 1895.	Height when cut. 1896.	Height when cut. Average 2 years 1895-6.	Yield of green crop per acre. 1896.	Yield of green crop per acre. Average 2 years 1895-6.
			inches.	inches	tons.	tons.
1. Lyme Grass	Elymus Virginicus	good	30	30	6.64	**7.74**
2. Western Rye Grass	Agropyrum tenerum	medium	27	27	6.24	**7.50**
3. Fringed Brome Grass	Bromus ciliatus	poor	36	27	8.24	**6.00**
4. Bearded Wheat Grass	Agropyrum caninum	good	27	29	4.00	**5.40**
5. American Brome Grass	Elymus Americanus	medium	27	21	3.92	**4.62**
6. Orchard Grass	Dactylis glomerata	good	38	25	6.56	**4.44**
7. Tall Oat Grass	Arrhenatherum avenaceum	medium	44	34	5.96	**4.28**
8. Timothy	Pheleum pratense	good	36	31	5.01	**3.84**
9. Meadow Fescue	Festuca elatior	"	36	27	4.48	**3.36**
10. Soft Brome Grass	Bromus mollis	very good.	34	29	2.56	**3.00**
11. Awnless Brome Grass	Bromus inermis	good	6	15	2.40	**2.78**
12. Meadow Foxtail	Alopecurus pratensis	medium	32	27	3.60	**2.42**
13. Red Top	Agrostis vulgaris	"	20	18	2.72	**2.04**
14. Rhode Island Bent	Agrostis canina	"	25	20	2.48	**1.94**
15. Canadian Blue	Poa campressa	poor	18	13	2.88	**1.54**
16. Perennial Rye	Lolium perenne	medium	20	16	2.12	**1.52**
17. Kentucky Blue	Poa pratensis	"	20	18	1.92	**1.38**
18. Yellow Oat	Avena flavescens	poor	28	19	2.16	**1.24**
19. Creeping Bent	Agrostis stolonifera	"	15	14	1.68	**1.12**
20. Fine Leaved Sheep's Fescue.	Festuca ovina	medium	18	15	.96	**.68**
21. Wild Timothy	Muhlenbergia glomerata	poor	11	11	.88	**.58**

It will be seen that five out of the six varieties stand at the head of the list in average yield of green crop per acre for two years, Orchard grass coming next, then Tall Oat grass, Timothy and Meadow Fescue. The four last mentioned varieties are all valuable ones. The Canadian Blue grass gave an average of one and a half tons per acre in the average of two years, and the Kentucky Blue grass had one and a third tons per acre. The average yields per acre of the grasses immediately on being cut was 3.69 tons in 1896 and 3.21 tons in the results for the two years. The grasses were all carefully dried in the field. It was found that each one hundred pounds of the average crop at the time of cutting produced 46.6 pounds of hay.

PERMANENT PASTURES.

Within the past eighteen years a considerable amount of experimental work has been done in testing varieties of grasses and clovers, both singly and in combination. When the varieties have been grown alone, they have been allowed to remain in the land for several years, providing they were hardy enough to stand the climate of Ontario. These grasses and clovers have been carefully studied and much information has been gleaned in regard to their usefulness for pasture and hay. In 1885 Prof. Brown recommended a mixture which he considered would be well adapted for a permanent pasture.

Only the most hardy varieties which had been tested up to that time were included in the mixture. 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 less number of varieties and requiring a smaller amount of seed per acre. The varieties recommended in 1893 should be very suitable for permanent pasture. They have all proven to be hardy varieties. An experiment was started in the spring of 1893 by sowing a plot of the mixture which was recommended in 1885, and also another plot of the mixture which was recommended eight years later. The seed was sown with a light seeding of barley, and the germination of the grass seed was quite satisfactory. The following table gives the results from two mixtures for the past two years.

Mixture recommended in	Grasses or clovers.	Varieties.	Amount of seed per acre.	Average height of first cutting, 1895-6.	Yield of freshly cut grass per acre, 1896. Cut June 30th.	Cut August 13th.	Cut October 3rd.	Average yield of green crop per acre, 2 years, 5 cuttings.
			lbs.	inches.	tons.	tons.	tons.	tons.
1885	Grasses	Meadow Fescue	6	23	12.48	5.76	4.72	15.48
	"	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 amt. seed used	35					
1893	Grasses	Orchard grass	4	25	13.92	7.84	6.24	19.64
	"	Meadow Fescue	4					
	"	Tall Oat Grass	3					
	"	Timothy	2					
	"	Meadow Foxtail	2					
	Clovers	Lucerne	5					
	"	Alsike	2					
	"	White or Dutch	1					
	"	Yellow or Trefoil	1					
		Total amt. seed used	24					

We have named all the varieties of grasses and clovers required for each mixture and also the quantity of seed per acre, principally for two reasons: in the first place that this experiment might thus be made as clear as possible; and secondly, that any person wishing to know the quantity of seed per acre of the different varieties which are recommended as a general permanent pasture mixture would be enabled to find the information in a good form. This mixture should be well adapted for good average soil; but on low lying land, or on land which is quite light in character, the varieties would necessarily need to be somewhat changed. From the results in the above table, it will be seen that the mixture recommended in 1893 gave an average of over four tons of green crop per acre, as compared with the average yield of the mixture recommended in 1885. It will also be seen that there were three cuttings from each plot in the past season, the largest cutting from each being that of June 30th, the second largest from the 13th, and the smallest from that of October 3rd. In every instance the yield of green crop per acre was larger from the mixture recommended in 1893 than from that recommended in 1885. The crop produced from the former was, however, somewhat coarser than that produced by the latter.

MISCELLANEOUS CROPS.

Besides the systematic experiments which have been reported upon in the foregoing pages, there were quite a number of minor experiments, the results of which could not be placed in tabulated form to advantage, but which are worthy of mention. Some of the crops which come under this head have been considerably boomed by seedsmen and others, who have made extravagant claims regarding the capabilities of the crops for farm use. When new varieties are suddenly placed upon the market at high prices, it is well for farmers and others to test only a small quantity at first, and also to watch the results of experiments conducted at the Agricultural College before large sums of money are spent for the purchase of expensive seed which may bring in but small returns. The following are some of the crops referred to which have not been spoken of in the preceding part of this report:

SACHALINE (*Polygonum Sachalinense*).

In the spring of 1896 twelve roots of Sachaline were purchased, and also a quantity of seed. Five plants were produced from the roots, but only four from the seed. The average height of the plants produced from the roots was 36.4 inches, and of those produced from the seed was 17 inches, in 1896. The plants became quite woody in the stalk in the latter part of the season. One or two plants which were cut at an early stage showed much tendency to send out branches from the same root, and showed some indications that in a short time the ground closely surrounding the plants would become pretty thoroughly covered with the Sachaline plants. It will be remembered that it was claimed that the plants would grow to a height of fourteen feet in the second year. Those which were grown in the experimental grounds in 1896 certainly came far short of this record.

PRICKLEY COMFREY.

In the spring of 1883, Prickley Comfrey roots were secured and placed in the plots of what was then the experimental grounds. The roots have been twice transplanted since that date and are still thriving well. This is a very hardy plant, as, in fact, it seems to live through almost any sort of treatment. There were two cuttings of Prickley Comfrey in the summer of 1896; one on July the 7th, which produced 14.4 tons of green crop per acre, and the other on August the 13th, which produced seven tons per acre, thus making a total of 21.4 tons of green crop per acre in 1896. This is certainly a good record for roots which are now at least thirteen years of age and have produced from one to three crops during each of these years. The crop, however, is not relished by animals, and for this reason is, we think, of but little use, although high claims were made for it several years ago.

FLAT PEA (*Lathyrus Sylvestris*).

Several plots of *Lathyrus Sylvestris* have been sown in the experimental department within the last six or seven years, but on the whole the results have not been very satisfactory, and we believe that this will not become a very important crop in general cultivation. The seed is very expensive and the plants require three years to obtain their full size. There is much trouble from weeds, and apparently the plants require a soil in good condition in order to produce satisfactory crops.

KIDNEY VETCH.

In the spring of 1894 a plot was sown with kidney vetch seed, and the germination was fairly good. The crop, however, has not given satisfactory results and appears to be of but little use, unless in very special cases.

KOHL RABI.

As Kohl Rabi is sometimes grown as food for sheep in some of the older countries three varieties were tested in the experimental plots in 1896. The yields were quite satisfactory. The amounts produced from the three varieties in 1896 were as follows: Early Vienna, 21.3 tons per acre; Purple Vienna, 17 tons, and Green, 20.5 tons per acre. The root and leaf somewhat resemble that of the Swede turnip, but the valuable part of the plant grows a few inches above the level of the ground. Kohl Rabi makes a very nice vegetable for domestic purposes.

Chicory.

A plot of Chicory, 1/100 of an acre in size, was grown in the experimental department in 1896. It is from the dry roots of this plant that the chicory of commerce is obtained and which is so commonly used as an adulteration of coffee. Nothing was done with the roots excepting that the yield of the fresh roots was determined. On harvesting the crop it was found that there were 11.35 tons of roots per acre, as determined from the yield of the plot.

Bokhara or Sweet Clover.

It will be seen in the report of 1895 that the Bokhara or Sweet Clover gave by far the largest yield of green crop per acre of all the clovers grown for that year. In fact, it yielded more than three times as much as any of the other varieties. The crop was rather far advanced when cut in 1895, and a portion of the seed became ripe. After the crop was cut, the plants all died; but in the spring of the present year there was a very thick crop of young clover plants, which gave a good growth during the present year, the yield being 3.9 tons of green crop per acre when cut on July the 7th. This clover is sometimes recommended to be grown for plowing under as a green crop, for which purpose it would likely prove quite serviceable. It is not relished well as a food for cattle, but in all past experiments it has proven to be a very large yielder.

Lupines.

Three varieties of Lupines were sown in 1896, but, as on all former occasions, they proved to be a failure. The seed usually germinates well and the plants make a good growth during the early stages of their existence, but the climate or soil of Ontario does not seem to be suitable for their full development. They have been tested for several years and have given very unsatisfactory results during each of these years.

Conclusion.

In conclusion I wish to say that the Experimental department was never so wel equipped as it is at the present time. The commodious experimental building, which was erected in 1895, will afford an opportunity for conducting several very important lines of work which we could not accomplish with the former accommodation.

I wish to direct the special attention of the reader to a close study of the results of the co-operative experiments in agriculture conducted over Ontario in 1896. These co-operative experiments are carried on conjointly by the Experimental department of the Ontario Agricultural College and the Ontario Agricultural and Experimental Union.

The Union opens up a channel through which the best material of the Experiment Station can be brought to the homes of the farmers; it makes direct application of the information gained at the Experiment Station by having experiments conducted upon hundreds of farms; and it systematises the co-operative work in such a way that the results can be summarized and made into valuable reports for the farmers generally. The influence of the Union is potent in bringing the Agricultural College into closer touch with the farmers, in fostering kindly feelings between the graduates and their Alma Mater, and in awakening wholesome lines of thought and observation in the minds of those engaged in the various branches of agriculture.

Respectfully submitted,

C. A. ZAVITZ,
Experimentalist.

Ontario Agricultural College,
Guelph. Dec. 31st, 1896.

PART XI.

REPORT OF THE

FARM SUPERINTENDENT.

To the President of the Ontario Agricultural College:

SIR,—I have the honor to submit herewith my annual report for the year 1896. I affords me pleasure to state that this year has been unusually prosperous, all our crops being good, with the exception of spring wheat, and our live stock being in a good healthy condition.

IMPROVEMENTS.

All the cross fences on the farm have been removed, which change, besides improving the appearance of the farm, has greatly reduced the annual expenditure for repairs, and the cleaning of fence bottoms has destroyed breeding places for weeds and grasshoppers. This change has also facilitated a systematic rotation of crops and the cultivation of the farm generally.

The farm being now divided into five sections, instead of twenty-acre fields as before, has received much attention from visitors during the past year. That part of section five known as field number twenty, the furthest north on the farm, had never been cultivated until this summer, when, on being cleared of old logs, trees, stumps and stones, it was plowed and thoroughly cultivated and made ready for cropping next spring. In this field there was a large basin which, for the want of drainage, could not be cultivated. This basin, on being excavated to a depth of four feet, was partly filled with one hundred and fifty loads of stones gathered from this section of the farm and then covered over with the earth that was taken out. A two-fold purpose was thus gained—first, the removal of the stones out of the way, and second, the making of arable land out of a pond-hole. In another portion of this same section there was a second basin that was dug out and filled in the same way. Many of the stones gathered from the field were so large as to require blasting before they could be moved. Besides having sufficient stones for filling the second basin, we have enough left for the erection of the large water tank at the College. Out of the sixty-two acres in section number five seven acres is woodland, and the remaining fifty-five acres, being meadow and pasture land, was plowed in August, thoroughly harrowed, disked and cultivated several times, and prepared for growing crops next season.

Under the head of improvements, I may mention that we have made a beginning in the repainting of the farm buildings. The horse and bull stables have been completed, having received two coats of paint. The work is for the most part done by the students, with a competent man to direct them. The paint is drab in color and consists of the following mixture, which is cheap and durable: First coat—40 lbs. whiting, 30 lbs. mineral drab, 25 lbs. white lead, 5 galls. linseed oil and 10 galls. benzine; second coat—80 lbs. mineral drab and 75 lbs. white lead, with 10 galls. linseed oil and 5 galls. benzine. The trimmings are brown mineral and oil.

Meadow.

We had eighty-five acres of meadow which yielded two hundred and fifty loads, the weight being estimated at two hundred tons. Sixty acres of the meadow was first year crop, chiefly clover, and about half of this yielded not less than three tons per acre. The remaining fifty-five acres yielded two tons per acre.

Pasture.

There were fifty acres of pasture land, and of this about twenty acres, with a portion of wood land, was allotted to the Dairy department. The remaining thirty acres, with several acres of wood land, pastured the farm cattle and sheep.

Grass Seeding.

Grass seed was sown with all our cereal crops, which consisted of one hundred and twenty acres of wheat, oats and barley. The mixture of grass seed was as follows: 7 pounds red clover, 3 pounds alsike, and 4 pounds timothy, being a total of 14 pounds per acre. The grass is growing well, as it has done for several years past. The system we have practiced is as follows: First, in the fall previous to sowing the land is prepared by the frequent use of the cultivator and harrow. This is done in order that the vegetable matter in the soil may be made available for plant food. As this decomposed vegetable matter is liable to leach away during the winter, the land is in the fall finally ribbed with a double mould-board plow, the drills being about twenty inches wide. The humus is thus kept in the centre of the drills undisturbed and ready for plant food in the spring. In preparing for seeding the drills are easily levelled by the harrow and cultivator. The second thing to observe is caution against sowing the grain too thick. The quantity should be rather under one and a half bushels per acre than over that amount. The third, and not the least important, observation to be made, is that of sowing the grass seed in front of the grain drill, so that the grass seed will be distributed between the rows of grain. After sowing the land should receive one stroke of the light harrow, or, what is better, one with Breed's weeder. The above rules, if followed, will give good crops and ensure a catch of grass.

Fall Wheat.

Twelve acres of fall wheat were grown in section number one, comprising fields numbers, one to five. In the system of rotation the wheat followed peas, the ground being prepared for the sowing of wheat by a shallow cultivation of the soil. After the peas were harvested in 1895 about thirty loads of barn-yard manure were spread over about three acres in a high portion of the field. The other part of the field received no manure, as it was sod previous to the growing of peas. There was sufficient vegetable matter in the soil for a crop of wheat. The manure was plowed in lightly, thoroughly harrowed and cultivated. The wheat was sown (drilled) on 26th and 27th August, 1895. and harvested July 10th and 11th, 1896. Six acres each of Dawson's Golden Chaff and Early Genesee Giant were grown, the average yield being thirty-five bushels per acre. The Early Genesee Giant yielded rather more grain and a much larger quantity of straw than the Golden Chaff. Although the high portion of the field received manure, yet the low land gave a much larger yield. The quality of both varieties of grain was excellent on both high and low land.

Spring Wheat.

The Herison Bearded and Pringle's Champion spring wheat were sown on 20th and 21st April, on the remaining portion of pea-land, twelve acres, but, like most of the spring wheat throughout western Ontario this season, it did not appear healthy from the time it was about three inches high. The lower leaves turned yellow, as if they had been blighted; and from the effects of this unfavorable beginning, the wheat never recovered. The only reason we could assign for this unusual occurrence was the early and very rapid growth while the subsoil was cold. The Herison Bearded yielded only nine bushels per acre; and the Pringle's Champion, six bushels.

Oats.

In section number one, there were thirty-three acres of Poland White oats, sown from 21st to 23rd April, and harvested from 28th to 30th July. As the oats are not yet threshed, the quantity yielded cannot be given. Considerable damage was done by the army worm. After eating all the leaves, it climbed to the top of the stalk and cut off the grain, allowing it to fall on the ground. In this way, about half the crop was lost, the later portions being damaged most.

In section number two, formerly known as fields numbers seven and eight, forty acres of Siberian oats were grown, the army worm destroying about half of this crop also. As this was a very fine crop, we may still have an average of forty bushels per acre. This variety was sown on April 16th to 18th and harvested on July 23rd to 25th.

Barley.

In that portion of section number one known as field number one, fourteen acres of Mandscheuri barley, two acres Oderbrucker, and two acres of Kinna Kulla barley were grown. Also in this field, two acres of peas and oats were grown to provide green feed for the dairy cows. The army worm did not injure the barley as much as the oats. Most of the leaves and beards were cut off, however, and about an average of five bushels per acre of grain. This field grew a crop of roots in 1895, and consequently the yield of barley was exceptionally good. As it is not yet threshed, the average yield cannot be given.

Peas.

In section number three and that part known as field number eleven, twenty acres of Prussian Blue peas were grown, which have not yet been thrashed, but will yield not less than thirty-five bushels per acre. The peas were sown on April 27th to 29th, and on Aug. 3rd to 6th eighty loads were harvested.

Corn.

There were thirty-five acres of ensilage corn, consisting of two varieties, the Mammoth Cuban and Wisconsin Earliest White Dent. It was sown on May 19th to 21st and harvested Sept. 14th to 24th. This year the corn was grown on low land, in the fields known as numbers twelve and fifteen. Two very heavy thunder showers at the end of May and on June the 20th, resulted in the destruction of three or four acres on the lowest parts. The remaining ground yielded fourteen tons per acre, which is considered a good average for these two varieties. The stalks are of medium size, but produce a large weight of ears. The yield was about fourteen tons per acre, four tons of which are ears. Cattle fed on such rich ensilage require little or no grain. With the exception of about five acres on knolls, the land had no manure. The sod which preceded the corn crop was plowed early in the previous fall and cultivated so that a portion of the vegetable matter was decomposed and made ready for the young corn plant to feed on. The corn was sown with the ordinary grain drill having all the tubes stopped but two, and so set that the rows were forty-two inches apart. Twelve pounds of seed were sown per acre, which may seem to be a thin sowing; but we prefer to have it so, since it produces a better quality of corn for ensilage.

Covering for Silo.

We have been experimenting each season to find a covering for the silo which would prevent the ensilage from moulding on top during the heating process. This season a cotton sheet, large enough to cover the silo, was first laid on the barn floor and given two coats of thick crude petroleum. It was afterwards spread on the top of the silo and two inch planks were laid around the sides, closely fitted at the corners. Occasionally a man walked on these planks for the purpose of pressing them down. It was found when the covering was removed, that there was no loss under the sheet, the only slight loss that occurred being between the edges of the planks and the walls of the silo. This loss might have been prevented by filling the space with salt. We commenced to feel the ensilage in the middle of October, and during the warm weather we covered the silo with the sheet after each day's allowance was taken out. The ensilage was thus kept perfectly sweet.

RAPE.

Two acres of rape were sown, one acre being sown on May 30th for the lambs while weaning in July, and the remainder on June 22nd for fall feeding. It was cut and drawn to the pastures each day for cattle, sheep and pigs. This feed put the animals in a healthy condition for winter. On the 20th November, it was cut and placed in wind-rows, where it kept in good condition until it was used at the close of the year.

FIELD ROOTS.

Section number two and that part known as field number nine were in sod previous to the growing of roots. The sod was plowed and cultivated in the fall of 1895. The land was given a coat of barnyard manure during the winter; and in the spring it was gang-plowed, and thoroughly harrowed and cultivated before being drilled. As this field was the only fall pasture for the dairy cows, the plowing was not done until November, so that there was not sufficient heat in the soil after that date to decompose the vegetable matter. Although it was harrowed and cultivated several times in the fall, yet the result was that the mangels did not germinate so quickly as they should have done, and there were many blanks. The different varieties were as follows: Four acres Yellow Intermediate, two acres Mammoth Long Red, and two acres Red Top Sugar Beets. The seed was sown on May 2nd to 5th in drills thirty inches apart, made with a double mould-board plow with marker. During the early part of the growing season, the roots were given shallow cultivation, chiefly with Breed's weeder. They were harvested on October 12th to 16th and taken directly to the cellar. The yield was as follows: 550 bushels per acre Yellow Intermediate, 775 bushels per acre Mammoth Long Red, and 500 bushels per acre Red Top Sugar Beet.

TURNIPS.

Six and a half acres of turnips, including the three varieties—Purple Top, Bronze Top and Green Top Swedes, were sown in the same section on June 13th to 15th. The drills were thirty inches apart, as in the case of mangels. The land received a thorough cultivating during the warm weather this spring, so that much vegetable matter was decomposed and made available for plant food. The young plants thus grew rapidly and a good crop was produced, averaging over seven hundred bushels per acre. The Purple Top gave the largest yield, with the Bronze Top second. As in the case of mangels, the cultivation was shallow and thorough. The crop was harvested on October 24th to 30th, and drawn directly to the cellar.

POTATOES.

Six acres of potatoes were grown in the same section as the other root crops, consisting of the following varieties: Touhocks and Burpee's E. E., first early; Rose of Erin and Crown Jewel, second early; American Wonder and Empire State, late varieties. They were planted on May 12th to 14th in drills thirty inches apart, with the sets one foot apart in the drill, and cut with two or three eyes in a set. They were planted about five inches deep and covered with a double mould-board plow. In about ten days the drills were harrowed down, and the ground kept thoroughly pulverized with Breed's weeder. We adhere strictly to the principle of surface cultivation in all root crops, and under no conditions is the cultivation deep, nor are potatoes hilled up, which course would mean the cutting off of a large number of feeders that supply the plants with nourishment. The potatoes were harvested on October 6th to 10th and placed in pits for twelve days, at the end of which time a part of each variety was repitted and will be kept for seed next spring. The quantity being kept for seed is five hundred bushels, while the balance, eight hundred bushels, was placed in the cellar to supply the College. The early varieties yielded about one hundred and fifty bushels per acre, and the late two hundred and fifty bushels.

Cultivation of the Soil.

In section number three twenty acres were fertilized last winter with coarse barnyard manure, at the rate of fifteen loads per acre. The land was gang-plowed in the spring and sown with peas. After the peas were harvested it was gang-plowed lightly, harrowed and thoroughly cultivated. The stones were then gathered and the land sown (drilled) with fall wheat on August 26th to 28th, at the rate of one and a halt bushels per acre, the varieties being Dawson's Golden Chaff and Early Genesee Giant. There were sown at the same time a mixture of three pounds of Alsike clover and four pounds Timothy per acre. The effects of this mode of cultivation were seen in the very hopeful appearance of the wheat this fall. Both the wheat and timothy fed on the nitrogen that collected near the surface of the pea-ground, which was not disturbed by the shallow cultivation which the pea-ground received. Early in the spring red clover will be sown by hand at the rate of seven pounds per acre and covered by crossing the rows of grain with Breed's weeder.

Sod Plowing.

Since haying one hundred and thirty acres of sod have been plowed and thoroughly cultivated by the use of the harrow, disc, and broad-share cultivator. Some portions of the field were cultivated several times for the purpose of cleaning the land of perennial and annual weeds, and of germinating and destroying the seeds. A second object gained by this method of cultivation was the decomposing a portion of the vegetable matter and making it available for plant food ; and to save this from leaching away with rains and melting snow, most of the land intended for spring crops has been drilled with a double mould-board plow, the drills being twenty inches apart. All the barnyard manure made during the summer was spread on the land before drilling, so that there will be no loss by leaching during the winter. This method of preparing the land in the fall by drilling was also applied to the root ground, which is decidedly preferable to plowing up the crude soil late in the fall, or, what is worse, in the spring.

Feeding of Live Stock.

The feeding and care of live stock has much to do with success in farming. A man may have a practical experience and also a scientific knowledge of feeding animals, and yet prove himself a failure at the successful management of live stock by not attending very closely to the many requirements of the animals. To obtain the best results the animals should be comfortably housed in winter, treated with kindness, and fed properly prepared food, regularly and in limited quantities. The stock should be fed according to the end one has in view. Breeding and young growing animals should receive bulky and easily digested food, such as ensilage, clover, roots and bran These are largely nitrogenous foods, which enter into the formation of flesh, bone, and muscle, the very thing the above mentioned stock are in need of. If the animals are fed on a concentrated grain ration, which is largely carbonaceous, they are liable to stunted development and disease.

Milch Cows.

It has been our custom for some years past to buy grade milch cows to supply milk to the College. Occasionally we got a good milker ; but as a rule after a short time they commenced putting on fat, instead of supplying milk. Early last spring we purchased three pure-bred Holstein cows and in the fall three pure-bred Ayrshires, which are giving good results. With these dairy breeds we have no difficulty in supplying all the milk required.

Feeding Milch Cows.

The ration for our milch cows this winter is as follows : Cut clover hay and chaff, 10 lbs. ; ensilage, 17 lbs. ; and pulped roots, 17 lbs. This ration is mixed the day before so that the cut clover hay and chaff have time te become thoroughly moistened. Of course, some cows require more than others, so that the above is the average per day. This is fed night and morning, with the addition of six pounds of bran and chopped grain.

At noon each cow receives twenty pounds of whole mangels. The average cost of each cow per day is twelve cents, which is an increase over last winter of one cent per day, due to the feeding of cut hay instead of all chaff. In summer, when on pasture, the ration is a feed of ensilage twice a day, fed when the cows are tied in for milking. In winter the cows that are not milking and the bulls rec ive only the mixture of cut hay and chaff, ensilage, and pulped roots. The average cost is six cents per day. The clover hay is estimated at seven dollars per ton, and the ensilage, roots and chaff, two dollars per ton. No value is put on the manure, as it is allowed to balance the cost of labor.

Results from Feeding Steers.

On December 19th, 1895, we purchased from three farmers in the neighborhood ten two-year-old steers, which had been stall-fed for about a month. They were sold to Messrs. J. A. Leaman & Co., of Halifax, Nova Scotia, and shipped on August 6th, 1896:

December 19th—Total weight, 10,857 lbs., @ 3¼ cts.	$352 85
Cost of food for 7½ months	247 80
Total cost	$600 65
August 6th—Total weight, 13,905 lbs., @ 4 cts.	556 20
Loss	$44 45

It may be asked why there should be a loss of $4.45 a head this year and a profit of $21.43 a head last year. There were two reasons for this: The first was that this year there was only three-quarters of a cent per pound advance, while last year there was two cents. It is essential that one should have a margin of two cents per pound between the buying price in the fall and the selling price in the following spring to insure a profit for feeding steers. The second reason was because the steers had been fed too much grain before we got them. One in particular only gained five pounds the first month. It is quite common for feeders to be astray in feeding rations. The steers were all fed on succulent food for the first six weeks, during which time their digestive organs were brought to a healthy condition. The same steer that gained only five pounds the first month gained sixty pounds the third month.

The daily ration for each animal per day for the first forty-three days was a mixture of forty pounds, containing ensilage, pulped roots, and chaff, with an additional five pounds of bran. This was fed night and morning, and at noon each steer received twenty-five pounds of roots. The ration cost ten cents per day. For the next eighty-nine days the same mixture and the same quantity of roots were fed, but the five pounds of bran were substituted by four pounds of chopped grain and two and a half pounds of bran. The daily cost of this ration was twelve cents. From the 1st of May until the 6th of August (ninety-eight days) the ration was forty pounds of ensilage and cut clover, with seven and a half pounds of chopped grain and bran. The cost was ten cents per day.

Pigs.

The breeding animals, male and female, are fed on the same principle as that applied to the rest of our live stock. They are given food that will produce flesh, bone, and muscle, instead of fat. The brood sows are fed night and morning on boiled roots with bran mixed, and at noon on raw roots. We do not feed kitchen slops to our brood sows. By adhering closely to these rules we are having excellent success with our pigs.

Results from Feeding Pigs.

On November 18th, 1895, twenty-four pigs, averaging about seven weeks old, were purchased in Guelph:

Cost of twenty-four pigs	$31 00
Cost of food until June 2nd, 1896	99 33
Total cost	$130 33
Weight June 2nd, 1896, 4,841 lbs., @ $3.85 per hundred	186 37
Net profit	$56 04

Food consumed for the six months and a half was as follows:

847 bushels roots @ 7 cents per bushel	$59 29
1,082 lbs. midd ings @ $15 per ton	8 11
2,500 lbs. bran @ $12 per ton	15 00
1,464 lbs. grain and bran @ 75 cents per 100 lbs.	10 98
3,300 lbs. skimmed milk @ 15 cents per 100 lbs.	4 95
30 lbs. ground flax seed	1 00
Total cost of food consumed	$99 33

Sheep.

For some cause the sheep on the farm have not done well for a number of years, but I am pleased to state that we could not wish for a more healthful lot of breeding ewes than we have had during the past season. We have been particular about keeping the pens dry and clean, by frequently removing the manure and replacing it with dry straw. Sheep manure ferments quickly and throws off a gas which is very injurious to the health of the animals. The sheep were shorn in the middle of April, and soon after they, with the lambs, were dipped, to keep them free from vermin. They were dipped again at the end of October. There was another trouble, however, to be contended with.

During the past two years we have had trouble with our young lambs. They would suck the wool, get it into their stomachs, and ultimately die from the effect. Last spring we partitioned off a part of each pen and made an opening large enough to allow the lambs to go in and out. In the lambs' quarters, we put a trough, and put in each day a mixture of cut clover hay, pulped turnips, and bran, which had been mixed the day before to moisten the clover. The lambs relishd this succulent food very much, and they had no further desire to suck the wool; consequently we did not lose any lambs last spring through the effects of wool collecting in their stomachs. We weaned the lambs in July. They were pastured on fresh clover, and during the heat of the day they were housed and fed some rape and bran, with a little ground flax seed. With this treatment our lambs did remarkably well.

In the fall of the year, both ewes and lambs receive a daily ration of rape, and in the winter season, the breeding sheep (sixty in all, including ewes and rams) are fed the following mixture per day: Cut clover 120 lbs., ensilage 120 lbs., pulped roots 180 lbs., and bran 30 lbs. This is mixed the day before to have the clover well moistened, and is fed night and morning. At noon they are fed pea-straw. The total cost per day is eighty cents, which is a little less than one and a half cents per day for each animal.

Horses.

Our horses are fed during four months of the winter, at a time when they are comparatively idle, as follows: Out hay 12 lbs., ensilage 17 lbs., and pulped turnips 17 lbs., being a total of 46 lbs., per day for each horse. This ration is mixed by spreading on the floor of feed room a layer of each kind of food alternately, until sufficient is mixed for the following day; and when the hay is well moistened, the mixture commences to ferment. In addition to the above, each horse receives daily three pounds of chopped grain and bran of equal quantities, which is divided at morning and evening meals. The average cost per day for each horse is nine cents, which is two cents more than last year. The increase in the cost is due to feeding cut clover hay, instead of chaff. We have an abundance of hay this year, which was not the case last year, owing to the severe frost of May 13th, 1895.

During the past three years, we have endeavored to work the farm with two cart horses and four teams instead of five teams as formerly. Our horses have additional work to perform, which would not be required on an ordinary farm, so that they require the best of food and attention. Last spring we disposed of three farm horses, two of which were too light for our purpose and one which was past work. These were replaced by three good young animals, having an average weight of 1,550 lbs. From the first of April until the first of December (eight months), the horses were fed at five o'clock in the morning and taken out to work at fifteen minutes to seven o'clock. They were brought in again at twelve o'clock for one hour, and worked till six in the evening, when they were thoroughly groomed and fed. During these eight months, they received the following rations: Cut hay about 20 lbs, chopped grain and bran 16 lbs. The average cost of each horse per day was eighteen cents. Our rule was to feed each horse just what he could eat within one hour after he was given his food. This rule applied to all animals.

Live Stock for Educational Purposes.

The following live stock are kept for educational purposes:

8 breeds of cattle, one male and two females of each breed.
9 " sheep, " " six " " "
5 " swine, " " two " " "

Practical Instruction.

The first and second year students were required to work on the farm and in other departments each alternate afternoon, for which they were paid in proportion to the work performed. The amount they earned was credited to their board account. Lists were prepared with the names arranged in alphabetic order, and each student was expected to take his turn at all kinds of work on the farm, among the live stock and poultry, at dairying, horticulture, carpentering, and in the experimental department.

In the beginning of November, an opportunity was given those students who have had more or less experience in plowing, to test their skill in plowing sod. Thirty-one students entered into the competition, each competitor plowing in turn according to the number he drew. Each person plowed eight furrows, forty rods long, using the same team and plow. The time allowed was one hour, and the standard size of the furrow was set at six inches deep by nine inches wide. Ten awards were made by two competent udges, the work performed being very creditable indeed. Mr. Colin Carmichael, head teamster, attended to numbering the lots and giving instruction. The students who required instruction in plowing were given it in loose land, which was necessary for beginners.

Before the examination last June, the second year students plowed a ridge each for the purpose of testing their skill, and marks were given according to work done. The plowing was judged by the following scale of points: Beginning, 20; even holding, 20; shaped ridge, 20; straitness, 20; finish, 20; total, 100.

The minimum number of marks required to pass was forty-five. They all passed, with one exception.

Annual Sale.

The annnal sale of surplus young live stock was held at the farm on October 14th. The prices realized were moderate, yet, considering the low prices of agricultural products generally the sale on the whole was satisfactory.

8 calves realized	$238 00
47 young pigs realized	381 50
24 lambs realized	166 00
Total	$785 50

Submitting the above in the hope that it will meet with your approval, I have the honor to be,

Your obedient servant,

Wm. Rennie,
Farm Superintendent.

Ontario Agricultural College,
Guelph, December 31st, 1896.

PART XII.

REPORT OF

MANAGER OF POULTRY DEPARTMENT.

To the President of the Ontario Agricultural College:

SIR—I have the honor of submitting for your consideration the report of the Poultry Department for the year 1896.

TEACHING.

Instruction has been given by means of lectures in class-room and practical work in the Poultry department. The course of lectures has been chiefly on the care and management of poultry, the characteristics of the different breeds, and their origin; the color of plumage of different varieties of utility birds and the classes to which they belong, the kind of fowl to select for meat and egg production; the dressing of poultry for the market, the diseases prevalent among fowl, and the treatment in each case; also the method of applying the standard in judging or selecting stock for breeding purposes.

BREEDING STOCK.

The following varieties of fowls were used for breeding purposes in the different pens this season and their average egg production was as stated.

No. of pen.	Name of breed.	Number of hens in pen.	Number of eggs layed.	Average per hen.
I.	Barred Plymouth Rocks	5	468	93.6
II.	Young Chicks	......	......	......
III.	Black Minorcas	6	366	61.
IV.	Black Langshans	5	393	78.6
V.	Light Brahmas	5	172	34.4
VI.	White Plymouth Rocks	5	434	86.8
VII.	White Javas	5	463	92.6
VIII.	Brown Leghorns	5	400	80.
IX.	Blue Andalusians	5	538	107.6
X.	Silver-laced Wyandottes	6	474	79.
XI.	Silver-spangled Hamburgs	7	357	51.
XII.	Black Spanish	6	126	21.
XIII.	White Leghorns	6	414	69.
XIV.	Houdans	5	206	41.2
			4,811	

We could not expect to get so large an average of eggs where fowls are confined to small runs and where we have to keep so many varieties. The Leghorns, Hamburgs, Minorcas, Houdans, and Spanish are true rangers; and unless they are allowed their liberty, we need expect no favorable results in egg production. Rocks, Wyandottes, and Javas belong to the middle class, as it were, and give satisfaction either in confinement or on a free range. The Rocks, Javas, Wyandottes, and Langshans layed the largest number of eggs in the winter months, and the Andalusians the largest number during the year. Two hens in the Langshan, Wyandotte, and Java pens, and three in the White and Barred Rock pens, were allowed to hatch and brood their young during the season; otherwise the average in those pens would have been larger.

The Brahmas were three years old: so we did not expect any great results from this pen. We were very much disappointed in the Spanish pen. They were over five months in getting through their moult, although apparently in good health. This year they moulted earlier in the season, and we hope to see better results in egg production.

Artificial Incubation.

The results we have obtained this year from this mode of incubation have not been very satisfactory.

We used a hot air and a hot water machine, one of 100 egg and the other of 200 egg capacity. We had no difficulty in keeping an even temperature of heat in the egg chamber. Neither of them in any case varied over two degrees during the period of incubation, and 51 per cent. from fertile eggs was the best hatch we had during the year.

In our experiments we used moisture in different ways and at different times, airing the eggs in some cases once and in other cases twice a day, and in every particular carrying out the directions of the manufacturers of the incubators used.

For safety, in case of fire, we had the ceiling of the incubator room in the basement covered with tin. At that time eighty fertile eggs had been in the incubator for twelve days. We did not think that pounding over the machine at the time would affect the embryo, or chick, in the eggs; but it certainly did, as we did not get one chick from the entire setting. We examined every egg and seventy-five contained chicks that had died during the time we were repairing the room.

In conversation the other day, a person who has been using an incubator with fairly good results, said he moved his machine to a room close to the railroad track and found that the jar affected the eggs in the same way.

There is no doubt that the two most important factors in the art of artificial incubation are warmth and ventilation. Nearly all the incidental phenomena centre around these two factors.

By the increase or diminution of warmth the vital activity of the embryo is stimulated or depressed; and through ventilation, the life-giving constituents of the blood are maintained. By regulating the degree of heat the development of the chick is controlled and the chick excluded at the proper time; and when the humidity of the air is properly regulated cooperation is controlled, and the embryonic structures retain within their membranes until the last the necessary liquid for the maintenance of their vital functions. To maintain a constant degree of heat is of vital importance. After a constant degree of heat, the most important thing is constant ventilation.

Mr. Chas A. Cyphers, author of incubation and its natural laws, says: "The move- of the air exerts a greater influence upon the rate of evaporation than the degree of humidity, and the ventilation controls the movement as well as the humidity of the air." Moreover, repeated experiments have demonstrated that supplied moisture is essential to successful incubation. The necessary amount is determined by the degree of humidity, and the rate of movement of the air within the chamber. There requires to be a nice balance maintained between the temperature and the atmospheric conditions, and unless this balance is maintained incubation cannot be carried to a successful conclusion.

With the four physical forces of incubation under control, that is, the warmth, purity, humidity, and rate of movement of the air surrounding the eggs, the balance can be maintained, and then artificial incubation becomes a normal progress that obviates many of the variable factors with the hen incubating.

With a thorough knowledge of the laws that control these forces, artificial incubation should be prosecuted more successfully in the future than it has been in the past. I have selected for our experiment for another year two machines of 100-egg capacity, one heated by hot air and the other by hot water. The system of ventilation in these incubators I consider better than in those used last season.

These machines have been placed in our department by the manufacturers, to be tested. I will give them a thorough trial, under the most favorable circumstances that I have at my command, and will give the results in my next report.

Fertility of Eggs.

On testing the eggs from the different pens in February we found 59 per cent. fertile; in March, only 52 per cent.; in April, about 60 per cent.; and through the month of May, over 85 per cent. The length of the winter and its severity was, no doubt, the cause of the small percentage of fertile eggs during the early part of the season.

Young Stock.

We hatched a few Rock chicks on the 23rd of March; and when five months old some of the pullets from this hatch began to lay. We raised to maturity 205 chicks this season, some of them extra fine specimens of their respective classes.

We find large and small chicks of different breeds running together do not thrive so well as when they are kept separate. As you have proposed to extend our yards another season, we hope to be in a position to raise a greater number, and we expect a general improvement in our stock.

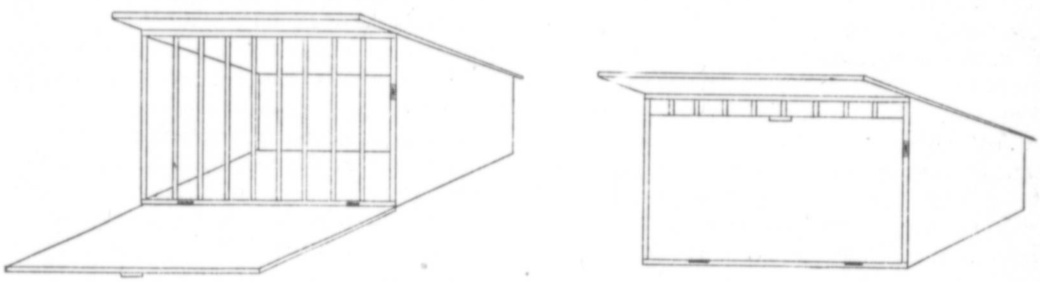


Fig. 1. Fig. 2.

Coop for Hen and Brood (Figs. 1 and 2.)

The coop used at our department is simple, cheap, and convenient. It is 3 feet long, 2 feet wide, 2 feet high at the front, and 1 foot high at the rear.

The floor is made separate, so that the coop can be taken off and the floor cleaned, which is very necessary for the successful raising of young chicks. At the front are eight palings, made of $\frac{3}{4}$-inch round strips, $2\frac{1}{2}$ inches apart, which give plenty of room for the chicks to pass through at liberty. The roof projects out about eight inches, to protect the occupants from the sun and rain.

The door, hinged at the bottom, is dropped down in the daytime and used us a feeding board (Fig. 1); and at night it can be closed, leaving a space at the top for ventilation (Fig. 2.)

Feeding.

A perfectly regular system of feeding has been adhered to in our department, and nothing perhaps is more beneficial to the condition of the fowl. The fowls look for their food at the hour they have been accustomed to get it. Feeding at irregular intervals causes restlessness among the flocks, and must necessarily prevent healthy growth and egg production.

No fixed rules can be made for the quantity of food that is necessary for the best results. Fat-forming foods can be given to a greater extent when fowls have a free range, than when they are confined in close quarters. An over-fed hen is not a good layer; and she is apt to get egg-bound or lay soft shelled eggs and become broody more frequently than when fed judiciously.

Give your hens plenty of exercise; and when they are confined in winter quarters, make them scratch and work for their living, if you do not want them to become over-fat or to die on the roost from apoplexy. To make them work, scatter all grain food in the litter on the floor, composed of cut leaves, straw or chaff. The practice of keeping feed constantly before laying hens is not only a waste but an obstacle to egg production.

Poultry, like other stock, should be fed in a rational intelligent manner. They should be given rations that are known to stimulate egg production. If we wish to fatten poultry quite a different kind of food is given. Some of the larger breeds of poultry do not forage to any great extent, and become too fat, if fed on certain feed that can be allowed the more active breeds without impairing their laying qualities or making them too fat.

What we used for the morning meal during the winter months, unless when very cold, is soft food composed sometimes of boiled potatoes, bran and shorts or middlings, in equal proportions; and at other times, of boiled roots with bran and middlings, a little chopped oats being added occasionally.

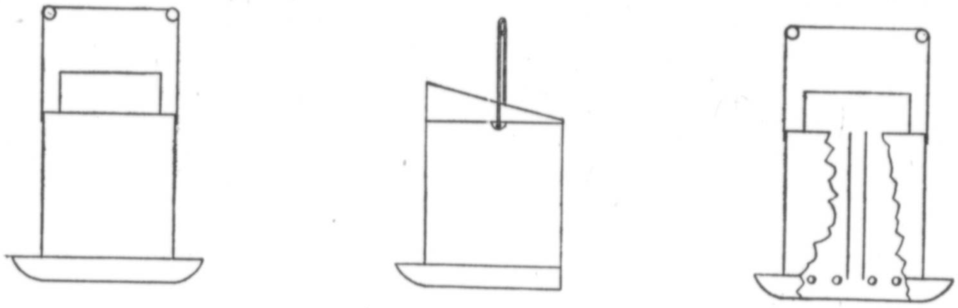
To insure perfect health, part of the food should be of a bulky nature, and we find that finely cut clover hay mixed with the other ingredients, answers the purpose very well. If the morning is very cold, we feed a little grain in the litter, but not all they can eat, to get them to take exercise; and then we give them the soft food at noon. If we give soft food on a cold morning, the hens huddle up in one corner of the pen, and do not take exercise sufficient to keep themselves warm. We always feed grain at night—wheat, buckwheat, oats and barley are the chief grains which we use. We give very little corn to laying hens as it is too fattening. We use green cut bone when we can get it, and we find that it increases the egg production. There is very little nutriment in the bones which we get from the College, as most of them have been boiled; and we find that it scarcely pays to cut bones of this kind. We are now getting a regular supply of pieces of stale bread and refuse from the College tables, and we find it a great help in making up soft food. We find that sweet skimmed milk, or sour milk also, adds materially to egg production. In fact, if fowls have plenty of milk to drink and vegetables to eat during the winter, with whole grain as their feed, they will lay as well and keep in as good condition as if they were fed on soft food once a day without milk.

Feeding Young Chicks.

The first meal for chickens after being taken from incubator or nest, should be the yolk of hard boiled eggs chopped fine and mixed with bread crumbs. We do not give the white of the egg to young chicks, as we find it very indigestible. After the first day, we feed stale bread soaked in milk. We prefer the milk scalded. We also use granulated oatmeal, fed dry, or granulated corn. This bill of fare will be found sufficient for the first two weeks, if the chickens have their liberty so as to get grass or insect food. In winter before the chicks can get outside, after they are two weeks old, we add to the above feed a little boiled liver crumbled fine. Lettuce cut as fine as possible or green oats raised in frames at the windows, is a valuable addition to the food. When green food is not available, steamed clover leaves will answer the purpose We continue feeding dry or stale bread or corn-cake soaked in milk during the summer. We also feed granulated corn and small wheat. We feed at least four times a day, as early in the morning and as late at night as they can see to eat, and no more at a time than they eat up clean. After they are two weeks old, we give them milk as well as water to drink.

The Supply of Water.

An abundant supply of fresh water is conducive to the health of the fowls; and during warm weather, fresh water should be supplied twice or three times a day. Drinking vessels are used as a proper means of supplying the water. After testing different kinds of fountains and vessels, we find that the one now in use at our department is very satisfactory It is both cheap and durable and may be recommended for general use both by farmers and fanciers. It is made of galvanized iron, square, with a place left in the top to pour the water in. It holds from four to six quarts. At the bottom, a two-inch trough is constructed on three sides, for those used in breeding pens; others used outside for young chickens, have the trough on four sides. Holes are made in the side of the fountain about one inch from the bottom, out of which water runs into the trough. The fountain having an air-tube inside, the water can rise only to the height of these holes; so as the fowl drink, the water comes out fresh and clean. The fountain is hung on hooks just high enough for the birds to reach it conveniently. This prevents dirt from getting into the water and also



Front View. Side View. Interior.

keeps combs and wattles dry, a great advantage during cold weather. Pans or shallow dishes are useless for drinking vessels, as the water becomes stale and dirty in a short time.

Different Kinds of Grit.

We have used several kinds of prepared grit—ground or broken oyster shells, broken brick and mica crystal. We have mixed them together and placed them in a trough prepared for the same, and find that our fowls prefer the mica crystal to the brick and oyster shells. They eat it first, leaving the others; yet oyster shells as well as grit, have been considered necessary for shell material. Fine gravel may be used, as it contains more or less lime. It can be used with crystal or other sharper grits to good advantage.

Buildings and Furnishings.

A great many farmers who were contemplating the erection of poultry houses, visited our department during the year, to get some hints or assistance to enable them to build suitable buildings at the smallest cost. Others have written for plans of buildings and furnishings I have endeavored to give them all the information possible, and have sent plans of buildings, which in a measure, would conform to the necessities of the location upon which they were to be erected; also plans of roosts, nest-boxes and feeding-troughs, the same as those used in our department. We present two cuts of buildings which we consider quite suitable for all practical purposes.

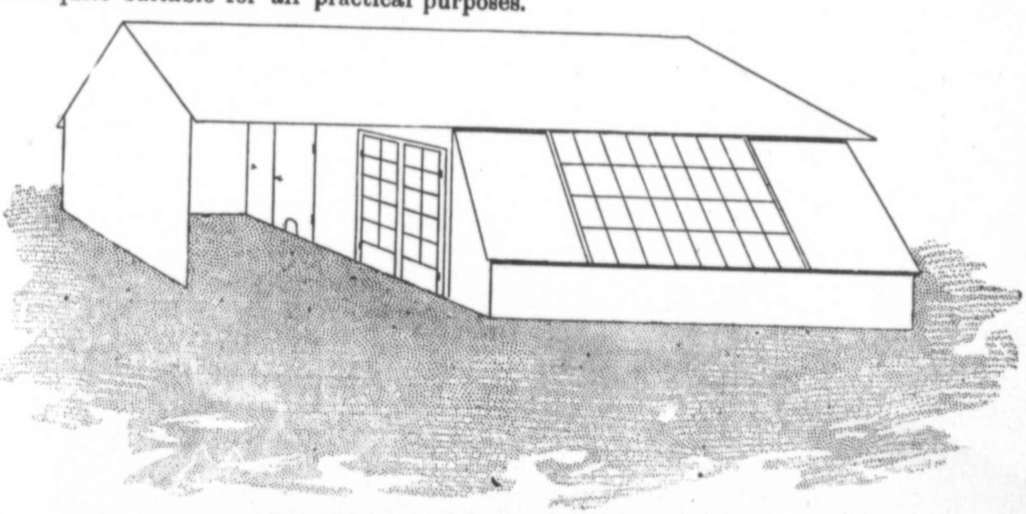


Fig. 1A.—View of south side of poultry house.

Figs. No. 1A. and 1B. represent a building 13 x 25 feet. The laying and roosting room with the two-foot projection, makes that room 15 x 15 and a shed or scratching-room

10 x 13; the front posts 7 feet, rear posts 5 feet, front roof $8\frac{1}{2}$ feet, rear $11\frac{1}{2}$ feet. There are two doors in front of scratching-pen, made to swing inward with a window in each, to

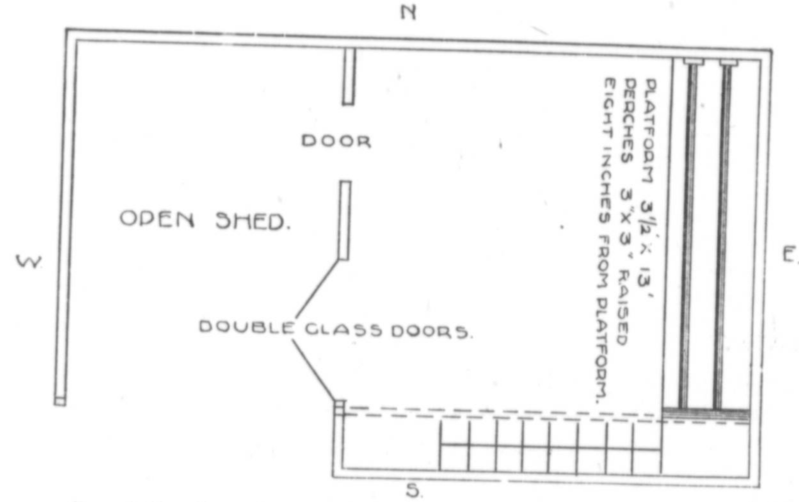


FIG. 1.B.—Ground plan of poultry house. Scale $\frac{1}{8}$-inch to the foot.

admit sunlight when closed. During mild weather they can be thrown open when the fowls may exercise in open air, being protected from wind and storm. Shutters may be placed on window in extension front, so as to be closed at night during cold weather and double windows on scratching-pen doors.

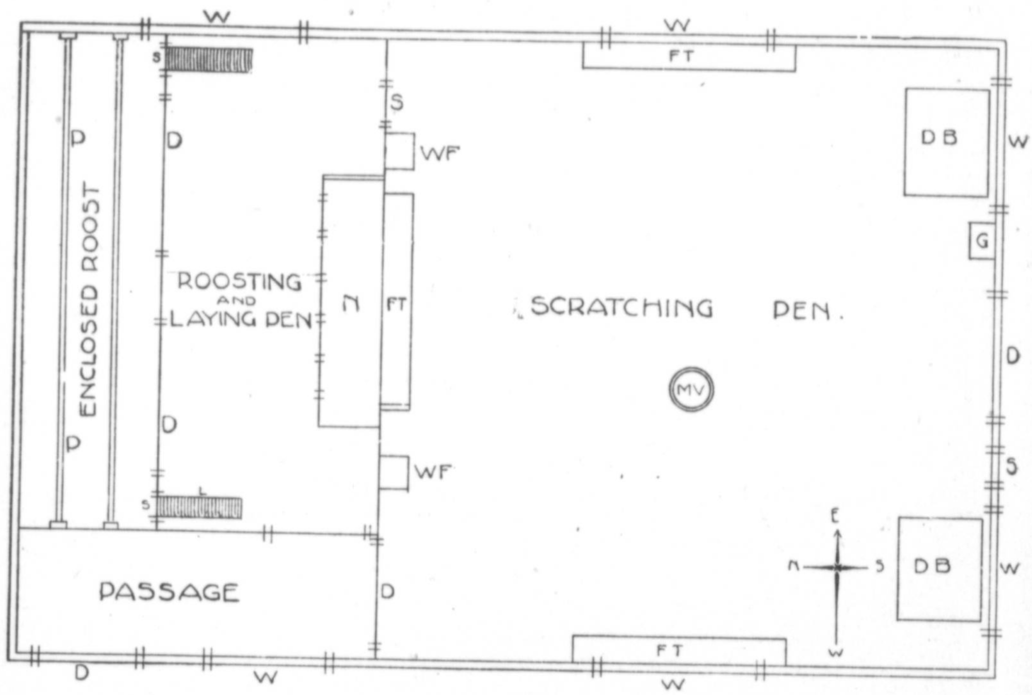


FIG. 2.

Ground plan of poultry building for 50 fowls. Scale, $\frac{1}{4}$ inch to the foot. D, doors; W, windows; S, slides; N, nests; FT, feed troughs; P, perches; L, ladders. MV, milk vessel; WF, water fountains; G, grit; DB, dust bath.

Cut No. 2 represents the ground plan of west wing of poultry house No. 1, better known as pen for mixed breeds. It is divided into two apartments, one the laying and roosting room, 9 x 12 feet, with enclosed roosts the full length of room, in space 3 feet wide and 3 feet from floor, with doors in front for the convenience of cleaning. At each end is a small hole through which the fowls enter by means of a short ladder. This is found to be a great advantage where there is no artificial heat used, as it is during the night that fowls become chilled in cold weather. There is a board floor on which chaff or leaves are thrown, as it is easier to clean and warmer for the fowl than a dirt floor. The scratching or feeding pen, which is 15 x 15 feet, being in front of the laying and roosting room, has windows on three sides, and thus admits the sunlight during the entire day. In this room are found two drinking fountains and a vessel for holding milk. This vessel is

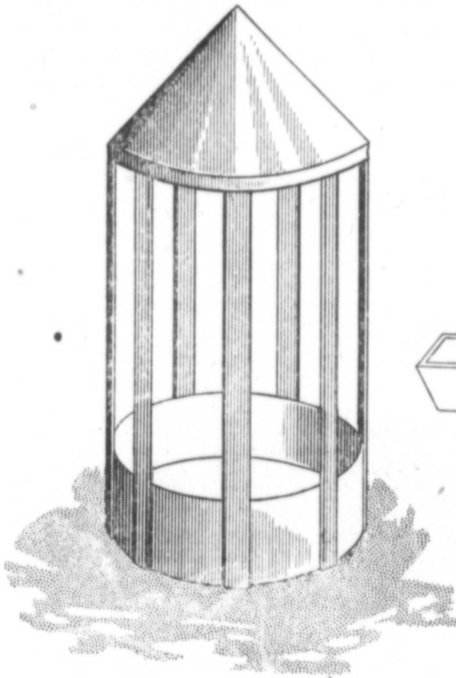


Fig. 3.
Dish, 3 in. deep; uprights, 4 in. apart and 15 in. long.

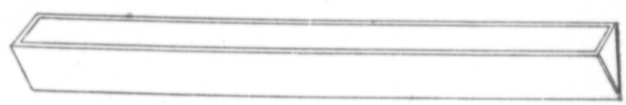


Fig. 4.

protected as in Fig. 3, by a frame made of wood, with a cone-shaped top of tin, to prevent the fowls from roosting on it. The contents of the dish under this frame cannot be dirtied or spilled by the fowl.

Fig. 4 is a trough for soft food, supported by two nails driven into the partition obliquely, so that it can be easily removed, if required, to be cleaned. There is a gravel floor in the room, on which is scattered chaff or cut straw; all grain is thrown among the litter, and the occupants may be seen any time during the day busy searching for food.

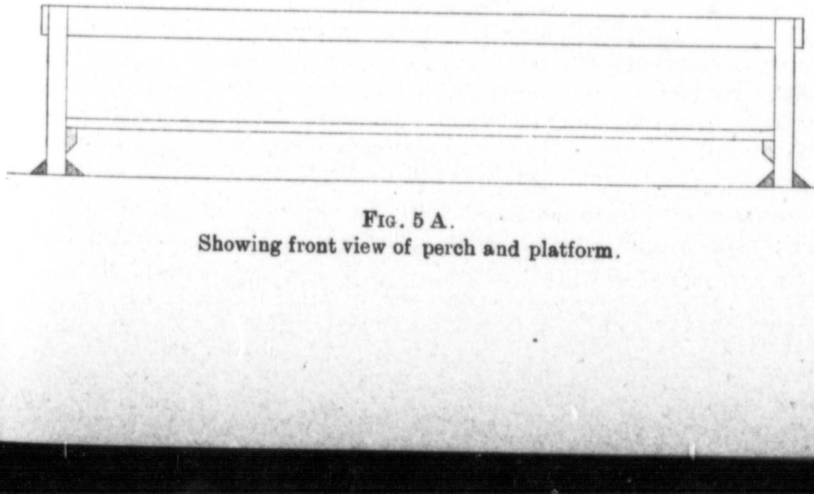


Fig. 5 A.
Showing front view of perch and platform.

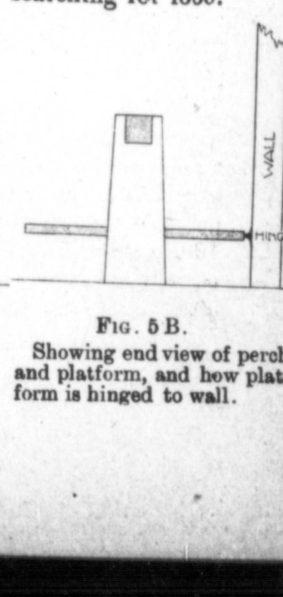


Fig. 5 B.
Showing end view of perch and platform, and how platform is hinged to wall.

Fig. 5 represents roosts used in No. 1 building, where all the heavier breeds are kept, and roosts have need to be as low as possible, as all varieties in the Asiatic and American classes are heavy birds, and if allowed to jump or fly from high perches, they are apt to injure themselves in different ways, especially during the laying season. The disease called bumble-foot is often caused in this way. This roost is 7 feet long and will accommodate 10 fowls of the larger breeds. The perch is 3x3-inch scantling, slightly rounded on top, supported by two uprights 2x8 inches and 18 inches in length. A notch is cut out of the top of this upright sufficient to admit the perch, and on the inside of it there is a cleat to support the drop board. The drop board is 2 feet wide, and is hinged to a partition by ordinary gate hinges, so that it can be taken off if need be, or during day time may be fastened back to the partition, or when cleaning out any filth that may gather from time to time under the same. This we consider one of the cheapest and most convenient roosts constructed, and it answers all practical purposes for the heavier breeds of fowl.

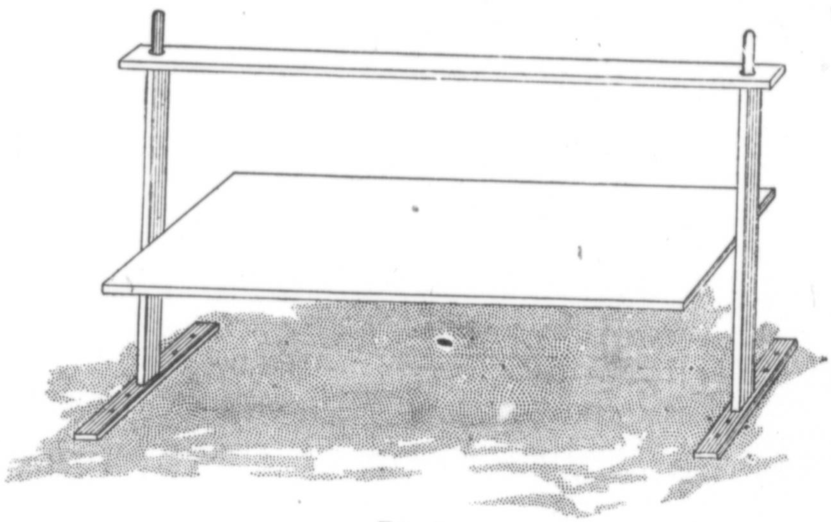


Fig. 6.

Fig. 6 is a cut of a roost used in house No. 2. It is neat in appearance, and the uprights being made of iron, is proof against vermin. It is durable, as there is nothing in its construction that can get out of order. It costs but little more than that used in house No. 1. The same uprights would support a perch 12 feet long, if required. As the drop board is about 14 inches from floor, hence it is convenient for cleaning; and, when necessary, it can be taken from the uprights and carried outside for extra cleaning. It is only necessary to turn a thumb-screw in order to turn the dropping board up under the perch and thus keep it out of the way during the day. When you require it for use at night you simply have to give the screw a reverse turn. We consider this the best roost for ordinary fowl. The perch, being 26 inches from the floor, may be considered a little high for the heavier breeds. The iron uprights are attached to floor by screws. The perch in use is 7 feet long and made of 2x4-inch scantling. A 3x3-inch perch is preferable for short roosts, as we find there is more surface than is necessary for small fowl.

Fig. 7 is a cut of an egg closet kept in the basement under our office. It is very satisfactory for preserving eggs, both for hatching and for ordinary use. Eggs layed in September and placed in this closet were found to be in good condition when tested on January 1st. The height of the closet is 6 feet, depth $2\frac{1}{2}$ feet, and width 2 feet. Holes are made in top and bottom of both sides for the free circulation of air. Ten trays, holding 100 eggs each, and three large drawers that hold 400 eggs each, make up the total egg capacity.

The trays (Fig. 8) are made of $\frac{1}{2}$-inch material, with fine wire for bottom, to allow the free circulation of air; (B) is a similar frame, with 12 cross wires, between which the eggs are placed; frame (B) is placed inside of (A), and being 2 inches shorter, will admit of this tray being moved, and by drawing the frame (B) back and forth, completely turns

Fig. 7 A.
Front view of closet with door open, showing drawers.

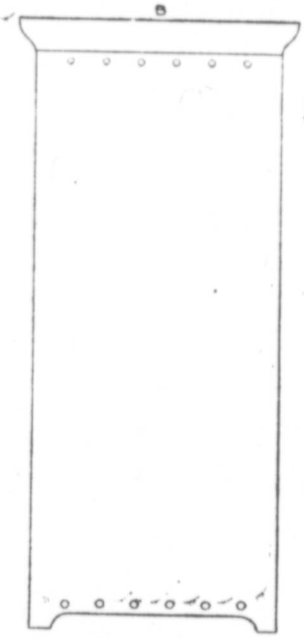


Fig. 7 B.
Side view of closet, showing holes for ventilation.

the eggs at the one movement. It is necessary to have eggs turned when they are kept for hatching purposes, and we have found this the most convenient and successful way of

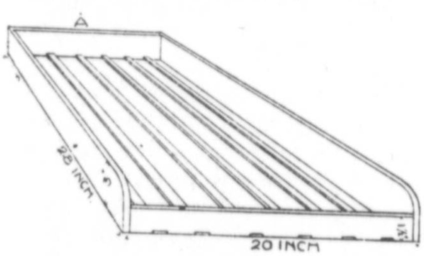


Fig. 8 A.
Drawer of egg closet. The strips in the bottom support a sheet of fine wire netting, on which the eggs rest.

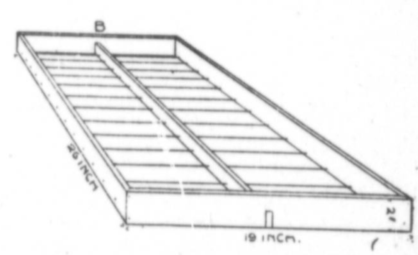


Fig. 8 B.
This frame fits inside of the drawer (A), and the eggs lie between the cross wires, which are two inches apart. The frame is two inches shorter than the drawer, and will slide backwards and forwards on the bottom of the drawer.

turning them. The drawers below may be used for the temporary keeping of eggs for home use or market purposes.

Improvements Made During the Year.

Four small houses have been erected for young stock during the past year. These were required for the young fowl before being disposed of in the fall. We have found them in every way suitable for the purposes intended. The cock-pens have been whitewashed, which added greatly to their appearance and has been beneficial. We think if houses No. 1 and 2 were whitewashed it would add greatly to their appearance, as the walls are getting dark in color and have a gloomy appearance, and the fowls in them do not show to their best advantage. An application of whitewash both in spring and fall would add much to the sweetness of the buildings, and at the same time would contribute to the health of the stock.

Losses from Disease.

We have but few losses to report, as during the year our stock has been in a healthy condition; yet we must expect to meet with some losses where a large number of fowl are kept, especially when not allowed their freedom.

Crop-Bound. We lost one hen from being crop-bound. We have seen and have treated a great number of fowl with clogging of food in the crop, and generally have succeeded in removing the trouble. We give a dessert spoonful of castor oil and knead the crop with the fingers. This treatment generally effects a cure. If this treatment does not give relief, cut open the crop and, with a wooden spoon, take out part of the contents, then sew up with silk—first the inner, and then the outer skin. Feed on soft food and very little at a time for several days.

Egg-Bound. We lost two hens from being egg-bound. Both of them had been troubled frequently in the same way. In such cases, a dose of castor oil will often give relief, or the injection of sweet oil into the ovaduct. Great care should be used so as not to break the egg, and thus injure or kill the hen. One male and one female in different breeding pens were found dead under the roosts. The cause was apoplexy. One male bird had a large tumor or growth on the side of his breast, and died from this cause. Where you are raising a large number of chickens you will find occasionally one deformed. Those we kill, as they are unsightly, and it does not pay to raise them for any purpose.

Scaly-Legs. This disease is caused by a very minute parasite working under the scales on the legs. If it is allowed to remain the scales will eventually become so thick that it is with difficulty that the fowl can walk. We have had a few birds this season among the stock purchased showing signs of this disease. A cure can be effected quickly in the first stages by washing the legs with warm soap-suds, using a coarse brush, and then applying the following mixture: Mutton tallow, sulphur and kerosene oil, with the addition of a few drops of carbolic acid in severe cases. Two or three applications generally effect a cure.

Bumble-Foot. A swelling on the bottom of the foot, which may be seen between the toes, and in some cases the leg may be swollen and very much inflamed. Treatment: Lance the swelling and squeeze out all the pus or matter, then wash clean with warm water, and when all bleeding is stopped, apply a nitrate of silver solution, using about fifty grains to the ounce of water. This treatment will effect a cure in every case if properly applied.

Chicken-Pox. At the Ontario Poultry Show, held at Port Hope last winter, we had to remove several birds on account of this disease, and I have seen several cases in different flocks during the summer. Symptoms: An eruption of a yellowish white color on the comb, face, eyes and wattles. Treatment: Remove all affected birds and disinfect the house. Remove the crown from each eruption or pustule. They will bleed profusely. Then wash with carbolic soap or apply nitrate of silver of the same strength as recommended for bumble foot. In ten or twelve days the scabs will disappear. In some cases the eyes will be closed so that the birds cannot see to eat, in which case it will be necessary to make the food into pellets and give it like medicine. You will find but little trouble in administering food in this way. If this disease is not taken in time it will carry off the entire flock; but it may be cured in a few weeks by the above treatment.

All of which is respectfully submitted.

L. G. JARVIS,
Manager of Poultry Department.

December 31st, 1896.

PART XIII.

REPORT OF APICULTURIST.

To the President of the Ontario Agricultural College :

SIR,—I have the honor to submit herewith my annual report for the year 1896. The honey crop during the past year has been of excellent quality and above the average in quantity. There is a growing interest in bee-keeping throughout the Province, and those engaged in this branch of agriculture are recognizing, to a greater extent, the importance of arming themselves with information and beginning in a small way until the necessary skill and experience have been acquired to warrant more expensive operations.

THE EXPERIMENTAL APIARY.

From the report of the Experimental Apiary it will be seen that several of last year's experiments have been continued, the intention being to make tests in certain directions for a number of years. This is especially necessary if we are to secure anything of much value in the various methods of wintering.

FOUL BROOD.

During the past year the Ontario Agricultural and Experimental Union has undertaken the important work of investigating some of the unsettled questions in connection with the disease known as "Foul Brood" (*bacillus alvei*). As director of the apiculture experiments in connection with the Union, I was fortunate enough to secure the assistance of Mr. F. C. Harrison, B S.A., College Bacteriologist. While there is much work to be done, important observations have been made by Mr. Harrison, and a full report thereon will be found in the Report of the Experimental Union.

We have given assistance by supplying bees, queens, securing infected combs and making suggestions from time to time. An experiment of great importance was carried out in the apiary, Mr. Harrison rendering valuable assistance by infecting the wax necessary for the experiments. One of the best samples of wax was taken, and Mr. Harrison thoroughly infected it with the germs of foul brood. The wax was then broken into small pieces to facilitate melting, and before all the pieces had melted it was dipped into sheets and milled, as in the ordinary process of making comb foundation. The foundation was immediately put into frames and a swarm put upon it, the date being June 8th, 1896. The bees began working on the foundation at once. The Queen deposited eggs June 11th. From the time the foundation was given to the bees until they were placed in winter quarters the combs were constantly examined. The Fould Brood Inspector, Mr. Wm. McEvoy, Woodburn, inspected the hive twice, first, on August 17th, 1896; the last time in October. Not a trace of the disease could be found.

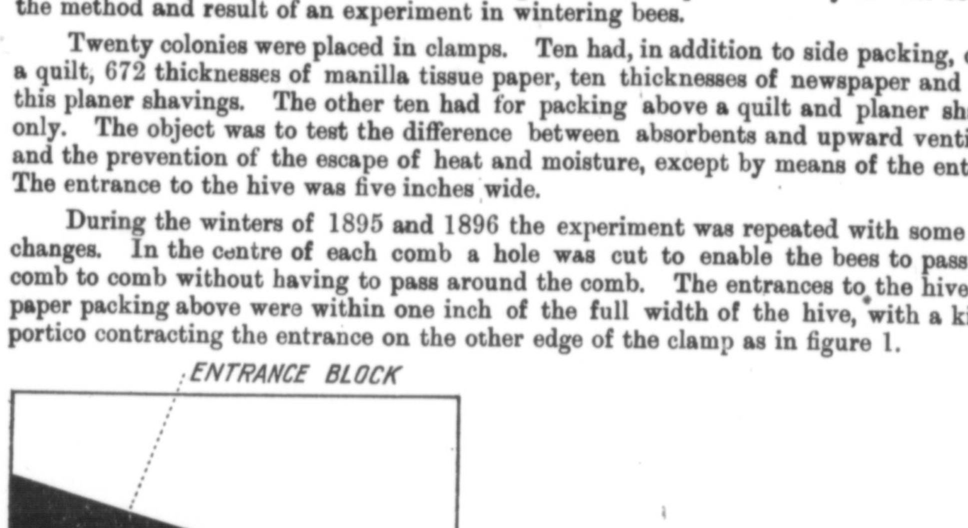
The experiment was conducted under the most favorable conditions for the development of the disease, if it could be transmitted through the wax, but so far there has been no indication of it. We hope to repeat this experiment in the summer of 1897.

Wintering Problems.

On pages 285 to 288 of the Ontario Agricultural Report of last year will be found the method and result of an experiment in wintering bees.

Twenty colonies were placed in clamps. Ten had, in addition to side packing, on top a quilt, 672 thicknesses of manilla tissue paper, ten thicknesses of newspaper and above this planer shavings. The other ten had for packing above a quilt and planer shavings only. The object was to test the difference between absorbents and upward ventilation and the prevention of the escape of heat and moisture, except by means of the entrance. The entrance to the hive was five inches wide.

During the winters of 1895 and 1896 the experiment was repeated with some slight changes. In the centre of each comb a hole was cut to enable the bees to pass from comb to comb without having to pass around the comb. The entrances to the hive with paper packing above were within one inch of the full width of the hive, with a kind of portico contracting the entrance on the other edge of the clamp as in figure 1.



The entrance constructed in this way is less liable to clog with dead bees.

Observations.

During the entire fall and winter there was no perceptible difference between the two systems such as was noticed the previous year. The bees in the clamps having the paper packing flew as little as those without. There were no symptoms of dysentery throughout the winter and spring, and the bees in both clamps wintered well.

Upon examination April 27th, 1896, the result was as follows:

Without paper. No. 1, XXX; No. 2, XXX; No. 3, XX; No. 4, XX; No. 5, XXX.

With paper. No. 6, XXX; No. 7, XXX; No. 8, XX; No. 9, XXX; No. 10, XXX.

This showed a slight difference in favor of the paper packed hives; but, in my estimation, not enough to give either system a decided advantage.

The bees were again examined June 1st.

Without Paper.

No. of hives.	No. of combs with bees	Amount of brood Langstroth frames.
No. 1	8	$7\frac{1}{2}$
" 2	8	7
" 3	8	$7\frac{1}{2}$
" 4	7	$5\frac{1}{2}$
" 5	8	$7\frac{1}{2}$

With Paper.

No. of hives.	No. of combs with bees	Amount of brood Langstroth frames.
No. 6	8	$7\frac{1}{2}$
" 7	8	$7\frac{1}{2}$
" 8	7	6
" 9	8	7
" 10	Swarmed.	

The above experiments would tend to show that when the hives are packed to prevent the escape of heat and moisture through the top of the hive, a free ventilation should be provided at the entrance.

Next, the bees wintered better with passages cut through the combs, facilitating the moving about of bees in the cluster and allowing the cluster to expand and contract according to temperature, without separating individual bees, as would be the case when passing around the comb.

The bees wintered outside showed no advantage over those wintered in the cellar, as they were kept in the winter packing during the spring. It was impracticable to weigh the hives to find out the amount of stores consumed; but, from previous experience, it is safe to estimate that the bees wintering outside consume a large quantity of stores.

On the other hand, bee-keepers must remember that the above comparison is between outside wintering and wintering in a fairly good cellar. If the cellar is liable to great changes of temperature the bees will undoubtedly do better if wintered outside.

An Experiment in the Production of Comb Honey.

Anything which can be done to produce better filled and straighter comb honey, with less travel stain, will materially increase the value of the honey crop. In addition, it will increase the demand for honey, which is a matter of vast importance in the healthy development of the bee-keeping industry. It may be argued that the points referred to do not influence the flavor of honey, and that a section not entirely filled, bulging and travel stained, tastes just as good as the comb free from such defects. In reply it may be said, that, in stimulating and pleasing the sense of taste, the eye plays no unimportant part, so that in this respect the statement is open to question. In having well-filled sections, free from bulges and depressions, clean and white, there are other great advantages. When the cells next to the wood which contains the comb are unfilled, or only partially filled, and therefore uncapped, a very weak point is left between comb and wood. If the sections be dumped or dropped, as is often the case, the comb at the weak point parts from the wood. It is difficult to handle or sell such sections. During transit they are frequently thrown backward and forward against the neighboring sections with sufficient force to break them; then, by the friction of the comb surface, the capping is broken and the liquid honey escapes and tends to depreciate the value of the entire crate. The dealer receiving such a shipment is a loser. He has no redress, and is likely in the future to be less inclined to handle and sell honey. With well-filled sections, properly crated and packed, there is no risk in shipping. The advantages to be derived from having sections with combs of an even thickness, and built straight, are:

They can be handled by dealers with small experience; facility in crating; sections more nearly of uniform weight and pleasing to the eye. In the experiments conducted, separators were used between adjoining sections and the evenness and uniformity of the comb were entirely satisfactory.

Again, comb honey producers know that, with rare exceptions, in the comb honey supers now used, sections having their faces next the wood are filled last, and the inner sections have to be left capped and finished on the hive, waiting for the bees to finish the surface of the sections joining the wood. Some have practised a system of removing the supers, freeing them from bees, taking out the sections, and returning the unfinished ones. This causes so much additional time and trouble, that it is almost, if not quite, impracticable.

The present experiment was conducted to test a plan to overcome this difficulty, the method adopted being suggested by S. T. Pettit, Belmont, Ontario, viz., to compare supers that have bee space over the sections with those without bee space; and the result of the present year's work confirms observations and experiments made by us in this direction during the past three years.

The main objects in the experiment were:

1st. To compare the number and size of pop holes in the sections of supers with the bee space above and those without. Those without, had a quilt next the sections; those with, had a board with ¼ inch bee space over the super, between the board and the sections.

2nd. To compare comb honey having the face of the last sections and wood sides of supers separated by only the usual one bee space, and those having two or more bee spaces. The two or more bee spaces were secured by means of dividers of different construction. Some were of solid boards with holes bored in them. See Fig. 2, No. IV. Others were made of strips. See Fig. , No. III. The bee space used was $\frac{1}{4}$ inch in every case, and it is very important that this should be exact.

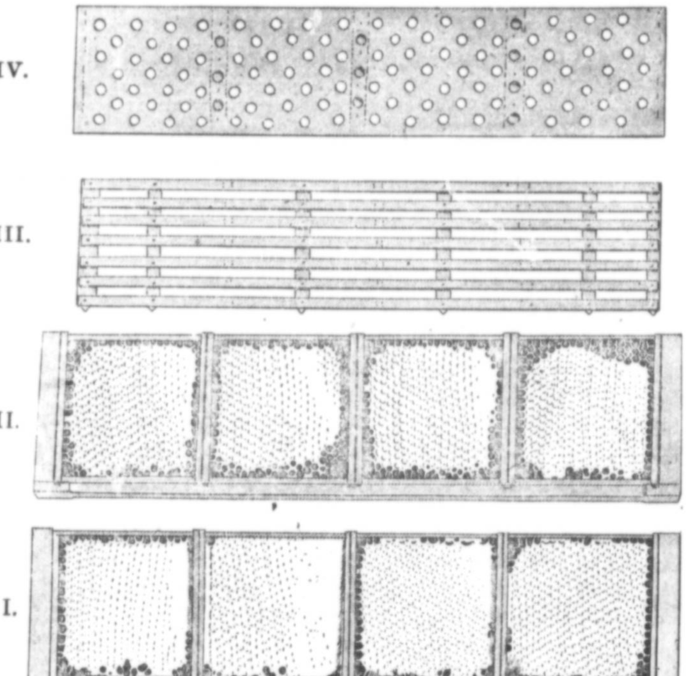


FIG. 2. No. IV., perforated divider; No. III., slatted divider; No. II., comb honey with one bee space between it and wall of hive; No. I., comb honey out of same super with two bee spaces between it and wall.

Following is the result of the work of seven colonies with cloth and no bee space over the sections:

Hive No. 1—An average percentage of pop holes.
" " 2—Same as number one.
" " 3—Pop holes slightly more numerous than the average.
" " 4—Rather better than preceding supers.
" " 5—Although sections were particularly well filled, the pop holes were remarkably numerous.
" " 6—A still larger percentage of pop holes in the corners both at top and bottom.
" " 7—About the same as number six.

The result of experiments with $\frac{1}{4}$ inch bee space over the sections, nine colonies in the group, is as follows:

Hive No. 1—About 10 per cent. fewer pop holes than the average of the above.
" " 2 and 3—Same as number one.
" " 4, 5 and 6—About 7 per cent. fewer pop holes than the average of above.
" " 7—Still fewer pop holes.
" " 8 and 9—A very decided advantage over no bee space.
" " 10—About the same as the average of those having no space above.
Nos. 11 to 16 showed a smaller percentage of pop holes.

General Remarks.

One fact was very conspicuous, viz., that the pop holes in sections with $\frac{1}{4}$ inch bee space were smaller than in those without. This report tallies with results obtained from experiments conducted in previous years, but not before reported. The probable reason for there being fewer and smaller pop holes with the bee space above the sections, is, that the bees appear to require a space to pass from section to section, and a bee space above facilitates this passage.

The result of the experiment with two or more bee spaces between the side of the super and the face of the section next the side, is as follows:

Two bee spaces and divider at one side of the super and only one bee space at the other.

Hive No. 1—The outside of sections with the two bee spaces and divider were better finished and cleaner than the side with only one.
" " 2 and 3—Same as number one.
" " 4 and 5—No perceptible difference as to finish of comb, but the sections were cleaner.
" " 6—A difference in favor of the two bee spaces.
" " 7—A marked difference in favor of the two bee spaces.
" " 8—The side with two bee spaces decidedly cleaner and better finished.
" " 9 and 10—Two bee spaces on each side of the super, both sides clean and perfect.

The dividers were differently constructed. One set had holes bored 5-16 inch in diameter and $3\frac{7}{8}$ inches wide, and material was 1-6 inch thick. The other set were made of strips the entire width of the divider, $3\frac{7}{8}$ inches, and seven strips 5-16 inch wide with $\frac{1}{4}$ inch spaces between. The dividers with the holes gave the best satisfaction. With the strips, there were more burr combs and the comb opposite the space between the strips was ridged, giving the entire section a ribbed and uneven appearance, a modification of what we find in the common washboard. Five other hives were supplied with two spaces on one side and one on the other. In three, there was no marked difference; in the other two, there was a difference in favor of the two bee spaces. Two hives were provided with queen-excluding metal as dividers. The result was as good as with any other divider; but, owing to the limber and pliable nature of the zinc and the importance of having the bee space neither more nor less than $\frac{1}{4}$ inch, we would not recommend this material.

The results of the above test and those obtained from other hives in the apiary, show a marked difference in favor of the two bee spaces. The reason would appear to be that with two bee spaces, the extra layer of bees on the outside, keeps up day and night the normal heat necessary for comb building and capping. With more than the regular bee space and no divider, the bees would, as is well known, extend the comb until, before the point of capping is reached, the space would be reduced to the regular size. Several tests were made comparing a still larger number of bee spaces and dividers, but no additional advantage was shown, and possibly they furnished too much loafing space for the bees. The one divider and two bee spaces, during the past season, showed a great advantage in this method of taking comb honey.

A Three Years' Experiment in Outside Wintering.

During the spring of 1893, we purchased a colony of bees supposed to be a particularly good honey-gathering strain. The hive was decidedly objectionable, owing to its peculiar construction and odd size; but, as stated, we were after a particular strain of bees. The brood chamber was divided into two parts, the lower set of frames, ten in number, measuring $14\frac{3}{4} \times 8\frac{1}{2}$ inches, and the upper ten measuring $14\frac{3}{4} \times 4\frac{1}{2}$ inches. After swarming, the young queen in the parent hive was lost, and we introduced a queen of our own rearing. In the fall of the year, the entrance to this hive was contracted to five inches, and an empty super, filled with old woolen clothing for packing, placed on it. Aside from this, without further protection, the hive was left on its summer stand. Snow was kept clear at the entrance. It was one of the strongest colonies in the apiary in the spring, and the first to throw a swarm. During the winters of 1894 and 1895, the experiment was repeated. Our attention was then drawn to the advantage of permitting free communication within the cluster, allowing it to contract and expand according to the surrounding temperature, without inconveniencing the bees on the outside of the cluster. The following year, the hive was prepared for winter as before. The bees again wintered successfully, and again threw the first swarm. The experiment was repeated under the same conditions during the winters of 1895 and 1896. They again wintered well and, as far as we could judge, were fully equal in strength to any other colony in the apiary.

In studying the above experiment, we must remember that the natural shape of a cluster of bees on the comb is that of a ball. In this way, they can best maintain the warmth which they generate. To regulate the temperature, the cluster contracts as the temperature falls, and expands as it rises. When the combs hang in the hives, with the bees clustered between the combs as in fig. 3 (spaces A B C D), if the cluster contracts, the bees must travel to the top or the bottom of the space, and the bees on outer spaces become separated from the cluster. As long as many bees are together, they do not easily chill; but when one or more become separated, they soon chill and perish. The natural direction for the bees to travel when the cluster contracts is towards its centre, and it will be found that the bees which by contraction become detached from the main body of the cluster, perish, owing to their inability to travel around the top and bottom of the combs.

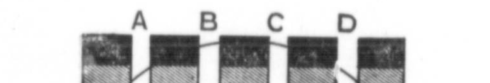


FIG. 3.

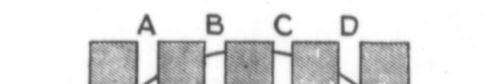


FIG. 4.

With the $\frac{1}{4}$ inch space between the two sets of combs (see fig. 4), the swarm can expand or contract without breaking the cluster, the bees passing between the two sets of frames. In the experimental work for the seasons of 1896 and 1897, a test is being made of the effect of cutting passages in the centre of each comb. Through these the bees can pass and repass as the cluster expands or contracts. These passages answer, to a certain extent, the same purpose as the bee space between the two sets of frames. If these passages prove as advantageous as the space in the two sets of frames, they will be much more desirable. Odd sized hives and frames, such as the one described, are decidedly objectionable in the apiary.

Moving Bees For Fall Pasture.

During the fall of 1895, sixteen colonies of bees were taken nine miles from home to buckwheat pasture. In forty-seven days, the bees at the home apairy gathered less than the quantity required for immediate consumption, there being no fall pasture in the vicinity.

During the same time those taken to fall pasture in the vicinity of abundance of buckwheat, secured as follows, in addition to what they consumed:

No. 1, 112½ lbs.	No. 2, 57½ lbs.	No. 3, 86½ lbs.	No. 4, 2 lbs.
No. 5, 49½ "	No. 6, 10½ "	No. 7, 40 "	No. 8, 2½ "
No. 9, 62 "	No. 10, 16 "	No. 11, 7½ "	No. 12, 41 "
No. 13, 44 "	No. 14, 53 "	No. 15, 71 "	No. 16, 42 "

This represents a gain of 706 pounds, showing a decided advantage in taking the bees to the buckwheat.

The experiment has led to an increased number of colonies being moved by bee-keepers to favorite localities for pasture. In Germany and England, but particularly in Germany, migratory bee-keeping largely practised; and the experiments during 1895 and 1896 demonstrate the advantage, under certain circumstances, of such a system.

As during the year 1895 so during 1896, colonies of varying strength were used. The stronger colonies made the greatest gain, an object lesson pointing to the importance of strong colonies to secure the best results. The past season has not been a good one or a fall flow of honey. The gains were as follows:

No. 1, 6 lbs.	No. 2, 43 lbs.	No. 3, 136 lbs.	No. 4, 39 lbs.
No. 5, 62 "	No. 6, 15½ "	No. 7, 9 "	No. 8, 1½ "
No. 9, 82 "	No. 10, 5 "	No. 11, 58 "	No. 12, 6 "
No. 13, 59½ "	No. 14, 25 "	No. 15, 13 "	No. 16, 9 "
No. 17, 13 "	No. 18, 93 "	No. 19, 14 "	No. 20, 32 "
No. 21, 28 "	No. 22, 30 "	No. 23, 34 "	No. 24, 6 "
No. 25, 5 "	No. 26, 51 "	No. 27, 13 "	No. 28, 92 "
No. 29, 66 "	No. 30, 40 "	No. 31, 29½ "	No. 32, 10½ "
No. 33, 35 "	No. 34, 9 "	No. 35, 45 "	No. 36, 26 "

This makes a total gain in weight by the thirty-six colonies of 1,251 pounds.

In 1895 the average of fall flow was forty-four pounds; last fall the average was only 34¾ pounds. This was in part owing to a larger percentage of medium and weak colonies. Some were not taken out to pasture until some in the first load had gathered a super full of comb honey, and, lastly, the general flow throughout the country was not so heavy as in the season of 1895.

Two years' experiments seem to indicate that, if fall pasture can be secured within reasonable distance, it will pay to take the bees to such a locality; and that the strongest colonies will yield the best returns, unless we take into account the advantage to be derived from the building up of the weaker colonies during the honey flow. No date has been taken to estimate this advantage; but, in a general way, it may be said that weak colonies gained very much by being stimulated on fall pasture.

Feeding of Bees.

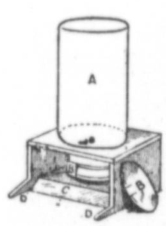


Fig. 5.
Boardman Feeder.

The experiment in feeding bees sugar syrup for winter stores was repeated this season. Last year, the "Boardman" entrance feeder (see fig. 5) was used. It is an air feeder in which the bees have continuous access to the syrup, and at the same time find it impossible to daub themselves with the liquid. In our experiment for the two years, the bees had a continuous supply of syrup; and, so far as we are aware, the conditions under which the syrup was stored, was the best. The stores supplied this year were made of two parts of granulated sugar, and one part (by weight) water. With two exceptions, the sugar was poured into boiling water and the mixture stirred until the sugar had dissolved and the mixture had come to a boil. It was supplied to the bees a little above blood heat. In the two exceptional cases above mentioned, the water was heated to 102 degrees and poured on the sugar in the feeders and without boiling, and the contents were supplied to the bees. This experiment was carried out, to test an idea advanced by a United States bee-keeper. There was no difference in results. Feeders side by side at the entrance, containing boiled and unboiled food, received equal attention from the bees. If further experiments bear this out, they will do away with the trouble of boiling the food. Last year colonies of various strengths were used; and the percentage of loss, during the process of storing, varied from 37% to 71%. This year, six colonies of nearly equal strength were taken, with the following results:

No. of colonies.	Weight in pounds.	Pounds of syrup supplied.	Weight 6 days after last syrup was fed.	No. of pounds gained by said feeding.	Difference between first weight, plus syrup supplied, and the actual gain in pounds.	Percentage of loss during process.
1	30½	17½	42½	12	5½	31
2	34	20	47	13	7	35
3	37	15	45½	8½	6½	56
4	33	20	45½	12¼	7¾	38
5	38	20	50	12	8	40
6	33	20	45	12	8	40

This experiment indicates:

(1) That there is a great difference between the weight of stores supplied to the bees in the feeders, and the increase in weight of the hive. This loss can in part be accounted for by evaporation; the remainder must be due to increased consumption of stores by the bees, caused by excitement during storing.

(2) That, considering the loss of vitality in the bees caused by activity, and the labor of the apiarist, it will not pay to extract the honey, and supply the bees with sugar syrup for winter, with a view to making a profit.

(3) That, when feeding has to be resorted to, strong colonies can be fed with the smallest percentage of waste.

Respectfully submitted,

R. F. HOLTERMANN.

Apiculturist.

Ontario Agricultural College,

Guelph, Dec. 31st, 1896.

PART XIV.

REPORT OF PHYSICIAN.

To the President of the Ontario Agricultural College:

SIR,—Permit me to present to you my third annual report. During the year which is just closing, I have, as in former years, carefully observed the by-laws relating to my visits to the College, to the inspection and examination of the students, and in every other respect. The statement regarding the inspection and examination of the students applies to the large class attending the dairy school as well as to those taking the regular course.

In looking over the records of my visits to the College, I find there were no cases of grave illness or accident requiring my attention this year. I should here possibly make one exception, the case of a young man whom we were obliged to remove to the Guelph General Hospital for an operation from which he made a very satisfactory recovery. After remaing two weeks in the hospital, he was able to return to the College and resume his studies. In the winter and early spring months, there occurred among the students and servants a number of cases of influenza—all of a mild character, followed by rapid recovery. During the months of October and November, several of the students suffered from attacks of tonsillitis. Bacteriological examinations proved the nature of these cases.

A matter of vital importance to the health of the College is its water supply, and I feel that my report this year would be very imperfect without reference to the change made therein during the past summer. Previous to that time, the College was supplied with water by the city of Guelph. Circumstances to which I need not refer resulted then in the discontinuance by the College of the city's water supply, and in the use of water from two artisian wells sunk near the main College building. The supply from these wells appears adequate for all the purposes of the College, and chemical and bacteriological examinations show it to be a potable water of the first-class. In this, therefore, as in all other respects, the sanitary condition of the College is excellent.

Respectfully yours,

W. O. STEWART,
College Physician.

Guelph, Ont., Dec. 30th, 1896.

AGRICUL

EIGHTEENTH ANNUAL REPORT

OF THE

ONTARIO

AGRICULTURAL AND EXPERIMENTAL UNION,

1896.

EIGHTEENTH ANNUAL REPORT

OF THE

ONTARIO AGRICULTURAL AND EXPERIMENTAL UNION.

OFFICERS FOR 1897-8.

President .... D. Z. Gibson, Willow Grove, Ont.

Vice-President .... Geo. Harcourt, Toronto, Ont.

Secretary and Editor .... C. A. Zavitz, Agricultural College, Guelph, Ont.

Treasurer .... H. L. Hutt, Agricultural College, Guelph, Ont.

Directors.—Dr. Jas. Mills, T. G. Raynor, N. Monteith, Elmer Lick, C. A. Zavitz.

COMMITTEES ON EXPERIMENTAL WORK.

Agriculture.—C. A. Zavitz (Director), Dr. Jas. Mills, Prof. A. E. Shuttleworth, James Atkinson, John Buchanan.

Horticulture.—H. L. Hutt (Director), Elmer Lick, J. A. Campbell.

Apiculture.—R. F. Holtermann (Director), F. C. Harrison, R. M. Husband.

Dairying.—Prof. H. H. Dean (Director), H. L. Beckett, S. P. Brown.

Economic Botany and Entomology.—Prof. J. H. Panton (Director), T. F. Patterson, Wm. McCallum.

Live Stock.—G. E. Day (Director), W. W. Ballantyne, Wm. Rennie.

Auditors.—Allen Shantz, W. J. Elliott.

ANNUAL MEETING.

The eighteenth annual meeting of the Ontario Agricultural and Experimental Union was opened in the Experimental Building of the Ontario Agricultural College, Guelph, at 1.15 p.m. December 10th, 1896.

The President, Mr. Elmer Lick, Oshawa, Ont., occupied the chair.

REPORT OF SECRETARY.

By C. A. Zavitz, B.S.A., Agricultural College, Guelph.

The Board of Directors of the Experimental Union held a meeting at the Agricultural College in the month of October, at which time the programme for the present annual meeting was outlined. Several changes in this outline, however, had, of necessity, to be made before the programme was completed. You will notice that over one-half of the speakers selected are ex-students of the Agricultural College. We have also been very fortunate in securing the services of the Hon. Sidney Fisher, M.P., Dominion Minister of Agriculture, Ottawa, Ont.; Hon. John Dryden, M.P.P., Provincial Minister of Agriculture, Toronto, Ont.; Prof. Chas. E Thorne, Director of the Ohio Agricultural Experiment Station, Wooster, Ohio; Mr T. Greiner, author of "How to Make the Garden Pay," etc., Lasalle, N.Y., and Mrs. John Hoodless, Principal of the School of Domestic Science, Hamilton, Ont., all of whom have consented to be present and deliver addresses at the various sessions of our meeting. I am also pleased to inform you that I received a telegram from the Agricultural College of Nebraska, stating that their Prof. Taylor was on his road to Canada to attend the meeting of the Experimental Union. Prof. Taylor reached here this morning, and has come all the way from Nebraska in order to meet the members of the Experimental Union and to study more fully the work which they are doing.

The committees appointed at the last meeting of the Experimental Union to look after the co-operative experimental work of the Union in agriculture, horticulture, live stock, dairying, apiculture, and economic botany and entomology have all been active in their work during the past year, and each will present a report of the work accomplished, which should furnish much valuable information, and give opportunity for profitable discussions.

The membership of the Union has considerably increased within the last year, and is now more than double that of two years ago. The members were never in a better position to conduct valuable experimental work throughout Ontario, but in order to increase the number of the experiments another year, an increased grant from the Government will be necessary, as the money granted for this work is used for postage, expressage, printing, and for the purchase of labels, and bag strings, and for the manufacture of bags. You will all understand that the cost for these items cannot be materially decreased unless the number of experiments are lessened. In 1896, the demand from farmers for experimental material was slightly larger than we were enabled to supply, owing to a lack of finances. I think that all of you will be of the one opinion in regard to the importance of a gradual increase of the co-operative experimental work in connection with our Union.

The report of the last annual meeting of the Experimental Union was published as an appendix to the report of the Ontario Agricultural College, and thus received a very wide circulation. Several articles on the work of the Union were written during the year and furnished to the newspapers of the Province, and in this way the work of the association has been kept before the people.

PRESIDENT'S ADDRESS.

By Elmer Lick, Oshawa, Ont.

At the beginning of the eighteenth annual meeting of the Ontario Agricultural and Experimental Union I am pleased to congratulate the members on the success of the association during the year 1896.

We are glad to know that our work is appreciated by a larger number than ever before. We are pleased to be able to state that we have the very best reports of experimental work ever presented to an annual meeting of our association.

It is an undoubted fact that thousands of the farmers of our land are thoroughly posted on the work of our association, and endorse the work to the fullest extent on all possible occasions. There are, however, still those who, through ignorance or lack of interest, do not seem to appreciate the work of the Union, and consequently do not reap the advantages from the results which it is quite possible for them to secure if they so desired.

The object of our association is to bind all the officers and students of the Agricultural College, past and present, in a common bond of sympathy. In this way the work of the College can be greatly developed. It is well that all connected with the College should have a high ideal of its work, and also a high ideal of the work expected of each individual. It is our object to elevate this ideal.

That part of our work which is of the greatest interest and value to the general public is the co-operative experiments conducted throughout Ontario.

So far as I can learn at present we stand as the pioneer in this kind of work. There are others following our example, but none have realized our attainments. Our work is to test in various parts of our Province the most promising varieties of agricultural and horticultural crops, with a view to determine their value generally, and also their adaptation to local districts. Besides this, we are taking up other kinds of work. We have already begun a good work in apiculture, dairying, economic botany and entomology, and live stock. The work of some of these committees is developing, and gives promise to rival in value that of our agricultural committee. Our object in testing new varieties of crops is not simply to supply farmers with samples of seed, but it is for the purpose of finding out which variety is most suited to each particular section and soil, and in this way enable farmers to see for themselves the crops that are best adapted for their own requirements.

In other words, the Experimental Union is not intended as a competitor to the seedsman, but as an aid to both the seedsman and the farmer, so that each may better his own business transactions. A seedsman cannot afford to sell a new variety at a high figure and have it prove a failure, for, if such a practice is indulged in, farmers are turned against purchasing new seed at all. The results of co-operative work enable the seedsman to put the proper varieties on the market, and also enables farmers to purchase more intelligently. Our committees have had an immense amount of material to smmmarize, in order that we may grasp the most important facts in connection with the results of these co-operative experiments.

The reports of these committees, as given at this meeting, cannot be expected to completely cover the ground, and those desiring to make a more thorough study of our work are referred to the annual report, where the results will be given more fully.

The work of our Union is of great importance to the farmer. To show this it is but necessary to produce a few figures in regard to the acreage of the various crops in this Province. There are about 800,000 acres of fall wheat grown in Ontario annually. An increase of one bushel of fall wheat per acre at 60 cents per bushel would give an increased value of \$480,000; an increase of one bushel per acre in spring wheat at the same price would give $120,000 ; in barley at 30 cents it would give $150,000 ; and in oats at 20 cents it would give $400,000 increase. Thus we see that by increasing these principal crops only one bushel per acre there is an increase of wealth of $1,150,000 for the farmers of Ontario in one year. This is an immense sum. Some will say that such an increase is impossible of realization. A farmer in Ontario county, and a neighbor of mine, obtained some Joanette oats, a few years ago and has grown them with excellent results every year since that time. This man would not have done so had he not observed by reports that they were an improvement on the varieties which he had formerly grown. This is only a little example of what thousands of others are doing throughout Ontario. Our financial position is one of great importance to us. We are now receiving from the Government the sum of $1,000 annually. We cannot greatly enlarge our work with our present grant. This problem will undoubtedly engage your attention. There are two things for us to do. One is for the Union to ask the Government directly for an increased grant, and the other is to leave it to the general public and to the farmers of this country for them to secure from the Government such a grant as will enable our association to fully meet the growing demands of our co operative work. In 1896, the applications from farmers for seeds of the best varieties of farm crops for experimental purposes were greater than the committee could furnish through lack of money for postage, expressage, manufacture of bags, etc.

Our association has an interest in everything connected with the Agricultural College. We, as ex-students, are anxious to find out what is going on at the College. *The O. A. C. Review* is a monthly paper published by the literary society, and it is of very great interest to the ex-students. We hope that all ex-students will subscribe for the *Review*, and thus secure a monthly reminder of college days.

In conclusion, allow me to express a few thoughts as to the future of the Union. We have considered briefly the nature of our work, its progress and results ; the value of our work to the farmers of Ontario, and the financial position of our association. Now what shall the future be ? Judging by our progress and by the rapidly increasing interest in our work, we certainly would be safe in predicting that before another decade has passed we will be one of the most if not the most influential agricultural association in Canada. If the Union will continue on its present solid foundation of work and economical use of its means, there is no power that can or will hinder our progress. It is quite a common thing now for farmers to use the results of our experimental work when discussing varieties of farm crops.

Every farmer should examine the results of our experiments before purchasing his seed. Let each member feel personally responsible for the success of the Union, that we may go on to still greater triumph along the lines which are distinctly ours to follow.

Mr. Geo. Harcourt, Toronto : It is with pleasure that I stand here to address you this afternoon. It is now six years since I had the pleasure of being present at the Experimental Union meeting, and it gives me pleasure to see so many old faces. The president has spoken of the objects of the association and upon this year's results ; but I want to call attention to the charts on the wall behind me. (Results of co-operative experiments in agriculture for 1896.) I find that throughout the country farmers refer a great deal to these results as given in the annual report. In this way farmers receive a direct benefit from the work carried on by the Union. The most important question that comes up to-day is that of money. Without money, some way or other, the work cannot be extended. Mr. Zavitz has explained to you something of the growth of the association, especially in the agricultural experiments. It is apparent from this that the work cannot be extended without an increased grant. He has explained to you how the money has been expended in expressage, postage, etc. Can it be cut down in any way ? The only thing that could be done to lessen expense would be to allow seed grain to pass postage free. You understand that the grant has been taken up by experiments in agriculture, dairying, live stock, horticulture, bee-keeping and entomology, along with other incidental expenses. I think the only thing that can be done is to ask for an increased grant. I also suggest that the board of control meet together and make out a budget for the different departments, and map out the line of work to be carried on in each. Any line of work that is not successful should be dropped. I believe that some of these minor lines, as bee-keeping and poultry raising, are going to be strong features in the work of the farmer in the near future and should receive consideration at the hands of the committee.

REPORT OF COMMITTEE ON ECONOMIC BOTANY AND ENTOMOLOGY.

By Prof. J. Hoyes Panton, Agricultural College, Guelph.

As director of the committee appointed to collect information regarding the presence of injurious insects, weeds, etc., throughout the Province of Ontario, the duty devolves upon me to report what has been done during the past year. During the month of October upwards of 200 circulars of enquiry were sent to the secretaries of Farmers' Institutes and many members of the Union. While it is gratifying to know that replies were received from thirty-seven counties, it is to be regretted that many to whom circulars were sent failed to answer. The accompanying blank form indicates the nature of the information sought, and when properly filled supplies some interesting and instructive notes on weeds and insects. It is very pleasing to notice that in filled out circulars returned by ex-students of the Agricultural College, attention has been paid to the giving of the scientific as well as the common name of the insects and plants referred to.

It is very important to give the scientific name, if possible, for the common names are merely local, and we often find as many names given as there are localities in which the specimen is found.

Very little information can be secured from such terms as red-root, pig-weed, bug weevil, when applied to plants and insects, as these terms are applied to plants and insects entirely different in the various localities where they are found. We would, therefore, ask observers to give, as far as possible, the scientific names, so as to ensure accuracy in our report.

The following is the substance of he circular sent out:

Ontario Agricultural College, Guelph, October, 1896.

Dear Sir,—You will confer a favor by filling out the following, and sending it to me, *at as early a date as possible.*

Information in reference to columns *three* and *four* is particularly requested. I shall take pleasure in identifying *plants* and *insects* forwarded at any time to the College.

J. HOYES PANTON,
Director of Committee on Economic Botany and Entomology.

1. Names of the six worst weeds in your district.	2. Six worst insects for 1896.	3. New weeds likely to be injurious.	4. New insects likely to be troublesome.	5. Is the Horn Fly increasing or decreasing in your district?	6. Is the Buffalo Carpet Beetle in your locality?	7. Has spraying been done in your district? What results?

REMARKS:

Name ....

....P. O.

....County

The following is a summary of the replies received :

1. The worst Weeds reported.

Canadian Thistle (Cnicus arvensis).
Mustard (Brassica sinapistrum).
Ox-eye Daisy (Chrysanthemum leucanthemum).
Wild Oat (Avena fatua).
Ragweed (Ambrosia artemisiæfolia).
Burdock (Arctium lappa).

Fifty-five species of weeds were referred to, but the above six represent those which were mentioned by twelve or more observers.

2. The worst Insects reported.

Potato Beetle (Doryphora decem-lineata).
Grasshopper (Melanoplus femur-rubrum).
Horn-fly (Hæmatobia serrata).
Cutworms (Hadena Mamestra).
Tent caterpillar (Clisiocampa Americana).
Army worm (Lucania unipuncta).

Forty-three species of insects were referred to by observers.

3. New Weeds reported likely to be injurious.

Perennial Sow Thistle (Sonchus arvensis).
Bindweed (Convolvulus arvensis).
Prickly lettuce (Lactuca scariola).
False Flax (Camelina sativa).
Penny Cress (Thlaspi arvense).
Wormseed Mustard (Erysimum cheiranthoides).
Ribgrass (Plantago lanceolata).
Bladder Campion (Silene inflata).

Twenty-two species were reported.

4. New Insects likely to be injurious.

Army Worm (Lucania unipuncta).
Oat Aphis (Siphonophora avenae).
Blister Beetle (Epicauta Pennsylvanica).
Hessian Fly (Cecidomyia destructor).
Pea Vine Caterpillar (Mamestra trifolii).
Squash Bug (Anasa tristis).
Cankerworm (Palaecrita vernata).

5. Replies regarding the increase or decrease of the Horn-fly.

25 per cent. of the replies report it increasing.
46 " " decreasing.
25 " " no change.

Observers on St. Joseph and Manitoulin Islands report no Horn-fly in these districts

6. Prevalence of the Buffalo Carpet Beetle (Anthrenus scrophulariæ).

8 report it present in their district.
30 report it as not in the district.
16 report that they do not know the insect.

This insect does not seem to be known. I fear it is more common than our report indicates. The accompanying cut may be of service hereafter.

The buffalo carpet moth, *Anthrenus scrophulariæ* Linn: *a*, dorsal view of larva; *b*, ventral view of same; *c*, pupa; *d*, beetle (after Riley).

7. To what extent spraying is followed and with what results?

Fifty-seven replies received. Thirty-five remark that it is done, and of these twenty-six report excellent results, the remaining nine state that the results were indefinite. Twenty report no spraying in their district.

As the season was one well suited to favor the growth of fruit, and somewhat unfavorable to develop fungoid pests, it is not a matter of surprise that the benefits from spraying were not so well marked as ought have been expected.

The practice should be followed, as it protects the crop, invigorates the tree and to some extent prevents future attacks from fungoid and insect pests.

The writer would ask the hearty co-operation of all to whom blank forms may be sent in the future, and thank those who have kindly assisted in furnishing the data for the report new presented.

Mr. T. F. Paterson: As I have but five minutes for discussion, I shall proceed at once to discuss the paper read by our worthy Professor on Entomology and Botany. I had the privilege of reading the fifty-seven replies which have been here summarized, and I may say that in the majority of cases the complete reports were sent in by ex-students. It is a great advantage to men in answering these questions to have a knowledge of botany and entomology. On looking over these reports I find that every ex-student has given the scientific names of the plants and insects. A person with a knowledge of botany knows that plants may be divided into three classes, viz., annuals, biennials, and perennials. He knows that an annual is a plant that comes from the seed, develops, matures and dies in one year; a biennial requires two years to complete its growth; and a perennial has a root which lasts for a number of years. From this it is apparent that an annual may be eradicated by keeping it from going to seed, so also with a biennial; but a perennial must be kept below the surface, in order that it cannot store up food in the root. I believe that farmers are too careless about getting their seed pure. A knowledge of the different weed seeds is of great value. If you do not know seeds send them to this institution and have them identified. Insects may also be divided into two classes, viz., those that have biting mouths and those with sucking mouths. The method employed for killing these would be quite different. For insects with biting mouths Paris green or some such treatment, while for insects with sucking mouths the kerosene emulsion is effectual.

Dr. Mills: I think this question of weeds should not be passed over, as it is a very important one for farmers of Ontario. Most of my travelling is done between Guelph and Toronto, and I may say that there has been a great change in that section of country during the last sixteen or seventeen years. Fields between here and Toronto that were completely clean some years ago are now overrun to a very sad extent. Much of this country is completely yellow at certain seasons of the year with wild mustard. This is something against which we have to caution our young men. Our land is not rich enough to produce two crops at once. You cannot afford to grow a crop of weeds. During the time of excursions in the summer people go on top of the College where they can see fields yellow with mustard, and go away with the erroneous impression that it is the College farm. The only way to get rid of these is to take your coat off and go to work. When we see a dirty farm we make up our mind that the farmer is either working too much land, is a poor farmer, or is lazy. You may read books till you are blind, but if you don't go to work to make a change, your farm will become more and more overrun with weeds.

Mr. J. C. Clark: On this subject of weeds and insects I would like to say a few words. In 1881, the potato beetle came to a section of Prince Edward Island. They were so bad in one field that you could see them at quite a long distance—they gave the field a red appearance. The farmers around took concerted action at once, and every beetle was destroyed. There wasn't another beetle on the Island for nine years. In regard to the sow thistle, we got a patch of it into our farm. We fenced off the section and turned in a lot of pigs without rings in their noses. They turned up and ate every root. Not one plant has come up since.

Mr. Nelson Monteith: We are troubled a great deal with foul seeds, which mostly come with seed grain. I think it would be a good thing if all seeds were required to pass a certain standard for purity before being offered for sale.

A Member: I found nine kinds of weed seeds in one bushel of crimson clover which I bought. If I had sown it, the bushel of seed would have been a dear one to me. Nine years ago I began experimenting with half pound lots of grain which I received from this place. In this way I began with a pure sample, and I find that it is the only way I can keep my farm clean. I would like to say a few words about the apple tree borer. Out of an orchard of 2,500 trees I lost over 300 trees. I tried several treatments, but the one I found to be successful was the use of soap. I bought a lot of ordinary soap, cut it into slices and placed one slice in the crotch of every tree. Since that I have lost no trees. The rains washed the soap down the trunk, and in this way the borer is killed or at least warded off.

Mr. Wm. Rennie: It is getting about time for this discussion to be brought to a close, but I would like to make a few remarks on the subject of weeds. I may say that we have a farm of 550 acres practically free from foul weeds. The plan adopted was surface cultivation. We keep weeds down with the cultivator and hoe. We had some of the perennial sow thistle but have succeeded in eradicating it. For thistles, we allow them to get up a few inches then cut them off. Do this two or three times and thistles will disappear.

REPORT OF THE LIVE STOCK COMMITTEE.

By G. E. Day, B.S.A., Director of Committee.

The full report of this committee is being published by the Department of Agriculture as Bulletin 104 of the Ontario Agricultural College. The report is based upon replies received from 170 dairymen in different parts of the Province, and deals with length of time cows are allowed to remain dry, dehorning, remedies for horn fly, winter and summer rations for dairy cows, etc. Seventy-five rations used in Ontario are given in full, and some thirty of them have been arranged so as to show the different constituents which they contain, and to compare them with the German and American standard rations for dairy cows. Additional material has been added, viz., tables showing the digestible constituents of fodders, remarks on principles of feeding, methods of formulating rations, etc., and we trust that the report will not be without interest to dairymen.

Mr. ALEX YUILL: I would like to say a few words in favor of dehorning. I thoroughly believe in the practice, but do not think that animals under two years old should be dehorned. If they are dehorned before this age, they indulge too freely in the practice of bunting. We do not find the clippers very satisfactory, as they squeeze the centre of the horn; the saw gives better results, as it cuts it clean off. The winter is the proper time for dehorning. In regard to the horn-fly, I think it is increasing. It was so bad in the west end of the county of Lanark that the cows went dry. We used kerosene emulsion, with a little carbolic acid, once in two weeks. It is necessary to apply it all over the cow. If this is done, we find that this mixture gives good results.

Mr. THORNE: I do not wish to take up much of your time, but may say that our results tally very closely with yours. We find that considerable work has to be done before results are reliable for publication. In regard to horn-fly, our experience is quite similar to yours. We find that washing the animals has given good results. We also use darkened stables. Of course there is an objection, but we find that the animals will pasture most of the night. We have been experimenting with roots and corn as food for milch cows, compared with dry hay. We find that roots invariably increase the flow of milk, but it also increases the total amount of food consumed.

THE ECONOMICAL FEEDING OF LIVE STOCK.

A very interesting and practical address upon the feeding of horses, cattle, sheep and pigs at the Agricultural College was given by Mr. Rennie. As this address is principally embodied in the report of the Farm Superintendent in the accompanying report of the Agricultural College, the reader is referred to that report for the valuable information contained in the address. (See page 207.)

THE FARM AND THE SCHOOL.

BY CHAS. E. THORNE, DIRECTOR AGRICULTURAL EXPERIMENT STATION, WOOSTER, OHIO.

The statistics indicate that the school training of the average Ohio boy or girl ends near the close of the sixteenth year of age, a little earlier for the great majority who never go beyond the elementary schools, two or three years later for the favored few. Nine or ten years of this school life are occupied chiefly in the study of language and numbers—spelling, reading, writing and arithmetic—and such study is evidently the necessary preliminary to the acquisition of any further knowledge. Whether this study is being conducted in the manner most economical of time and most effective in results, is a question open to argument; but I do not propose to discuss it here further than to suggest that in my opinion much of the necessary training in the use of language and numbers might be given incidentally to the teaching of other branches of knowledge.

All agree that the work of the elementary school is the necessary prelude to any further progress; the question upon which opinions differ is, what is the next step?

When Europe began to shake off the slumber in which she had lain through the thousand-year night of the dark ages, she discovered that the accumulated wisdom, which had culminated in the civilization of Greece and Rome, had been garnered in the languages of those nations, and thus held for the future use of humanity; and it naturally followed that the study of those languages, for the sake of the treasures of knowledge of wihch they were the storehouses, became the leading feature and groundwork of a system of education which was built upon an ignorance so dense and so general that even kings could not write their own names.

In these languages have come down to us the history, literature, arts and philosophy of the ancients, and even the beginnings of modern science found their expression through them; the earlier botanists, especially, using the Latin as the vehicle for conveying their discoveries and their philosophy to posterity; and thus, when the education of the boy was begun—girls were not supposed to need education in those days—he was put into Latin as soon as he could master the alphabet, and his education was supposed to be complete when he could use this language as readily as his mother tongue.

But modern thought cannot wait on the sonorous measures of the Latin, nor has it patience to unravel the intricacies of Greek roots; its vehicle of expression must be simple, plain and direct, and hence no important record of discovery is now made in those languages. More than this, the translator has rendered into current speech all the most valuable portions of the ancient learning, so that to-day the English, German, and French languages have superseded the Greek and Latin as the storehouses of ancient as well as modern knowledge.

Notwithstanding this, most of our colleges still refuse to graduate a student who has not spent from four to six years in the study of Latin at least, if not of both Latin and Greek, and the School Commissioners' report shows that in 1894 more than 15,000 pupils in the public schools of Ohio were studying these languages—presumably in preparation for college—while only 2,362 were studying chemistry.

The contention is made that the study of these ancient languages is essential to the proper comprehension of our own, and I admit that it is a help in this direction, but the trouble is that in the majority of cases too much time is spent upon the dead language, and far too little upon the living one.

It is claimed that the study of these languages is most excellent mental drill—that is, a sort of intellectual gymnastics—which may be true; but I insist that drill of a superior quality may be obtained in the study of German and the romance languages, and that these languages, when acquired, will be of infinitely greater practical use in the busy world of to-day, in the majority of cases, than the dead languages.

The point I am urging is, not that all study of these languages is useless—such study has never brought more valuable results than in the hands of the modern philologist—but that we have come to a condition of society in which the average boy (or girl) cannot afford to spend four or five or six years of the truly golden days of youth in the study of languages for which he will find no use when he enters upon the world's work, while he is blindly walking past mines filled with nuggets of pure gold in the shape of knowledge of the processes of Nature—processes with which he must come in contact every day and hour of his life, and ignorance of which may mean to him actual death or years of misery.

But it is not so much the time wasted on these languages which I deplore, as the system of education which they represent—a system which upholds the languages and literatures of the dead and buried Past as the models upon which to build the Present, throbbing as it is with new and vital issues.

There is probably no country in the world in which education is more nearly universal than in China. Practically every boy is taught to read the ancient literature of that country, which is written in a language as different from the vernacular as Latin is from English; and he is not simply taught to read it, but to memorize entire books of that literature, whose authorship reaches back two thousand years or more; and under the Chinese civil service, it is said that he who can repeat the greatest number of pages from these ancient classics has the inside track for political preferment.

Commenting on the results of this system, Hon. W. T. Harris, United States Commissioner of Education, says in his last annual report :

"The history of education in China shows that a nation may have a universal system of school education and yet develop little or no local self-government. If the memory is the chief faculty cultivated, and the course of study includes little else besides the sacred codes of morals and religion, the result is to fill the mind with the traditional forms of thinking and acting. Whence it results that the child learns to think and act and to take precisely the view of the world that his fathers took before him. The more education in Confucius and Mencius, the more safely conservative will be the life of each new inhabitant in China. But, on the other hand, let the child start in a kindergarten, and develop self-activity along all the lines of his character ; let him keep abreast with scientific research ; let him have access to the literature of the world, and he will find a constant stimulus toward freedom and local self-government, toward emancipation from authority."

Until within a very few years Japan was as deeply lodged in the ruts of tradition as China. She was started out of those ruts largely by America, and for the past fifteen years she has been reaching out to us and to Europe for help, and is rapidly becoming seized with the spirit of modern scientific research. She now has her agricultural colleges and experiment stations, modeled largely after our own and the German ideals, developed largely by American and German teachers, who were sent for in large numbers a few years ago, were kept just long enough to train the native Japanese in the work, and then sent home; and now these native Japanese are rapidly taking position as acknowledged authorities in modern science.

And the spirit which has enabled the Japanese to thus seize upon living ideas, is what has given them the victory over China.

The effect of freedom upon intellectual progress is forcibly illustrated in the history of America. The great inventions and discoveries which have revolutionized human industry have either had their origin or their chief development on this continent, and in the free northern zone at that. The cotton gin was the invention of a northern man, and Ohio to-day manufactures cotton planters, and machinery for the reduction of the phosphatic rocks of Carolina, Florida and Tennessee.

But wonderful as has been the progress of our age in mechanical invention, it is not more wonderful than the progress which scientific discovery has made during the same period. Indeed, invention and discovery have gone hand in hand, sometimes the one leading, sometimes the other. The discovery of the laws of light made possible the invention of the microscope, and the microscope has opened up a world undreamed of before, and inhabited by living organisms, a knowledge of which is of the utmost consequence to humanity.

The chemist, aided by the inventor, has revealed another world, and farmers are learning that the revelations of the biologist and chemist are opening possibilities which promise to accomplish even more for the agriculture of the future than has been done by the invention of labor saving machinery in the past.

But to profit by these discoveries of science involves an altogether different training from that which was sufficient to make use of improved machinery, and farmers are realizing that agriculture is no longer a mere handicraft, requiring industry and manual skill alone, but that it is becoming the most comprehensive of all sciences, involving, for its complete mastery, a wider range of knowledge than is required in any other line of human industry.

Modern chemistry and biology have shown us that the soil is the seat of most laborate chemical and vital activities, and that we may so direct these activities as to largely increase our crops. As one result of this knowledge the farmers of Ohio are to day buying chemicals, to be used on their fields, for which they are paying a million dollars or more per year. A portion of the crops produced by these chemicals is being fed to animals, for the production of milk, meat and wool, and here again further chemical and vital operations are started, the course of which cannot be wisely directed in absolute ignorance of the laws which govern them.

But the need of more knowledge in the growing and feeding of our crops is an insignificant matter as compared with the urgent need of such knowledge in the care of our children. The statistics of deaths in Ohio for 1892 show that half the 33,000 people who died that year were under thirty years of age, and one-third of them under ten years.

This was probably not an exceptional record, and I believe it is not too much to say that fully one-half these premature deaths were due to the ignorance of parents, teachers and the general community, in regard to the laws of health and the causes of disease. Modern science is showing that the most destructive of the diseases which afflict humanity are preventable; but the teaching of physiology and hygiene has only quite recently been made compulsory in our public schools, and there is reason to believe that such instruction, as is now given, is of the rudest and too often of the most perfunctory sort.

And when we pass from the common schools to the high schools and colleges, if we find this most important of all branches of knowledge in the curriculum at all, it is given a third or fourth rate place, after the dead languages and their literatures, the abstractions of mathematics and the histories of the world's interminable wars have all been most liberally provided for; and thus the teacher who would gladly fit herself for giving the best instruction in this vital field must hunt the continent over to find the school of higher education in which she can properly qualify herself for the work.

Returning now to the common school: What can be done to make that school more effective as a preparation for life's work? What changes can be made in its present course of study? What can be spared from it; what can be properly added to it?

In my judgment, the thing to do with the common school is to strengthen it along present lines. Prune a little, perhaps, but prune cautiously; add a little, but add carefully; for the great function of the common school is to furnish the child with tools for work; with which he may make his way through the world, and these tools are language and numbers. Next to these, and as the first branch of actual knowledge, physiology holds the most important place, a place which has heretofore been given to the comparatively unimportant study of geography; for while geography is useful, it does not come so close home to the individual as does the knowledge of his own organism.

But physiology is inextricably interwoven with chemistry and biology, and indeed these three branches of natural science are so intimately related to every day living that no system of education can longer be tolerated which does not give to the study of their elements the first place, after a moderate use of language and numbers has been attained.

I am not insensible to the great difficulties in the way of putting into successful practice the scheme of education which I am trying to outline. I remember very distinctly a class of two who began the study of natural science some years ago in one of the country schools of my state. The text book was one of those labor saving contrivances which print question as well as answer, thus reducing to a minimum the intellectual effort required of the teacher, and the teacher was one who was not inclined to refuse assistance so generously proffered. The class soon discovered that the questions were always asked in the words and in the order which they were found in the book, and that the members of the class were always taken in simular regular order. Then followed, as a matter of course, the conclusion that the class might as well save labor as the teacher; so, when the lesson for the day was to be studied, the girl, watching a chance when the teacher's back was turned, motioned to the boy that she would study the first paragraph and he should take the second.

The plan worked admirably, so far as the recitations were concerned, but to one member of that class the memory of that text book, called "The Science of Things Familiar," recalls the dullest, dryest, dreariest piece of educational literature that ever fell into his hands, until, a few years later, he had a similar experience with geology, taught by the book alone, and by a Professor who expected the student to follow the Chinese plan of memorizing the entire contents of the book.

And yet this very chemistry of familiar things, which was the subject of the first book, and the geology of the soil which was the ultimate and logical conclusion and application of the second, have since been followed with the most unflagging interest, when presented in their actual relation to everyday life.

It was not altogether the fault of the pupil, then, that such a failure was made in the first attempt to study natural science, nor should the teacher be too severely blamed. She was the logical product of the educational methods of the time, methods suited to the traditional education, but always and everywhere a failure when applied to the study of nature. Nature is a veritable Priscilla, and no Miles Standish methods of courtship will ever win with her.

This is the first and greatest difficulty in the acquisition of a true education—to secure competent teaching. Fortunately this difficulty is disappearing; even the most conservative of our higher institutions of learning are beginning to discover that the truly liberal education is not formed after the ancient, but on the modern ideal. The chemist and biologist are mustering their clans in front of the citadels of dogmatic tradition in which, hitherto, so many of our higher institutions of learning have been ensconsed. One by one the outer ramparts of prejudice have been abandoned, and to-day the scientist's laboratory is safely lodged within the walls of every institution which makes any pretention to keeping abreast with modern thought.

Very often, the laboratory has only advanced as far as as the basement; but when the scientific camel once gets his head within the tent of dogmatism it is very easy to predict the ultimate result, and I, for one, say God speed the day when that result shall be attained! And I say this with the utmost reverence, for I am one of those who believe that the book of Nature was just as surely written by the divine hand and written for man's good as the Book of Revelation, and the great teachers who have interpreted for us the pages of Nature's book have been as truly inspired as were those who penned the lines of Revelation. And I believe, further, that that spirit which holds truth to be the most sacred thing on earth—to be, in fact, the manifestation of Divinity, and which stands always ready to divest itself of every pre-conceived belief when shown to be contrary to truth—is the spirit in which God would have us approach Him. But this is the scientific spirit, neither more nor less.

As I have said, this scientific spirit is capturing the outer strongholds of all our institutions of learning, and in the phsychic movement which this capture symbolizes the colleges of agriculture have led the van. Especially is this true of the few agricltural colleges which, like this one, within whose walls I am speaking—an institution I have watched from across the lake with envious eyes for many years—have held their work closest to the farm. You are now reaping the fruits of your years of patient endeavor, in a clientage of trained thinkers and investigators of which you may well be proud.

But I apprehend that the work to be done by the young people who spend a few years within these walls and then return to their farm homes is not more that of extending the boundaries of actual scientific research, than of implanting in the minds of the people a true concept of the value of scientific method in education.

When your primary schools, in both town and country, are taught by teachers who have been trained in the scientific method; and when you have intermediate, or higher schools, scattered throghout the Province, in which this method shall be carried still farther by teachers who have learned from you to carry into the schoolroom the wealth of illustration and practical application which only the farm affords, and from these higher schools students come to you for still higher training, then will have begun an educational cycle which will mark the beginning of a new era in the intellectual—yes, in the moral and religious life of your people.

With one more thought I will close: As I have said, for years I have watched the work of this institution with envious eyes. But as I come here and walk through your well equipped laboratories, museums and libraries; as I inspect your splendid outfit for dairy work, and your great poultry houses with their beautiful fowls; as I walk through your botanical laboratory and greenhouses, and look over your grounds with their wealth of adornment; as I look into the bright faces of your students and meet in friendly converse their instructors, I am seized with an irresistible regret to think that all this magnificent equipment, all this beautiful environment, all this talent for teaching, are being wasted upon a land where there are no girls!

For I assume no other demonstration is needed that the farm homes of Ontario are without daughters than the fact that those daughters are not found within these walls; for it cannot be possible that the fathers and mothers of Ontario look upon the cultivating and fertilizing of the soil and the rearing and feeding of cattle and sheep as matters of greater importance than the feeding and clothing of children in such a manner as to keep them in health. But if the mothers of the next generation are to have that preparation for the care of their homes which Science is offering, and from which we have reason to hope so much, it must be given to the daughters of to-day, and it must be given by such schools as this.

THE RELATION OF DOMESTIC SCIENCE TO THE AGRICULTURAL POPULATION.

MRS. JOHN HOODLESS, PRINCIPAL OF THE SCHOOL OF DOMESTIC SCIENCE, HAMILTON, ONT.

When asked by your Secretary to give an outline of a course in Domestic Science suitable for the agricultural population I felt somewhat puzzled at first to know where to make a distinction between life in a country house and in that of a city home, as the actual needs must be very similar and the same scientific training necessary. However, I accepted this opportunity to express my views on a matter, which, I believe, contains more revolutionary power for good to humanity at large than any other single influence. It is gratifying to know that a subject bearing so directly upon the welfare of the home, and consequently upon the nation, is being considered by a class whom all admit form the solid foundation of our country. While we feel somewhat reluctant about admitting the superiority of our neighbor to the south of us, *in some respects*, it is only reasonable to suppose that in a population of about seventy millions there may be a few more clever people than in our country of six million, and in this spirit let us glance for a moment at the progress being made along these lines in the United States.

The Agticultural Colleges of the States were the first on this continent to introduce Domestic Science into their curriculum and to place this science on a level with the other departments. The President of the Kansas Agricultural College said in 1874: "That a girl had just as much right to special education in the line of what was likely to be her life-work as a boy had to be fitted for a farmer, business man or professional." When I ventured to express the same opinion four years ago I was quietly informed that I was cultivating a "fad" or that I was in advance of the times. What must the people have thought of a College President making such an assertion twenty-five years ago? However, the example set by the Kansas College has borne good fruit, and during the last twenty years nealy all the leading Agricultural Colleges of the Union have added a department of Domestic Science to their curriculum. In some a post-graduate course has been provided where students may return after taking the regular course and receive additional training.

Mrs. Kedzie, Professor of Houshold Economy in the Kansas Agricultural College, says of its introduction: "After a course of lectures on the chemistry of food, the sanitary arrangements of a home, the hygiene of dress and kindred subjects, had been delivered, there grew a demand for practical work." The idea expressed by Ruskin had been developed, that "There can be no healthy thought without labor, and no happy labor without thought." So when a girl is taught to *think intelligently* she should be given opportunity to practice. The same writer says in connection with the influence of these lectures: "After a girl had been taught the value of the different articles of food it was but natural that she should be ready to put together materials so as to give the most nutritive and palatable food," and so from seed sown in these preliminary lectures a system of household science was developed.

Mrs. Ellen H. Richards, Instructor in Sanitary Science, Massachusetts Institute of Technology, Boston, says, in connection with such training in our public schools, and as emphasizing the need of practical application: "A fact discovered by a child for himself, through his own direct observation becomes a part of his being, and is infinitely more to him than the same fact learned by hearsay or acquired from a lesson book." In this respect we are all children. I have attended lectures on scientific cockery and been deeply interested at the time, but unless the instruction given had been practiced at home, the lecture would only remain as a pleasant memory. So, to sum, up we need first to stimulate the intellect, second, encourage practical effort, third, to appreciate and acknowledge good results.

In order to keep to my text, as I am tempted to wander into public school work, I shall ask you to consider the vast possibilities contained in scientific knowledge, applied to life in the country. The public school system has much to answer for in robbing the rural districts of many of their brightest and most valuable pupils. Just so soon as a boy or girl develops a special aptitude for text book working—and country life rather conduces to a more retentive memory—finding themselves at the head of an examination list, they become convinced that their intellect is of the "genius" order, and that they are destined to shine as bright professional lights, or possibly future Cabinet Ministers. They are encouraged and stimulated by their teacher, whose highest ambition is to pass more pupils at the entrance examinations than the rival in the next section. Everything gives way to the text book. Individuality is crushed, object teaching and practical work is overlooked, the mental powers of the child are over developed, very often at the expense of the physical. And what is the result, an overstocked community of mediocre professionals and neglected agricultural opportunities. When will farmers realize the mistake they are making in permitting agriculture to sink below the intellectual standard of the profession? There is no occupation bearing more directly upon the needs of humanity than that of agriculture, and now that our legislative bodies are giving attention to the question of providing scientific training for the farmers, it seems only a natural sequence that something should be done for the farmers' wives and daughters. In order to emphasize the need of attention being given to this question, permit me to give an extract from a letter recently received from Mrs. Rorer, one of the most celebrated domestic scientists in the United States, in which she makes the following statement: "In carefully investigating the statistics of the Hospitals for Insane throughout the Union, we find a greater number of rural people than those from cities; why is this? Because in the larger cities we have markets from which we buy our daily food. The masses follow the example of the more educated class, but in the country they eat what they have at hand, selling what brings in the most money, in consequence of which, they frequently exist entirely on food without tissue building qualities. Insanity is but a physical breakdown."

In making similar enquires in Canada, the same startling information was given. Doctors frequently attribute the cause to overwork and monotony. In either case the causes are easily preventable. In the first, by scientific knowledge of the various articles of food and their nutritive value, and in the second, by the introduction of schools of domestic science in the rural districts, with lecture courses, and clubs for farmers' wives, where the better methods of producing good results in butter making, poultry raising, bee culture, house decoration, cookery, etc., can be intelligently discussed, thereby providing the best class of recreation, which is pleasure and profit combined. The influence of the Agricultural College has been felt throughout the whole Province. The farmer is beginning to realize the importance of scientific knowledge, that he must understand the chemistry of the earth, the care of sheep, cattle and other live stock, the proper food required for certain climatic conditions, etc., and in consequence his work has become more attractive. He not only finds his mind developing, but feels the power of knowledge in his social intercourse with other men, and who will dare say that a cultured, intelligent farmer is not the peer of any man, professional or otherwise. Now, if this scientific culture is so necessary for the development of a higher class of farmers, is it not equally necessary for the farmer's wife, as we are told that it is not good to be "unequally yoked." Is it of greater importance that a farmer should know more about the scientific care of his sheep and cattle, than that a farmer's wife should know how to care for her family; or that his barns should have every labor saving contrivance, while she toils and drudges on in the same old treadmill instituted by her grandmother, perhaps even to carrying water from a spring a quarter of a mile from the house—which I know has been done—and providing the pies, hot cakes, etc., which cause so much of the unrest and discontent in country homes? I leave you to answer this question.

By following the example set in England much could be done to not only brighten the lives of farmers' wives and daughters, but lead them to take a more intelligent interest in their surroundings and responsibilities, as the health and home-makers of the family. The county councils in England employ bright, cultured teachers to give instruction in domestic science to the farmers' and artisans' wives and daughters. They have a district arranged, where two lessons a day are given in five different villages or centres, one lesson at 2 o'clock for farmers' wives and daughters, and another at 7 p. m. for those unable to attend day classes. The lessons are given in halls, unoccupied buildings or shool-houses, and have proved intensley popular, the women of the neighborhood looking eagerly forward to the weekly visit of the cookery teacher. In this way new ideas are brought into their lives. More hygienic, nourishing and palatable ways of preparing the produce of the farm are taught. We occasionally met a farmer's wife who has kept in touch with the outside world, and whose progressive spirit has led her to discover much that is taught in a domestic science course, and we are sometimes met with the advice from husbands and fathers of these exceptionally clever women, that the home is the place where all such instruction should be given, forgetting the fact, that such housekeepers are very rare. Mrs. Swing, principal of the Chautauqua School of Science, says: "Not one woman in a thousand knows when housework is properly done, and not one in ten thousand is qualified to give instruction in housekeeping and domestic arts." If scientific training is so valuable in other pursuits, why should its influence not be brought to bear upon woman's education in relation to rural life as well as in the city, thereby enabling her to appreciate the value of pure air, wholesome food, sanitary laws, economy and honesty in household management, the power to discriminate between good and bad material, the ability to impart knowledge to others, to economize time and nervous force to cultivate a love for the beautiful in art and nature, in short to make her what Col. Clark, in his notable book on "Art and Industry," says she should be, "The highest ideal of humanity." I hear some farmer's wife say, "Oh, yes, this is very fine in theory, but how are we to carry it out? it is so much easier to cultivate a taste for the beautiful in the city where you have so many more privileges provided for developing higher aims." This may be true, and why the women in the country places have submitted to such restrictions so long, is beyond my comprehension. I cannot help thinking the fault lies, as previously explained, in our system of education. Why the same course should be laid out for country and city schools is one of those perplexing questions we try in vain to solve. You say, "Would you deprive country children of the intellectual training given the city child?" By no means; give them the very best mental culture. But, as education should be utilitarian—to a certain extent—should there not be a point in the education of country children, where their talents may be directed into a channel connecting with their daily life. I venture to say that a bright intelligent teacher would stimulate more mental effort in a thirty minute walk through a field or wood with a class in natural history or botany, than in compelling them to memorize pages from a book on the same subject. Teach them to value and appreciate the privilege of living in the country the dignity of labor, the honor of doing any work well. In the sewing course, as outlined for the public schools, girls are taught the value of neatness and order, the study of textiles and fabrics, a knowledge of correct form and color, harmonious blending of color—in short, what the term given implies—domestic art. Why should not true art be taught in connection with our everyday work and surroundings and in the simple adornment of a home in the country, as well as in the more pretentious home of the wealthy citizen? By inculcating a love for harmonious coloring, and impressing upon a child the fact that beauty does not consist in the money value of an article, much could be done towards making country homes more attractive, and that social bridge erected between city and country life more easily crossed.

Thus we see much of the evident needs of country life outlined in the course we have asked the Minister of Education to provide in our public schools. We hear protests from various members of the teaching fraternity against additional studies. It is with a view to reducing the already too numerous studies that we urge the introduction of domestic science and art. Some of the studies will have to be limited, some, we trust, dropped entirely. Physiology, chemistry, hygiene, temperance and botany may be incorporated in the domestic science course, and one lesson a week in history and geography give place to the sewing course, which I venture to say will be infinitely more valuable for practical purposes than a knowledge of dates or the number of mountains in Africa.

Now we have glanced at the existing conditions and noted the influence which would be exercised through more scientific knowledge. The next thing is to outline a course whereby these practical results may be attained. In the first place, such training cannot be provided without properly qualified teachers, and this is a point I wish to emphasize—*that a high standard be determined for this department.* A master in science has given the following definition of what constitutes qualified instructors for such work: "They must be in thorough sympathy with the work, full of academic training and experience; they must know not only the art they teach, but how to teach it; use the English clearly and correctly, and of unexceptionable character."

If it takes four years to prepare a doctor to enable him to cure disease, should a knowledge of how to prevent it receive less consideration? Let us urge the powers in authority to provide a Normal Training School in connection with each Agricultural College, where only applicants possessing a general fitness for such work will be admitted, where high intellectual attainments will be required, and who will go out into the agricultural districts fully equipped for their work. The next step will be to provide a thoroughly graded course in the district schools, or else establish a School of Domestic Science in each county in the place of so many High Schools. These provisions made for the rising generation and a plan as previously outlined as existing in England, for present needs, would do much towards arousing more intelligent interest in a matter which bears so directly on the welfare of the country.

In order that I may not be misunderstood, let me give a summary of what is taught by theory and practice in a Normal Course of Domestic Science and Art.

The Domestic Science Course includes household science, chemistry and physic, bacteriology, what to do in emergencies, home nursing and hygiene, cookery, laundry work, marketing, keeping accounts, and in Agricultural Colleges, dairying, bee culture, poultry raising, horticulture are added.

The Domestic Art Course includes drawing, form and color study, history of art, sewing, millinery, physical culture, study of textiles and fabrics.

In the Agricultural Colleges in the United States four years are allowed for this course.

In Pratt Institute and other training schools two years are required, but the entrance examinations are more difficult.

What has been done in other countries may be done in ours, and, in conclusion, let me beg the Ministers of Agriculture present to give their very best attention to the needs of the women in the agricultural districts, as well-managed, happy homes are the best foundation for a nation's prosperity.

Domestic Science in the Public Schools.

In order that some idea may be conveyed to those who have not studied the question of more scientific education for girls in our public schools, of the rapid progress being made on this line in other countries, I shall preface my remarks with a brief history of its growth in some of the educational centres of the world. In the first place, I would draw your attention to the fact that in every country women have been largely instrumental in promoting this branch of education, and in nearly every case the knowledge of its need came through organizations of *Christian* women, thus clearly proving the close connection between religion and education, when rightly directed.

Instruction in cookery was first given to the public schools of the United States under the auspices of the Young Women's Christian Association of Boston in 1880. In 1885 Mrs. Hemenway, of that city, established a Vacation School of Cookery—at her own expense—in order to demonstrate the practical value of such teaching. This school was supported by Mrs. Hemenway for three years, when it was taken over by the Boston School Board. Since that time sewing and cooking have been added to all the public schools of Boston, Philadelphia, Washington, nearly all in New York, Minneapolis, St. Paul, and fifty other cities and towns in the Union. In order to provide suitable teachers for such an important branch of education, Mrs. Hemenway established a Normal Training School, now known as the Boston Normal School of Domestic Science. I give the history of this work in the United States first, as being nearer home, and condition of living so similar; it may lead you to consider the question from the same standpoint, that of the example set by the older countries, by Germany, for instance, which was and is the leader of all nations in scientific education. In the early seventies the question of better domestic education was taken up in Germany under the patronage of the Empress Frederick, who has continued to advance the cause in every way possible. There, as in other countries, its need was first discovered through philanthropic organization, the Imperial School in Berlin leading others to establish similar schools throughout Germany. Frau Krupp, the wife of the celebrated gun manufacturer, succeeded in persuading her husband to establish a school on such an extensive scale that two thousand pupils are admitted annually. This is one of the most thorough schools in Germany. Notwithstanding all the efforts made by these generous philanthropists, it was found, as in all similar cases, that the class more particularly requiring such education was not being reached, consequently the matter was taken in hand by the State, and is now part of the Public School System of Germany, with Normal Schools, Government Laboratories, and every advantage provided for a thorough technical education for both boys and girls. England has been forcibly reminded by the inferiority of many of her products to those manufactured in Germany that this system of education is proving a very strong influence in German prosperity, and with the usual pluck and discrimination displayed by the Mother Country she has been making rapid progress during the past few years to make up for lost time. Immense Technical Schools are being established in all the large manufacturing cities, including Schools of Domestic Science. Cookery, sewing and laundry work have been added to all the Board Schools, London having one hundred and forty-six centres for cookery alone. The County Councils employ teachers of Domestic Science to travel through the rural districts to give lessons in cookery and lectures on sanitary science to the farmers' and artisans' wives and daughters. Scotland has given special attention to this department of education for girls. Glasgow has one of the best training schools for teachers in the world. France, Sweden, Switzerland, Belgium and New South Wales have a regular system of manual training under Government support and control. These countries have adopted manual training as the wisest means to secure material prosperity, not viewing the question from a purely utilitarian standpoint, but as a factor in promoting a higher class of citizenship, believing that what will elevate the dignity of labor and create higher ideals of life must react upon the welfare of the nation.

Not having an Empress Frederick or Princess of Wales—who has recently established a School of Domestic Science—a Mrs. Hemenway, or even the advantage of the London School Board of having women on our boards, the women of Canada have allowed matters to drift pretty much as the men who control our educational affairs have seen fit. Now, I do not wish to convey the impression for one moment that I am advocating these reforms or speaking in any critical or condemnatory spirit, or that the educational authorities are to blame for providing precisely the same training for boys and girls. How could any one reasonably expect men to understand the special needs of a woman's education? As well expect them to manage our households as to plan for the education of our girls. We certainly owe much to the Educational and Legislative authorities of Canada for providing so liberally for the higher education of women, and if, through their desire to provide for a fuller development of women's mental powers they have overlooked the practical side of woman's life and work, are they to blame? I say most emphatically, no! The women of Canada are responsible to a great extent for the present one-sided system of education. As stated at the beginning of this address, its introduction has been through the influence of women in nearly every country. Are the women of Canada less alive to the value of home life or its influence upon society at large than those of other countries? I do not believe they are, but not having a recognized medium through which they could approach the controlling powers of the country, they were obliged to submit until a suitable opportunity offered through which they could make their wishes known. Now that the National Council of Women has formed a chain of workers from Halifax to Vancouver, one of the first and most united efforts is being made to secure introduction of Domestic Science and Art, or manual training for girls, into the public schools of Canada; thus demonstrating the need of a united women's organization, irrespective of creed or politics, in order to bring before the proper authorities any manifest needs of the women of the country. Who so capable of knowing her own needs—her ambition to become what God intended she should be, man's helpmeet; her struggles in trying to break down traditional customs which hamper her at every turn; To elevate woman's work to an intellectual plane with other professions; to bring scientific knowledge to bear upon the care of her children; the power to create high ideals and noble ambitions in her children; to make the home what it should be—the purifying influence of society at large—as the women of the country who by social and intellectual privileges are enabled to meet together, with the first lady in the land for their president, and discuss the best ways and means for furthering these aims? Through experience in Young Women's Christian Association work (an association which has done more for developing this line of education than any other, outside of school boards), the need of more practical education for girls was plainly demonstrated, and when the National Council of Women was organized, and being privileged as one of its promoters to suggest a plank for our platform, I realized that the time had come when the women of Canada might, through such a united force, accomplish something in this direction, and accordingly moved the following resolution, which was unanimously adopted, viz.: "That the National Council of Women will do all in its power to further the introduction of manual training for girls into the Public School system of Canada, believing that such training will greatly conduce to the general welfare of Canadian homes; and that copies of this resolution be sent to the Ministers of Education of each Provincial Government." The success attending this effort has far exceeded our expectations, clearly demonstrating what has long been a pet theory of mine, "That woman's influence, if wisely directed, will accomplish what she may desire in legislative reform without the franchise." At the very next meeting of our Ontario Legislature, the School Act was amended, making this an optional course with School Boards. In Montreal, eleven of the largest Protestant schools are already receiving instruction in Cookery. Quebec has established a school of "Household Arts." Toronto has added Cookery to the Technical School course, and also established a centre in the Elizabeth street School. The Hamilton School Board has consented to the introduction of sewing, and within the past week granted a subsidy of four hundred dollars to the School of Domestic Science for public school classes. Kingston has introduced Sewing and is agitating for Cooking. London is also working up interest in the matter. Halifax is prosecuting a vigorous campaign on the same lines, and so it goes from one end of the country to the other, and yet there are people who will still ask, "What is the National Council of Women; and what are they doing?"

Now that I have given you the history and progress of the work up to date, let us look at the question as an educational factor. We are occasionally informed by those who have not studied this question, "That the state has no right to educate for utilitarian purposes, to teach trades, etc." Now it is evident that anyone making this assertion has not grasped the true meaning of manual training. Dr. Felix Adler, of New York, says: "Among those who have given most thoughtful attention to the subject, the following points are accepted, viz.: that manual training means the training of the intellect as well as the hand, and its chief recommendation is, that it offers a new instrumentality for training the mind, that the manual training logically connects with the system called object teaching. The old object method was to teach the child to observe, but manual training teaches not only to observe but to create." This brings us to the direct influence of manual training as applied to girls' work. The question has been asked, 'Can cooking—the use of kitchen tools—be placed on a level with the use of workshop tools, as a means of mental and physical training?" Mrs. Ellen H. Richards, Professor of Sanitary Chemistry, Boston Institute of Technology, answers this question as follows: "Let the skeptic go into one of the school kitchens, and see the girls standing at their tables, with the measuring cup and scales, instead of a foot rule, with the moulding board and rolling pin, instead of the plane, the dough for a loaf of bread, instead of a piece of pine board, their hands the most effective tool of all; let him watch their graceful, unstudied motions as they tidy up the desk while the prepared dish is cooking; let him note their bright faces as the soup is tasted, and then tell whether there is no value in the work as a physical development and mental exercise in judgment, exactness and neatness. The executive faculty, the most important of all our powers in the practical work of life, is called into play by the bringing of the preparation of materials and cooking within the specified time. The school girl who has had the elements of chemistry and physics, which are often taught as abstract subjects, summed up and applied to the making of a simple dish, has had her mind awakened to the relation and interdependence of things as no other training now given can awaken it." The objector may say that a pudding made by practised hands is just as good as one made by hands which are actuated by brain knowledge. It is quite true, but the advocates of manual training as a factor in education turn their eyes, first of all, and chiefly, to the effect upon the child, for the proof that the training has been successful in that which it aimed to accomplish, namely, *a result upon the child*. The subjects required in a domestic science course are nearly all taught in some fashion in the schools, so that this plea is not for the introduction of new subject matter, but for the simplifying and correlation of what is now attempted, so that the result may be a valuable educational development, mentally and morally, instead of a useless hodge podge of isolated facts, with no effect on the after lives of the pupils." The same writer says: "That in education, each step should follow closely upon the previous one and the connection between all the branches clearly apparent to the pupil's mind." Often the most effective lessons are those which are indirectly learned. Thus one of the most valuable influences of the cooking schools is the indirect one of neatness, cleanliness and promptness.

Even admitting that public school education should not be considered as a means to an end, is it not reasonable to desire a certain amount of practical benefit from the time given by the pupil to the public school course, and why cannot we have subjects taught practically instead of mere theory and memorizing from text-books, by incorporating such subjects as Temperance, Physiology, Hygiene, Physics and Botany in the Domestic Science course; and instead of studying the effect of alcohol upon the system as a text-book lesson, connect the subject with that of providing good wholesome food and a clean comfortable home as a preventive measure against intemperance? Instead of memorizing pages of physiology, telling how the blood circulates, teach the child how to keep the supply pure, and how to nourish the brain and muscles by proper tissue building food. We all know how much more willingly we attempt a task, if we feel we know how it should be done, and if scientific training is valuable anywhere, the home is the place where its full value may be realized. Mrs. Richards, who is such an acknowledged authority on these matters, that I may be pardoned for quoting her so freely, says: "The science of home life should keep pace with outside affairs. At a time when electric lighting and steam heating and other modern inventions obtain, the housekeeper needs a correspondingly broadened education." And where is this to be received, if not in our public schools, under properly qualified teachers? Mrs. Swing, a well known authority on Domestic Science matters, the Principal of the Chautauqua School of Domestic Science makes the following statement: "Before women can be qualified for household management, there must be teachers competent to qualify them, and such teachers we can never have until schools are established where practical instruction is given in household science." Mrs. Swing states further, "The question of household labor is a question that becomes more complicated the longer we dilly-dally with it. It is a question that women must grapple with and settle, or abandon their homes." The question must be met in a manner that will meet the requirements of all classes of society, and in no way can a uniform system of knowledge be diffused so thoroughly as by its introduction into the public schools, where rich and poor will receive the same training and where intelligent labor, or in other words, the dignity of work well done, will be understood and appreciated. In conclusion I beg to draw your attention to the fact which has been clearly demonstrated, "that a child devoting three hours a day to text-book work and two to manual training is as far advanced at the end of the year in text-book work as the child giving the whole time to the latter."

I am sometimes led to compare our boasted educational system in its relation to the older countries, to the eighteen year old boy who knows so much more than his father. We are only beginning to realize our mistakes, and surely it should not be beneath the dignity of any young country to follow the example of the older and wiser nations, which have benefited by their long experience, and who are setting such a good example on these lines. There is no test like time, and we have given our system a fair chance. I do not think you will find a conscientious educator to-day, no not even the Minister of Education himself, who will say with assurance that our system is producing the best results, and the old proverb is applicable, "An ounce of prevention is worth a pound of cure."

BEAUTIFYING THE HOME.

By T. Greiner, La Salle, N. Y.

If I were to write a treatise on "Beautifying the Home," and looking for a motto to put in small type beneath the title, I would hardly be able to find anything more appropriate than one of the first Latin phrases which we learned in school, namely, "*Ubi patria, ibi bene.*" In boyish frivolity we used to take some liberties with this phrase, and reversing it made it read, "*Ubi bene, ibi patria,*" with this tacitly accepted interpretation, "Where we have lots of fun there we feel at home." The word *patria* literally meaning "fatherland," however, may also be used to signify "home," and a proper interpretation in good popular English would be, "There is no place like home." Indeed, where my hearth and home and family are, there is my country also.

The phrase "No place like home," unfortunately admits of more than one interpretation. In poetry and theory the home is the truly happy home that it should be, and as such the quintessence of all earthly blessings. In reality and practice there is no place so desolate, so cheerless, so God-forsaken, as many so-called homes. They consist of little more than structures of shelter, eating and lodging places, we might say of barns for human cattle. We find these human shelter barns just as often on the premises of the rich as on those of the poor. Some of them are elaborate structures, costly mansions surrounded by parklike grounds and beautiful scenery, offering every luxury and every convenience which the fertile brain of man can suggest, and money can buy. They may have the conveniences of the aristocratic club house, but the real home comforts are missing.

Our object in beautifying the home is to lead to the greater enjoyment of home life and increased love for the home. In many ways the means to beautify his home and enjoy real home comforts are just as accessible to the poor home owner as to the rich. Much can be secured without money and without price. While the world may be very far from being perfect, when we once have learned how to make the most of our opportunities, through the enjoyment of the beautified home I have in mind, then we can pass through this life with a great deal of genuine comfort and bliss.

One of the first means that I would look to for beautifying the home, is light—brightness. Sunshine is the life of the plant; there is also a kind of sunshine that is the life of the home and of home enjoyment—the sunshine of a cheerful disposition, of love, of tender consideration for one another's feelings, peculiarities and even faults; the sunshine of the smile of happy laughter and kind words. With this most potent home beautifier present, other means of beautifying the home will present themselves from their own accord, for love of the home brings pride in and care for its appearance.

Plenty of good light stands in the front rank as a device for beautifying the home. It is not appreciated as it deserves. We want the direct rays of the sun during the day, and the very best of artificial light these long evenings. Our fathers may have taken a good deal of home comfort in the log hut dimly lighted by a pine knot or tallow candle; but greater comfort has come with the rapid improvement of our means of lighting our homes. The dismal darkness of their so called homes drives many a boy and girl from the parental roof, and makes them seek elsewhere the cheerfulness which they miss at home. It drives many a husband to the gilded halls (hells) that are glittering brilliantly in electric light and deceptive cheerfulness. The cost of the best lamps, and all the kerosene necessary to keep the house lighted up in full glory and brightness from ground floor to garret, is as nothing compared with the results, the enjoyment and contentment they give to the whole family, and especially to the younger portion. Light gives cheer. Darkness is desolation and despair. Beautify your home by lighting it up as brilliantly as can be, with electric devices or with good gas light if they are accessible, with the best of kerosene lamps and high grade oil if you can have nothing better. It is an investment that will pay exceedingly well.

For a painter to decorate the interior of the house, a stream of direct sunlight is not surpassed. The sun ray paints the cheek of the peach and apple with beautiful blush or brilliant vermillion. It also paints your own cheek with the color of health. Open up the blinds. Let in the golden sunlight. Better that the carpets fade than that the cheeks of our dear ones pale in the darkness of musty rooms. Direct sunlight wipes out the stains of molds and decay, and covers us with a coat of mail impenetrable for many of the germs and bacteria which threaten our peace and safety. Let us not despise sunlight and fresh air, even if they are free to all. If trees are close to the dwelling, and overhang the windows to such an extent as to hinder the entrance of these great beautifiers of the home, we will have to trim off the branches in the way, or cut the trees down altogether.

Surely we want trees, or some taller growths of plant life, near the dwelling to add their indescribable charms and beauty to the general appearance of the premises. I would have them just as close as possible without danger of having sunlight shut out of the house. Partial shade, outside of the house, during summer is highly gratifying. We like to have the hammock swinging between porch and tree, right under the leafy branches. The trees, too, serve a good purpose in draining the ground in immediate vicinity of the dwelling, and to purify the soil by absorbing foul accumulations. These services of one or more trees around the house are seldom appreciated as fully as they deserve.

The tree usually employed for such positions is the sweet cherry (Hearts and Bigarreaus), and I don't know whether there is a tree better suited for the purpose. The maple makes a good tree for show; but it gives shade and nothing else. I would prefer a fruit tree, or, perhaps, the linden, which is not only a beautiful tree in itself, but one very useful to everyone who keeps bees. It is worthy of being planted more largely, even in groves by the professional bee-keeper. Pear, plum (especially prune) and even apple trees can be used for these same situations. In the more southern portions of the Province, as well as almost anywhere in the States, the new Paragon chestnut may be found an excellent tree to plant near the house, and not only give shade but excellent nuts within two or three years of the time it is planted. No tree should be planted closer than twenty feet from the house, and only one or two should be allowed to stand thus closely. Others may be set further away.

In attempting to beautify the grounds around the house, a nice clean lawn, perhaps set into a frame work of shrubbery or taller growths, is the most necessary, indeed, indispensable feature. Its essential feature is the lawn itself. If well taken care of, kept green and thrifty and closely shaven, a small lawn is beautiful in itself, even with very little or no shrubbery, and a fine lawn can be secured at trifling cost. You want the ground perfectly graded, and the surface made smooth and fine as a floor, and the soil fertile in order to bring out a good growth of grass. Poor soil will not do that without outside help. Our seedmen sell special lawn mixtures at (to them) profitable prices. You can hardly get a finer lawn than by using the common cheap Kentucky blue and red top grasses. The former alone is good, but we may mix the two, half and half, and sow at the rate of five or six bushels of seed per acre, and thus secure one of the best of lawns at lowest possible cost.

I have nothing to say here on the subject of laying out and planting more extensive home grounds, and but little about the selection of growths for the average small lawn. Individual tastes and preferences differ, and these must be humored. A fine example of planting more extensive areas can be seen on the beautiful grounds of the College here. Study the effect and apply the principles to any other work of this kind. For single specimens, we will have to look long and far to find a match in beauty and universal favor to the Colorado blue spruce among the evergreens, and to the Japanese purple-leaved maples among deciduous growths. The blue spruce will make a large tree in time. The Japanese maples are shrubby, but their remarakably beautiful, delicate foliage makes them an object of attraction and admiration when planted singly on the lawn.

Outside of house and lawn there are many other things that aid in making a home beautiful. A flock of pretty Leghorns and Langshans in an enclosed yard, or in a well-arranged poultry house, adds life and variation, and offers the suggestion of fresh eggs and roast fowl besides. Then there is the well-groomed Jersey and Alderney or Guernsey in her clean stall—what a beautiful creature! and making us think of the rich cream for our berries and coffee, and of the golden butter. I might also speak of the orchard that furnishes us a continuous supply of good fruits almost the whole year round. Whether in bloom, in fruit, or in leaf only, the orchard, may it contain hundreds of trees or only half-a dozen, is a thing of beauty and of joy, and of thought, and perhaps of disappointment for variation.

There is only one thing more to which I wish to call your attention as a beautifier of the home, and that is the kitchen garden. I wish to lay purticular stress upon this as an essential factor in making a beautiful and perfect home. At different times I have seen country homes which were beautifully laid out, with vevelty lawns and groups of choice shrubs and trees, the glorious *Clematis Jackmamii* clambering all over the verandahs, beautiful blooming plants displaying their charming colors here and there and filling the air with their fragrance. Everything looked bright and inviting in the front, yet we found Gehenna in the rear. Those tell-tale currant and gooseberry bushes along the garden fence were standing with bare stems, the leaves eaten off by worms, and the stems themselves half hidden in briars and thistles. Then there was the strawberry bed and the vegetable patch all lost in weeds. Some piles of freshly-pulled weeds, and a few almost bare spots in all this swamp of weedy growth, with a few spindling radish plants, and a few melon hills, etc., gave evidence of the fact that some feeble efforts had been made to reclaim the garden, but for once it had been found "too late to mend."

In reality the garden can be made not only practically useful, but also a thing of beauty, and an ornament to the home grounds. It can well be fitted into the scenery, and planted and taken care of with this very object in view. A few rows of peas in bloom, (well supported if tall) will show off to better advantage than the costly dwarf sweet pea "Cupid" which was introduced last spring with such extravagant claims, and which has been such a complete failure with us last season. Then there may be a wire trellis as a support for so-called pole beans (limas if your seasons are long enough), and this will be a thing of beauty and joy as long as the season lasts. Then we can have some tomatoes held up by stakes or other suitable supports, showing their perfect fruits of red, purple and yellow colors, and of various shapes. Then think of the thrifty foliage of melon and squash vines thickly covering the ground, only allowing here and there a glimpse of the golden-colored, luscious fruits, in all their beauty and attraction. The straight rows of radishes, beets, carrots, etc., also add their mite to the general inviting appearance. Take a bed of carrots, how perfect and delicate, and fern-like the foliage! Then what lovely plants are peppers and egg plants, both in bloom or when laden with their bright colored, often grotesque-shaped fruits!

There is an eternal fitness of things. The true beauty of the home is in its completeness and in the prefection of all its details. We want the display of beauty in the house as well as outside, cheerfulness and brightness in the sitting-room, in the kitchen, in the parlor. We want beauty in the lawn and shrubbery, and in the garden, too. Let us strive for this perfect combination, so that our children, long after they have left the parental roof, will think of the blessings that they enjoyed with us—an inheritance that they in their turn will leave to their children.

TREASURER'S REPORT FOR 1896.

Receipts.	$ c.	Expenditures.	$ c.
Balance from 1895	176 52	Agricultural experiments	592 51
Membership fees for 1896 (after balancing accounts)	24 00	Horticultural "	121 00
Government grant	1,000 00	Dairy "	15 28
		Live Stock "	23 25
		Botanical and Entomological experiments	5 40
		Apicultural experiments	51 95
		Part expenses of annual meeting, 1895	70 30
		" " 1896	75 60
		Meeting of Executive Committee	16 20
		Salary of Secretary for 1895	25 00
		Salary of Editor and Secretary for 1896	105 00
		Total expenditure	$1,101 49
		Balance on hand	99 03
	$1,200 52		$1,200 52

We, the undersigned Auditors of the Ontario Agricultural and Experimental Union, beg leave to say that we have examined the accounts of the Treasurer and find them to be correct, with the exception that no vouchers were shown as to the expenditures of the Apicultural Committee.

PERCY HODGETTS,
WILLIAM J. ELLIOTT, } Auditors.

RESOLUTION.

The following resolution was moved by Mr. T. H. Mason and seconded by Mr. H. L. Hutt:

"That Mr. C. A. Zavitz and Mr. George Harcourt be a committee to interview the Minister of Agriculture as regards an increased grant; also the question of membership of our Union; and that the Board of Directors be given power to change the constitution as advised by said committee."

The above resolution was unanimously carried.

REPORT OF CO-OPERATIVE DAIRY EXPERIMENTS FOR 1896.

BY PROF. H H. DEAN, DIRECTOR OF COMMITTEE ON CO-OPERATIVE EXPERIMENTS IN DAIRYING.

The committee appointed by the Union to plan and conduct experiments in dairying for 1896, beg leave to report as follows:

About the middle of March a circular-letter was sent to eighty-four cheese-makers and forty-one butter-makers. This circular said:

DEAR SIR,—The Committee on Dairy Experiments, appointed by the Ontario Agricultural and Experimental Union, desire your co-operation in regard to experimental work in dairying. Every dairyman, cheese-maker, and butter-maker should be an experimenter. To secure co-operative experiments on the same lines we have selected the enclosed for 1896, and hope that you may be able to undertake one or all of them during the year. Please fill in the blanks and send the results to us as soon as possible after the work is done—not later than November 15th, 1896. Your ordinary cheese or butter work will answer in most cases. It is a matter of recording the facts and sending them to us.

The results of all the experiments will be published in the Annual Report of the College, of which a copy will be sent to each one who sends in a report to the committee. As a further inducement to dairymen and makers, who send us a complete report for one experiment repeated at least six times, the choice of one of the following books on Dairying is offered:

			Price.
American Dairying	by	H. B. Gurler	$1 00
Cheddar Cheesemaking	"	J. W. Decker	1 00
Dairy Bacteriology	"	H. W. Russell	1 00
A Book on Silage	"	F. W. Woll	1 00
Milk Testing	"	Schoenman	75

As the Committee has limited the number of books which may be awarded to 20 in the cheese experiments, and 20 in the butter experiments, the first 20 in each department who signify their intention to take up the work by writing the Director of Experiments to that effect, will be awarded the books, when the experiments are completed and the blank reports are properly filled out.

H. H. DEAN,
Director of Dairy Experiments.

Owing to the difficulty experienced in getting makers to co-operate in this work in former years it was decided to offer these books as a premium. Seven cheese-makers and two butter-makers agreed to take up the work. Suitable blanks were furnished for recording the work done. The cheese experiments were: (1) The effect of an increase in the per cent. of fat in the whole milk on the yield and quality of cheese; (2) Effect of milling at different stages of acid; (3) Effect of putting curd to press at different temperatures. Only two reports were received, the other experimenters were unable for various reasons to do the work. The reports of Messrs. Wm. Dwyer, Chesterville, and A. D. Perry, Harrowsmith, are as follows:

No. 1.—THE EFFECT OF AN INCREASE IN THE PER CENT. OF FAT IN THE WHOLE MILK ON THE YIELD AND QUALITY OF CHEESE.

Mr. Dwyer made eight trials in the months of May, June, August and September, with milk containing different percentages of fat. The fat ranged from 3.1 to 4.1 per cent. The quality of milk used in each trial varied from 600 pounds to 1,400 pounds. The yield of cheese per pound of fat in the milk varied from 2.37 pounds in 4.0 per cent. milk, to 3.55 in 3.1 per cent. milk. In two cases, the per cent. of fat lost in the whey was one-tenth of a per cent. higher from the richer milk, and in the others the loss was the same from the rich and poor milk. In his comments on the results this experimenter observes:

1. "I had buyers examine the cheese at maturity, and they could not see any difference except when told, and then they often preferred the cheese made from the poor milk. For myself, I prefer the cheese having the large per cent. of fat, as I think they have better keeping qualities."

2. "As to the effect of heating rich milk curd and poor milk curd to different temperatures, I prefer heating rich milk curd to a higher temperature than curd from

poor milk, all things being equal, for this reason: I think the cheese will be closer in body, and not so liable to open up in warm weather. I think an addition of salt is a benefit to the body and texture. I also think if cheese makers would use more salt and less hand stirring they would improve the quality of their cheese.

No. 2.—Effect of Milling at Different Stages of Acid.

I did as directed in No. 2 experiment, and I do not think there is any difference in the acid you give, say from $\frac{3}{4}$ of an inch to $2\frac{1}{2}$ or 3 inches, providing you let it lay until it has come to maturity before salting. For a gassy curd, I would mill at an early stage of acid and let lay afterwards in order to improve flavor of the curd before salting. Some advocate matting down until the curd has become thin—from $\frac{1}{4}$ to $\frac{1}{2}$ inch in thickness before milling. I don't think this a good practice as I think you injure the grain of the cheese by doing so.

No. 3.—Effect of Putting Curd to Press at Different Temperatures.

I made several trials as directed, and I think for May, June, July and August 75° to 80° better for putting to press than 85° to 95°, as I think the cheese are not so liable to open up after being placed on the shelves in the curing room. Now, taking the fall months, I prefer putting to press at say from 82° to 86°. I think if put to press at a lower temperature you cannot get so good a rind on your cheese (unless your make room is very warm) as the curd is liable to get cold next to the hoop.

Mr. Perry reports on experiment No. 3 that he made 18 trials in the months of July, August and October. The temperature of putting the curds to press ranged from 70° to 94°. Some of his comments are:

1. July 17th, where temperatures were 79°, 86° and 94°—flavor uniform, body best in 94°; texture best in 86°; the cooling required too much stirring.

2 July 23rd—temperature 74°, 86° and 92°—the higher temperature caused more fat to press out unless pressed slowly at first.

3. August 19th—temperature 72°, 85° and 92°—no difference in cheese.

4. October 12th—temperature 70°, 85° and 91°—all even in flavor and body. The texture was best in the higher temperature curds at time of putting to press.

Conclusion: The proper temperature for hooping is anywhere between 75° and 90°; if the temperature is high, press very slowly on the start to prevent the butter fat coming out.

The experiments in butter-making were: (1) Effect of washing on quality of butter; (2) Effect on quality of butter when cream is cooled to a temperature of 50 degrees, or below, after separating; (3) Creaming milk by shallow pan, deep setting with ice, and separator methods.

Mr A. Wenger, of Ayton, Ontario, reported as follows on No. 1.

Effect of Washing on Quality of Butter.

Mr. Wenger's experiments were made on July 24th from cream gathered in his ordinary creamery practice. The chief point of interest centres about the effect of "washing," on the flavor of the butter.

Kind of Butter.	Score of flavor at end of— 3 days.	2 weeks.	1 month.	3 months.
Unwashed	35	30	25	25
Washed once....................	40	40	35	35
Washed twice....................	42	42	42	40

The maxmium score for flavor was forty-five points. It will be noticed that the flavor was better in the "washed" samples at the beginning and all through the experiment. It is rather difficult to account for this, except that there was some foreign flavor in the butter which "washing" removed. The butter was kept in an ordinary creamery cellar at a temperature of 56° to 58°.

The foregoing are the chief points gleaned from reports of the experimenters who were induced to carry on the work.

Those who made the experiments have received their premiums. These books make a valuable addition to the dairy library, and we do not understand why more makers are not willing to go to a little trouble to obtain information which will be valuable to themselves, also to the whole dairy industry, and at the same time obtain standard works on dairying which will be a continual fund of knowledge.

REPORT OF COMMITTEE ON APICULTURAL EXPERIMENTS.

The committee on apicultural experimental work continued the investigation of Foul Brood in bees during the past year. For this work, the committee arranged with Mr. F. C. Harrison, Agricultural College, Guelph, to conduct a series of bacteriological investigations. The results of this work are given as follows:

FOUL BROOD IN BEES (*Bacillus alvei*).

BY F. C. HARRISON, BACTERIOLOGIST, AGRICULTURAL COLLEGE, GUELPH.

Early in the present year, Mr. R. F. Holtermann approached me with a view to my undertaking certain bacteriological work in connection with the Foul Brood of bees.

On my expressing willingness to undertake such work, he sent me a pamphlet by Dr. Wm. R. Howard, of Fort Worth, Texas, on Foul Brood, and in it marked a number of propositions which he wished me to investigate. My attention was at first directed to said propositions; but other interesting details manifested themselves during the progress of the work. These I shall reserve for a more detailed report.

In this paper I shall give under each head, first the proposition as stated by Dr. Howard, and then the results of my own investigations.

Proposition VIII, page 21, Howard on Foul Brood, "That the vitality of the spores of *Bacillus alvei* is destroyed when exposed to atmospheric air from twenty-four to thirty-six hours."

In giving the results of his experiments, Dr. Howard does not state whether he exposed the spores to sunlight or diffused daylight; and we noticed that he worked with "dry Foul Brood masses from several cells." In my experiments, I exposed the spores, obtained from a pure culture, on the surface of nutrient agar (a nutrient medium on which bacteria readily grow) by spreading them on small discs of glass, called cover-glasses, and placing these in a glass chamber, so arranged that a current of air was circulating over them all the time. This chamber was exposed to the ordinary light in a room with six large windows; and a cover-glass was taken out every twenty-four hours and tested, to see if the spores would grow. This experiment was continued one month; and at the end of the time, the spores germinated readily.

The experiment was repeated with cultures of *Bacillus alvei* obtained from several parts of Ontario, from Florida and Michigan, from Germany, and from Austria,—always with the same result.

Cover-glasses were also exposed in a darkened chamber, simulating the conditions which exist in a hive, and a vessel full of 1% formic acid was left inside. Result,—active growth up to one month, when the experiment was discontinued.

Another method was as follows: Thin strips of filter paper were plunged into a beef broth culture of the spores, allowed to dry, and afterwards threaded on a wire. These were then suspended in a wire basket, and exposed so that the air could freely circulate around them in the ordinary light of a room. Trial cultures were made at intervals; and at the expiration of six months, the spores germinated when the strips of filter paper were placed on the surface of nutrient agar.

Again, a drop of beef broth containing spores, was placed in an empty sterile tube; and, at the expiration of 124 hours (thirty-six of which were in direct sunlight, temperature varying from 80°-98°F), sterile beef broth was added. The tube was then placed in the incubator; and, in less than twenty four hours, a good growth of the germ had taken place.

From this it will be seen that our results are directly at variance with Dr Howard's eighth proposition. They go to show that the vitality of the spores of *Bacillus alvei* is not destroyed by exposure to atmospheric air for even a much longer time than twenty-four to thirty-six hours. Even a month's exposure seems to have no injurious effects on spores, under the conditions stated in our experiments.

Proposition VI., page 20, Howard on Foul Brood: "That the vitality of the spores of *baccillus alvei* is not always destroyed when exposed to a temperature approaching 212° F. (boiling point) for forty-five minutes."

I notice considerable discrepancy between Howard's and Sternberg's conclusions on this point. The latter investigator states that the spores are destroyed by four minutes' boiling at 212° F. At Guelph, we are unable to reach this temperature on account of the altitude. Water boils here at two or three degrees below 212° F., but in boiling water even at this slightly lower temperature the spores were killed by exposure for forty-five minutes. In steam at 212° F., twelve minutes was sufficient for their destruction.

This again is at variance with Dr. Howard's conclusion.

Proposition V., page 19, Howard on Foul Brood: "That the honey is stored by the bees in these foul cells, and sometimes capped, thereby retaining the germs of foul brood as long as the comb lasts; that the honey in these cells is not detrimental to the vitality of either spores or bacilli which are productive of the disease, and that in such cells the spores and bacilli are found suspended in the honey, still retaining their vitality."

To determine the truth or falsehood of this proposition, two methods were pursued: First, the examination of honey and pollen masses, or bee-bread; and, secondly, an attempt to grow the spores under conditions similar to those which exist in honey.

Under the first head, we may say that a number of samples were examined, and in most instances the bacillus was found in honey and in bee-bread taken from badly infected hives.

In considering the second method, we thought that the only antiseptic in honey, the only thing which could possibly destroy or check the germs of the disease, was the formic acid in the honey, and with this thought in mind, we had two samples analyzed in the chemical laboratory. One, a sample of buckwheat honey, was found to contain fifteen per cent. of formic acid; and the other, which was clover honey with an admixture of about five per cent. of buckwheat honey, contained only .0579 per cent. of the acid. So we made two mixtures (1) containing 15 grams of formic acid in 100 grams of nutrient agar, and (2) containing .0579 gram of formic acid in 100 grams of the agar; and, for convenience of reference, decided to call the former "strong formic agar" and the latter "weak formic agar."

Portions of both these formic agars were poured while hot into small glass dishes and allowed to cool, and when perfectly cold were inoculated with cultures of *bacillus alvei* from several different sources.

When the cultures were four days in the incubator, the germs on the surface of the weak formic agar began to grow, and after a time grew abundantly. The presence of the formic acid in this case simply delayed the growth.

Upon the surface of the strong formic agar, however, no growth occurred, although the cultures were left in the incubator for twelve days.

The culture growing on the weak formic agar was then transferred to the strong formic agar to ascertain whether the germ could be accustomed to more unnutural food by previous cultivation on weak formic agar. This transfer, however, was unsuccessful. No growth took place on the strong formic agar, but transfers from the strong formic agar to the weak formic agar grew rapidly.

After the spores had been lying for three weeks on the surface of the strong formic agar they were transferred to ordinary nutrient agar and grew abundantly, proving that the amount of formic acid present even in the strong agar was not sufficient to destroy the spores, but only to inhibit or restrain their growth.

From these tests, it would appear that Dr. Howard is correct in stating that honey stored in foul brood cells contains spores of *bacillus alvei*, and that the honey, within certain limits of time, does not destroy their vitality. It is to be observed, however, that the greater amount of formic acid in buckwheat honey tends to check the growth of the spores, and experiments are now in progress to determine whether prolonged suspension of the spores in this kind of honey will destroy their vitality.

Proposition III., Howard on Foul Brood: "That when *bacillus alvei* or its spores are excluded from oxygen or atmospheric air, they retain their vitality indefinitely and are capable of reproducing the disease in the presence of suitable nutritive material."

Regarding this proposition, I may say that, in my experiments, I repeatedly grew the germ on culture plates in hydrogen gas, proving that the spores can live and grow without oxygen or atmospheric air, but I found that they will not grow in illuminating gas. Further experiments, however, went to show that the spores retain their vitality for some time even in this gas, for transfers, at the end of a month, from both hydrogen and illuminating gas to nutrient agar grew readily.

Hence I agree with Dr. Howard's statement in proposition III., but I do not think that we are warranted in using the term "indefinitely."

To sum up very briefly, I may say that, with much labor and great care, I have investigated the four propositions submitted by Mr. Holtermann, and I can only express my regret that the results which I have obtained do not support all the statements made in these propositions.

Health and class-duties permitting, I shall continue investigations along these and other lines in the hope of reaching at an early date, some conclusions that will be of practical value to the bee-keepers of this Province; but it must be borne in mind that work of this kind requires infinite pains, and that reliable conclusions are not hastily reached.

Other Experiments Under this Head.

During the past season I made several examinations of wax from infected hives, but did not succeed in growing foul brood germs therefrom.

I also made very close examination of three queens from infected hives, but did not find the bacillus.

Lastly, I melted wax at as low a temperature as possible and inoculated it with a large quantity of spores. This wax I sent to Mr. Holtermann, who melted it again and made it into comb foundation. The foundation made from this wax was given to bees to work on, and up to the end of the season no trace of foul brood appeared.

Next year we hope to proceed further with experiments bearing on this part of the investigation.

OUR PROVINCE.

By Hon. John Dryden, Minister of Agriculture for Ontario.

No more inspiring topic could be given to any speaker on an occasion of this kind than the subject set opposite my name in your program. Having been born in a county bearing the name of our Province, educated in her schools, associated intimately with our institutions, and having been required in later years to think of its possibilities and to assist in a public way in its development, the name, Ontario, has for me an inspiration which does not come to all. It thrills me with pride, it arouses me to enthusiasm, and in such a spirit I want to speak to you to-night.

I am speaking to numerous students and ex-students of our Agricultural College; it therefore appears to me fitting that these as well as others should be reminded of the excellence of our own country, lest, because foreign fields sometimes look green, they may be attracted elsewhere, and forget that at our own doors we shall find after all something better.

Let me speak to you first of its extent. You have learned the number of square miles, but you will, I apprehend, never fully realize its full extent until you have, like myself, travelled from end to end over its territory.

Commence if you will at the eastern end—say beyond Ottawa—and travel on an express train on the Canadian Pacific Railway all day, all night, all the day following, and the night following, and far on into the next day you still find yourself whirling over territory belonging to this Province. Or, if you could travel from south to north, you would find a distance covering fully 700 miles in that direction.

Most of us however judge as to these matters by comparision. We have all been familiar with the adjoining territory of the United States. We have heard of Vermont, New Hampshire, Maine and other adjoining States, but our own Province is larger than the six New England States, with New York, New Jersey, Pennsylvania and Maryland added. It is larger than the great states of Ohio, Indiana, Illinois and Michigan all put together; larger by eleven thousand square miles than Iowa, Minnesota and Wisconsin combined. It is larger than Great Britain and Ireland, the home of our fathers, by seventy-eight thousand square miles.

But as you travel over its vast extent of territory in your first trip I fancy I hear you exclaim, What a barren waste; what a dense wilderness, unproductive and uninhabited. To all appearances this remark may be true, but after all it is not really true, because this territory, which you suggest is barren and unproductive, is found to be rich in mineral wealth and rich also in natural beauty. Ontario as a whole, with its abundant lakes and rivers and hills, presents much of an extremely attractive character to one who delights in gazing upon nature as the Creator left it.

I need not stay to speak of the Great St. Lawrence, the constant attraction of travellers, or of Niagara with its wonderful falls, which all the world know and desire to behold. Nor need I stay to speak of the great inland lakes, Ontario, Huron, Superior, grand as they are. These are familiar to all; but I want to say that our northern country is full of lakes of smaller size but of unsurpassing beauty. I could speak about Wabigoon, Eagle Lake, Rainy Lake, and others well known, but the lake of all others which specially commands attention for beauty and variety of scenery is the great Lake-of-the-Woods near the north-western boundary of our Province. It is called the Lake-of-the-Woods apparently because of its innumerable islands, said to be thousands in number, and largely covered with timber, giving it the appearance in the distance of a large tract of wooded territory.

These islands are of every conceivable size and shape, some of them being low and level and others high and rocky. A trip through this lake will be remembered for a lifetime, and no one who has visited it but is filled with admiration for the work of nature as presented. The northern country also abounds in beautiful rivers. Only two need be mentioned as an example of others of smaller dimensions.

Rainy River is a feeder of this Lake-of-the-Woods and is a medium of connection between that lake and Rainy Lake lying to the south east. This is a river of surpassing beauty in its natural condition, of even width, beautiful curves and gently sloping banks, and withal in its lands on the Ontario side possessing a richness and fertility unequalled anywhere in Ontario. It is found to possess during its entire length of 100 miles attractions which call forth from the travellar constant exclamations of delight.

But the one river in our Province that every Canadian ought to see is the river Nepigon, connecting the waters of Lake Nepigon to the north with the waters of Lake Superior, covering a distance of 30 miles, during which there is a fall of 300 feet. This river in some respects is the very opposite to Rainy River. It is more direct, varies very much in width and in velocity; is rugged and mountainous in its banks, and contains on either side very little land suitable for agriculture. It abounds in speckled trout, old enough and wily enough to defy at times the efforts of the most expert angler, and is the point towards which many sportsmen tend at certain seasons of the year. Its banks are uninhabited, and those who visit it must make up their minds to spend their time in tents as there are no dwellings or hotels of any description from one end to the other. It is to-day entirely in a natural condition, and the only way it can be travelled is by the canoe of that country. Even then it has numerous rapids and fall preventing continuous travel by water. The fisherman who desires to go from the mouth of the Nepigon river to its commencement will find numerous portages over which he must carry canoe, provisions, etc., some of which are fully two miles long. This adds much to the labor of the journey and the time consumed. The effort, however, will be well repaid by the grand views and abundant sport he will obtain on the way. It abounds in variety of scenery and great changes in the river itself. At some points the fall is very rapid, causing the waters to rush and roar with a mighty force. On reaching the bottom of the falls the waters frequently spread out into a small bay or lake, over which they will be seen to boil continually, afterwards passing over a considerable distance, and yet running so quietly as scarcely to be perceptible.

Presently the waters spread into a lake of considerable size. Then again they dash over other rapids, and so on and on over the entire extent. The banks of the river are varied, in some places fully 150 feet high, of perpendicular rock, and in others the river itself is dotted with islands covered with trees of different shades of green and presenting a beautiful appearance. The whole stream is considered by sportsmen who have visited different parts of the world to be the greatest trout stream the world knows.

A trip to the northern parts of our Province, by those who can stand the rough usage which they will be obliged to put up with, will repay in health-producing qualities much better than a trip to the older countries of the world.

I said that the great tract of country to the north, which appeared to be barren, contained a great wealth of minerals. We have read of the mineral wealth of South Africa, and we are to-day reading of the mineral wealth of British Columbia, and we dream of the great riches of these countries, but I want to say that in my judgment we have in this Province riches greater than either, much of which is yet undiscovered.

It is now a generation ago since the early settlers discovered in the back townships of some of our eastern counties, such as Hastings, Frontenac and Peterboro,' large bodies of iron; but to day we are made aware that the chief iron deposits of our Province are away to the north beyond Lake Superior and in the wilderness country lying between that lake and Rainy Lake. Here no railway has yet entered. When it does, it will be found that this country is able to supply millions of tons of iron for the furnaces of the future.

Forty or fifty years ago, during my boyhood days, I remember hearing of the Bruce Mines on the north shore of the Georgian Bay where copper was produced in considerable quantities. To day these are surpassed and excelled by the mines of the Sudbury district, where copper exists in large quantities. But not only have we copper in that district but large areas of nickel as well. The nickel mines of Sudbury have now attained a rank second to none in the world; and the many and valuable uses found for this ore leave no doubt in the minds of well informed persons that these mines have an assured future; and there can be no doubt on the question of Ontario's pre-eminence in so far as the production of nickel is concerned.

In silver also it is found that we have considerable wealth, but that which is attracting the greatest attention within the last few years is the richness and extent of our gold mines.

Gold is being sought for the world over. The reason I presume that this is the case is that to-day gold is worth more in proportion to other commodities than it has been for a quarter of a century.

Miners and men with money are now flocking into this vast extent of mineral-bearing land, seeking and hoping there to find great fortunes. Our mining country has now won the confidence of Englishmen and Americans to an extent hardly second to South Africa and British Columbia, and within the next three years our inhabitants will be surprised when they realize the activity which will prevail in this enterprise.

Some of the reports that reach the department having this branch of industry under its charge almost stagger belief. Within the last two months a gold-bearing quartz vein has been located close to the height of land north of Lake Superior, which is described as of mountainous size, and if I were to state how much of gold some of the samples taken from it have assayed, the statement would hardly be believed.

Then, within the last few days word has come to the department of the discovery of an enormous gold bearing reef west of Lac des Mille Lacs. It is said to be three miles long and ranges in width from 50 to over 450 feet. This property has been carefully examined and its ore tested by experienced mining engineers, and at the present time plans are being matured for placing upon it a gold mill equipped with 120 stamps, or a capacity of treating 250 tons of ore per day. The cost when equipped will be about $100,000. Engaged in this enterprise are some of the strongest capitalists of the United States.

Farther west in this territory, near the mouth of the Seine river and around the lower part of the Lake-of-the-Woods, there are several mines which are now regular producers of bullion, besides others which are being developed.

It ought to be remembered that the ore in this district is what is called free-milling and is much easier managed than the ore of British Columbia. Besides all this there is an abundance of wood and water.

The lakes and rivers are also navigable for a very wide extent, so that, compared with gold fields elsewhere, the amount of capital required is much less.

Then I am informed that in Hasting county, in consequence of the discovery of a process for successfully treating the refractory ores of that district, an English company has commenced operations with a capital of two and a-half millions.

I ought not to omit mentioning that within the last few months a new discovery of an additional metal not heard of before in this country has been made. It is that of Corundum, an extremely hard mineral, almost as hard as the diamond and extensively used in making emery wheels and for polishing. The man who lays claim to having made this discovery states that there is a mountain of it.

All this goes to show that in our own Province we have a great future in the development of its minerals. I speak of it strongly as a farmer because the development of our mining means the introduction of a much larger population than we now have. It means a market at our own doors, which, to those who are nearest, will mean better prices and a more rapid development of our agricultural interests.

Then I must not forget to mention our great forest wealth. It is supposed by some that the larger portion of our wealth in this direction has been consumed already. Very large quantities of pine have been cut in our forests, but there is a large area left, and in addition other timber in very extensive quantities which in the future will prove of great value. Besides all that, I am quite prepared to say that if we are able to provide reasonable fire protection for our forests, we may be permitted to go on at the present rate of cutting, and even at a much greater rate than in the past, and still be assured of a continual supply of pine. It is now being definitely determined that if it can be preserved, the growth of pine upon the districts of our country which are unsuitable for agricultural purposes will be quite equal to the annual consumption.

In addition, our Province boasts of a soil which, although varied in quality, possesses in many respects a richness that is not excelled by any part of the North American continent. We have abundant proofs of the richness of its production in our unexcelled cereals, our choice and highly flavored fruits, our dairy products, our live stock of every description. No one state or province can show such a diversity of excellent products, affording unwonted opportunities for development in agriculture.

Upon these three resources, our mines, our forests and our soil, must our Province depend for its future. In their development there is ample room for the energy, enterprise and effort of all her people; indeed we shall hope to have our population supplied from foreign lands to aid us in this work.

In the Province of Ontario we have a varied climate, but, generally, it is of a character calculated to produce not only the superior agricultural products mentioned but men of spirit, energy and pluck. Our population are proving themselves to be superior in this regard when placed side by side with others reared in a different atmosphere. It is this feature, which if it be rightly used, will bring us into prominence in the more remote future, for after all it is not what we have that makes us great but what we are.

May we not further boast of the educational advantages of our Province. I shall not stay to speak of our educational system as a whole, which, when compared with other systems, was first in so many respects in the world's competition at Chicago; but what I should like to-night to present is the special educational advantages which our young men have who are preparing to engage in the agricultural industry in this Province. In no province or state on this continent will you find so many organizations specially intended for the education of the farmer and for the development of the industry he represents.

Passing by our agricultural societies covering the entire Province, educating and stimulating our people, every class of our live stock is represented by an association looking after its interests. All these are doing excellent work, and conveying to the people general information which is invaluable, and which is adding greatly to the enthusiasm and enterprise of our agriculturists everywhere. Who can calculate the benefit in the past of the educational work of our dairy associations? It has added millions to our revenue; it will keep our dairy products to the front in the future.

Further, I believe that Ontario can boast of the best Farmers' Institute system in the world. More of our people are reached by the work of these institutes than anywhere else. While this is true, the work costs the Province less money than is expended elsewhere. No work is more important, and no organization has succeeded in accomplishing better results than the Farmers' Institutes of this Province.

In addition to this we have in this institution, under whose auspices this union is gathered, the best all round equipment for an agricultural college that can be found. The young man who may be entering upon this industry and cannot find a proper equipment for his life work with this institution at his hand, does not deserve to be aided in the work he has before him.

With the farm proper—a constant example of neatness, efficiency and economy—the dairy department, with its complete equipment, its special courses, the horticultural and botanical departments, covering every phrase of these subjects; the chemical department so necessary to the study of agriculture; the bacteriological department, without which, in these days of warfare with new insects, diseases and germs of every description, we cannot succeed; and lastly, and what I desire especially to mention to-night, the experimental work having its centre here, and which is being carried on by the union of our ex-students and other farmers represented by this Association, you have an institution at once unique and complete in all its parts.

This system, which has had a steady growth from the beginning, started in a very humble way and has now grown to very large dimensions. Because it has grown step by step, it has grown surely, and no money which the Legislature annually gives for the purpose of the development of any of our industries is doing greater service than that which is annually given to this Union. When we find Prof. Hunt, of Ohio, using the words printed upon the back of your program—saying to the world that "to imitate is the sincerest flattery," and that he is now putting into operation a similar system in that State—you have testimony which will not be gainsaid as to the correctness of the work you have in hand.

It is a great thing for the young beginner to have some things settled and determined without the necessity of going over the ground gone over by others. This Experimental Union within the next twenty-five years will have settled many difficult problems the truth of which we do not now know. It ought to be understood that it is possible that some of these may be thus settled and settled for all time, so far as our Province is concerned. When they are thus settled, let the land marks be plainly set so that those in the future may observe them clearly. They can then go forward from the standpoint gained towards further enquiry covering other questions.

May I be permitted to say to the young men who are listening to my voice that what I have said to you is but an outline of that which is your heritage in this Province. What will you do with it? Are you prepared to bare your arms for the work of its development? Are you prepared to do your part? Will you aid in keeping your Province to the front? We stand to-day in the front rank for superior production. Every loyal man wants to hold this place, but it cannot be done without education and without effort. The Province has provided the means; it is for you to use them and use them well. Our brightest and best young men, having availed themselves of this educational equipment, are wanted in every county, in every township and in every school section. You are being educated, not to consider yourselves superior and thus to frown on your fellows, but rather to lead, to help and to inspire them. To the young men of our Province must we all look for future development and for our future wealth. This must spring, not from the town and city, but from the field, the forest and mine. To you, who are devoting yourselves to agricultural pursuits, all our people are especially looking; the bankers, the merchants, the manufacturers and the statesmen depend upon you for the production of the wealth which is to set in motion the wheels of commerce and give new life and vigor to enterprise everywhere in our land.

But, while we are thus inspired by a look at our resources and advantageous position, we must not forget that we are Canadians, that we are but a part of this great Dominion, extending, as it does, from ocean to ocean, and comprising a number of provinces which, though they may not be superior, are equal in many respects to our own. We extend to all these a brotherly hand. We are willing, as we labor and toil for the development of our own Province, to send a message of greeting to our brethren in the far east—to our sister Province of Quebec. Her people are of a different race, but are loyally uniting with us in building up in North America a great nation. To our children who have gone to the far west we shall be ever ready to offer a helping hand. We say to all our sister provinces, while we are greater and are thus entitled to lead, we shall always take you with us. We shall share with you our prosperity as we shall share with you our glory. And in saying this, we do not forget the further fact that we are members of the greatest empire the world now knows; an empire which has subjects in every clime, which is the greatest in power, in wealth, in culture, in civilizing tendencies and in statesmanship. While we share the protection of Britain's flag we shall seek to show ourselves worthy of her notice and attention. We will always declare our loyalty, but we believe it is best shown by doing our part well.

REPORT OF COMMITTEE ON CO-OPERATIVE FRUIT TESTING.

Mr. H. L. HUTT presented the report of the committee on the co-operative testing of small fruits. He was sorry to have to say that but little of value could be got from the reports received from experimenters, as many who received plants failed to report regarding their experience. He recommended that the Union cease sending small fruit plants and bushes to individual experimenters, as the fruit experiment stations now spread over the Province were reporting on the leading varieties of small fruits. He claimed, however, that the distribution of plants by the Union had been the means of giving a start in small fruit growing to many farmers who otherwise might never have made the attempt.

Mr. J. A. CAMPBELL: I should like to refer to a matter which is somewhat outside of the report which we have listened to. We all want to get as much information as possible from such a gathering. We are after practical results. Our requirements are not so much for production as for a commercial market. Low prices have caused farmers to go extensively into fruit growing, and at the present time prospects are not very bright along this line. We have a large tract of country well adapted for fruit growing, and the output is constantly increasing. The apple crop for the two years past has been almost a failure, but this year when the supply is large prices are exceedingly low—not more than forty or fifty cents a barrel. I have heard of farmers selling their apples to canning factories for 2½ cents a bushel. This is certainly not encouraging. I have more than once helped friends to take apples to the old country in small lots, and these have always brought a good price. I know a man who made a practice of shipping small lots of apples to the old country. He thought he would try it on a large scale and make a fortune. He tried this and it proved a failure. He only got what the apples cost him. There yet remains an uncertainty about the marketing of fruit. To my mind it would be a good plan if the Government would appoint a commercial agent in Britain to furnish full information concerning the markets. In Denmark they send agents to England to look after the interests ef their butter. England should buy from her own people. I understand that a resolution has been passed by our board of trade or one of our agricultural associations in regard to marketing farm produce in England. The Government has already done something along this line. The whole subject appears to me to be one that calls for co-operation—effort directed, if possible, by somebody, and aided by the Government. I hope soon to see the interest of the farmers aroused in this matter, and to see promise of better trade in this direction.

THE GARDEN AS AN EDUCATOR.

BY T. GRIENER, LASALLE, N. Y.

Those among you who have even superficially examined into the history of France of ante-revolutionary times, have undoubtedly heard of the king to whom his own grateful people gave the honorary title "Good King Henry" (Henry IV., 1589-1646). Unlike most of his immediate predecessors, he was animated by the earnest desire to promote the happiness and welfare of his subjects, and as one of the proofs of his good intentions, a favorite expression of his is frequently mentioned, namely: "I hope to see the day when every peasant in the land will have chicken pot-pie for his Sunday dinner." The object which the good king had in view must have been very grand and remarkable to be thus transmitted in history. Should it not be just as good and worthy an aim—even if the efforts are feeble—to induce every family to have a good garden, and to aid them in maintaining it?

Let it not be said that the garden, like chicken pot-pie, appeals only to the coarser needs of mankind. I claim a higher mission for the good garden. Primarily, it is true, its object and purpose was to furnish food—something to fill the stomach. But even in this aspect, let us consider that food makes the man, and that the proper selection of food —proper nourishment—exerts a most potent influence upon the development of psychical as well as physical life, and upon the perfecting of mental as well as bodily functions. Crime as well as sickness is largely preventable through control of what is allowed to go into the stomachs of mankind.

In this connection I wish to make a suggestion that may seem a little foreign to the subject in hand. Much has been said in recent years by agricultural writers, and especially in the bulletins of the experiment stations, about the "balanced ration" for farm stock. The question of balanced rations for human animals seems to me of vastly greater importance, and yet has found little or no consideration. I know from personal experience and observation that the rules of proper nourishment are being grossly violated by a large portion of the American people. The inhabitants of whole farming districts become toothless almost in childhood—the result of living exclusively on starch and fats, etc. This is a question deserving investigation and especially agitation. The people who suffer aches and pains with their teeth, and the pangs of dyspepsia, etc., suffer through their own ignorance in regard to what they should eat. But it is not my purpose to-day to discuss at length the garden simply as a furnisher of food materials, or even as a hygienic aid, but in its higher mission as an educational device.

There must be something enobling, something elevating in garden work. I well remember, when a lad scarcely a dozen years of age, how I disliked to be sent on an errand that involved the carrying of a basket or bundle through the streets of the city. The student was ashamed of menial work. But that was long ago. Even now, however, and while continuously telling my boys, and others, that all honest work is respectable and honorable, I confess that nothing short of starvation would induce me to do the work of the city street cleaner, handling the droppings of horses and other foul accumulations. Yet when it comes to garden work, there is no job too low for me to do in an emergency, even to the extent of handling manures. In most of my experiments with fertilizers, I have made the applications myself—disagreeable as the job sometimes was. This is a plain case of the "end justifying the means," a noble purpose—the creation of fine fruits and vegetables or flowers, or the discovery of desired information—glorifying even a lowly action—the handling of the mean, odorous raw materials. Contact with nature is always enobling. The garden seems to be "hallowed ground," and no action can be mean or despicable if done in the legitimate pursuit of garden work. The most noble lady can dig and weed among her garden treasures, and apply plant foods in any form she may desire to them, without the least risk of being snubbed by her aristocratic friends on that account. The truth is that the beauty of the creation and the whole atmosphere of the garden enobles everything connected with it. We seem to feel instinctively that it has a higher mission, which is refining and educational in its nature.

More than thirty years ago I attended a teachers' training school in Germany—something like what we in the States call a Normal School. The institution owned or rented a piece of garden land near the city line, and there we students met twice a week during the summer months to receive regular lessons in practical garden work, such as planting, tilling, budding, grafting, etc. Unfortunately I did not appreciate the opportunity. I did not take much interest in the work, and usually played truant.

Even in Germany, however, the country famous for its schools and institutions of learning, and the recognized leader in educational work, the garden as an educational device does not find the full appreciation that it deserves. We in America have a good chance of beating our preceptors in this field. When I first set foot on this great continent, more than a quarter of a century ago, I possessed what the Germans call a fairly good general education. But this was book learning only—a dead weight of theoretical knowledge not yet quickened by practical test and application; learning that was as yet of little account because I had not yet learned how to use it.

Accidentally I came to live for some time on a farm. Being very fond of berries, and of good vegetables, and admiring the beauty of the tomato, etc., I began to take an interest in, and after a while assumed sole charge of the garden. I soon saw that a well-kept garden can be made one of the most ornamental and attractive as well as useful features of the home grounds. This stimulated me to renewed efforts in doing the work well, and in adding new details of an attractive nature. Then with an increase in the garden area came the need of labor-saving devices, methods and implements. Thus the task before me seemed at all times inspiring and stimulating because occupying attention and thoughts. This was the great service which the garden has given to me. In my case, it was really a "college of applied sciences."

In garden work we find ourselves confronted by problems of all sorts—problems which we have to solve in one way or another, if we desire to make a full success of our undertaking. For instance, there is this problem of plant-feeding. The garden offers an incentive as well as a field for and means of the study of chemistry so far as it relates to the nutrition of plants. The needs of the garden soon lead us to an earnest inquiry into the new chemical problems before us. We want to know what our soil and crops need, why they need it, where and in what form it can be most cheaply obtained, and how it can be used with best effect and profit. This inquiry makes it necessary for us to exert our thinking and reasoning powers, and the solutions have to be based on study as well as on practical experiment and observation. To me personally, this investigation has been a source of great interest and satisfaction, both in itself, as a study, and in its results.

Another study which the needs of the garden force us to take up is that of entomology. The garden brings us in contact with all sorts of flying, crawling and creeping things, and in order to treat them according to their merits, we have to know their life history, to become acquainted with them in all their different stages of development, and learn how to distinguish friends from foes. Soon we find this study so charmingly interesting that we follow it up even far beyond the garden practice. New insect enemies and friends make their appearance from time to time, too, and keep our interest awake, and therefore our eyes open. I have derived much enjoyment in watching, for instance, the shy grand lebia and the soldier bug on their hunting expeditions, attacking and destroying the larvæ of the potato beetle, or the lady beetle feasting on the eggs of the same foe of the potato. Many persons walk through the garden and potato patches without ever noticing these sights, so very common everywhere.

Next, as a compulsory study, comes that of vegetable pathology. The gardener cannot achieve highest success unless he be also a successful plant doctor, and understand something of the diseases of the plants which he handles, and their hygienic needs. This also is an interesting study that is apt to lead us on to further investigations. The science of vegetable pathology in its practical application in the garden and fruit patch, is of very recent development, and new points are constantly brought to light, or may be expected. This also keeps us on the alert all the time, and makes us eager students.

I will say only a few words of the garden as an aid in the study of botany. In this capacity it is of especial value to the lover of flowers ; but even the ordinary gardener learns something about the classification of the plants he handles, of species and varieties, and in order to distinguish them, has to observe delicate differences in structure, leaf, habit of growth, etc. Seedsmen make use of botanical names very freely in their catalogues. This gives a chance to brighten up our little knowledge of Latin, almost forgotten. And by the way, Latin is often sneeringly referred to as a "dead language." It may not be used in conversation, but I think it is pretty much alive, and as a foundation for and a rounding up of a general good education, I hold it high up above all modern languages. Some knowledge of Latin is indispensable for the doctor and the lawyer, and a source of much satisfaction to the gardener. If a child of mine studies but one language besides his own mother's tongue, I invariably let it be Latin.

The garden is also full of object lessons in natural philosophy and mechanical sciences. Through impressions received by the eye, we learn something about soil structure, about the movement of soil water, about capillary action, about absorption, evaporation and condensation ; about frost and heat and their effects, and about many other things. We are taught many of the laws of nature in the easiest possible way. The application of electricity is the latest innovation in the garden. The garden owner will do well to look into the matter, although I have grave doubts that it will ever amount to much except for use in large commercial forcing houses.

The garden also teaches us numerous valuable lessons of life. One is that of the need of promptness in action. Lost opportunities seldom return. If we miss the right time in planting we will miss the results in their season, or altogether. The task of subduing weed growth is easily accomplished with promptness, and impossible without.

Of course some of our planting is done for test and experiment. Thus the garden sharpens our powers of observation, and teaches us fine discrimination. It developes our æsthetic taste. It teaches us patience and perseverance, and protects us from the folly of drawing conclusions hastily. We soon find that it often takes years to settle definitely upon the true value of a new plant, device or method. The garden also leads us to acquire a habit of thoroughness, for we soon find that what is worth doing at all is worth doing well. The garden furthermore develops good judgment, which is needed in the task of planting and laying out the ground, in deciding the proper size of beds or patches to furnish just enough of each kind of vegetable, the most suitable time of planting, etc. The garden stimulates our inventive faculties, too, for we are constantly in need of labor-saving tools, and labor-saving methods, and of all sorts of mechanical devices.

Another practical lesson of life taught in the garden is that disappointment is the rule in this world, and pleasure the exception. Our seedsmen are taking good care that this lesson is made very impressive and emphatic, they arouse our highest anticipations by their gay pictures and enthusiastic descriptions, and leave it to us to get reconciled to the reality as best as we may later on. We learn to be moderate in our expectations, patient in disappointment, and thankful for anything that has some value.

Many more practical lessons of life can be learned in the garden. I will mention only one of them, namely the need of being extremely slow in accepting any of the old-established rules and doctrines unless you can verify them by the test of reason or practice. A large portion of our farmers believe in the influence of the moon, and in doing things "when the sign is right." Gardeners seldom do because many of their crops require repeated planting, in every moon phase and every sign of the zodiac. Yet there are many fads and notions which have clung to the great mass of the people. We are told that Lima beans should be planted eye-downward; potatoes cut-side down; or that this or that crop should not be hoed while wet with dew, etc. We will find it a good rule, not only in garden practice but in all other lines, to accept nothing as gospel truth unless we have the best authority, or can get proof of our own for it.

In conclusion let me say that the garden still contains unsolved problems enough to keep your thoughts occupied for the rest of your natural lives. I can name only a few. Others will suggest themselves to the enthusiastic gardener as he goes along. We need yet more light on the point of feeding special crops, on the use of chemical measures, etc. I have always contended that our experts did not lay half stress enough on the importance of humus in the soil for most garden crops. One of the questions with me has been how to fill the soil with this most necessary material without stable manure. Growing clover for green manuring has been recommended; but we can not always allow time enough in the garden for growing the crop, unless we might use crimson clover, which is not always practical or suited to the climatic conditions. From last season's experiments I infer that we might grow oats and peas for that purpose. At least I have planted these on some rich garden spots after the crop (onions) were harvested, and now the ground is covered with a thick mat of the decaying stems and foliage, undoubtedly to the great benefit of the soil.

The irrigation problem is always before us. The Ohio Station has done excellent work in this line, and solved the question so far as greenhouse crops are concerned. But the best ways of getting and applying water for outdoor crops is yet a canumdrum for many, and worthy of our best thoughts and efforts.

We have also much to learn yet about the proper treatment of plant diseases. We have been making some, though slow progress for some years, but there is a good deal of room for further improvement. For greenhouse crops a small quantity of copper sulphate dissolved in the water to be used for overhead watering, has seemingly given great promise of preventing "damping off," celery blight, etc.

Then we should settle this question of the influence of the size of seeds on the resulting crop. If radish seeds, from which all the smaller ones are screened out, give a better crop of radishes than the usual lot of mixed small and large seeds, then we will call on our seedsman to furnish us the carefully screened larger seeds.

The influence of the age of seeds upon the resulting crop is also a proper field of enquiry. Has the plant grown from fresh seed stronger vitality than that grown from older seed? Will older, and therefore enfeebled seed, tend to drive the plant into seed production ahead of the plant from fresh seed? These are unsettled points.

Only one thing more in this respect. It is true that during recent years we have made remarkable improvements in varieties of fruits and vegetables. Yet there is plenty of room for further progress. Even the attempt to create new things, whether entirely successful or not, is interesting and instructive. Luther Burbank, of California, who originated the Burbank potato, and a number of the most handsome plums ever grown, and many other things curious and useful, among them highly interesting hybrid berries, shows us what can be achieved in this line. Much can be done by simple selection. Mr. Livingston's experience in originating his beautiful tomatoes (Acme, Perfection, Beauty, Potato Leaf, etc) is highly suggestive, and the same principle which he followed, namely, selection of plant for its characteristics rather than of the individual specimen for its characteristics, may possibly be applied to other subjects also. For instance, to increase the size of the bean, I would try to select a plant bearing especially large beans for propagation, rather than pick the large beans out of a bag of seed.

Then there are a number of native fruits which have not yet been improved and which offer us a splendid foundation on which to build, and possibly to develop something quite valuable. Among such fruits we have the elderberry, the June berry and others.

Much more might be said on this same subject, but if I have succeeded in convincing you of the great possibilities which may be found in the garden as a stimulator of learning, and an educational device generally, and in making you resolve to make use of it for yourselves and your families to the extent it really merits, I shall have accomplished the purpose of this paper.

Geo Robertson: We are glad to have Mr. Greiner with us to-day, as he is an authority on the subject. We heard a very able address last evening on "Domestic Science" by Mrs. Hoodless, but while we should improve our methods of cooking, we should first get a greater variety of vegetables and fruits. The opportunities and privileges of gardening have been greatly increased of late years. There are few circumstances under which a man cannot have a garden. It was not always so. As civilization advanced gardening became more common. The Persians were the fruit and flower gardeners of early times. Egypt's influence in this direction was not felt in Europe till after the Roman conquest. Ancient Greece was noted for its art, and it was from the Grecian slaves that Rome acquired this art. Rome was first to introduce an architectural element into this art. As the influence of Rome spread abroad by her conquests the love for learning increased and with this love for learning was joined a love for the beautiful which found its counter-part in the cultivation of flowers and fruits. The influence of the garden on our early life develops the powers of observation Most fruits and vegetables can be traced back to early times, which forms an interesting study along the line of our practical work. The subject of keeping the boys on the farm is often spoken of and written about. I think the reason why boys leave the farm is that the farm is not attractive enough. Too many farms are without a garden or ornamental trees. The boys remain there just so long as they are not big enough to go to the city. They think they will enjoy themselves better in the city. If efforts were made to improve the surroundings of the home, this great rush to the cities would cease.

Dr Mills: I was much pleased with Mr. Greiner's paper, knowing him, as I do, to be a very successful man in the work he has undertaken. We are not in a very favorable locality for horticultural work, but still there is a great deal that we can do, and a great deal for our students to learn along this line, especially along the line of market gardening. Also about varieties of fruits for different soils. The young man who has just spoken (Geo. Robertson) is a son of a merchant in Kingston, and is now engaged in fruit farming near St Catharines. A number of our boys are looking to this branch of work. I am glad to encourage you in this work, and hope that you will all profit by what Mr. Greiner has said about the influence of a nice garden. I do not refer to a little patch behind the house Use a little more land for this purpose, so that you may use a horse cultivator. In this way you get a large supply of wholesome food in the proper season of the year. I shall not take up more of your time, but ask Mr. Taylor, of Nebraska Experiment Station, to give us a short address.

A NEBRASKA VISITOR SPEAKS.

Mr. Taylor: Your worthy president just now said that this was not a particularly good horticultural country. That reminds me of a conversation which I heard a short time ago I was talking with some gentlemen at an agricultural meeting in Iowa. One of them was speaking of the success which he had. He was asked what county he was from. His reply was that he was from such and such a county, and a fine county it was. Another speaker of his section said, "We have a fine county down there." Now it is strange that you never meet the men who live in poor counties. But in speaking about horticulture the opposite is the case. Nearly everyone says that his particular district is not well adapted for horticulture; about fifty miles from here they grow grapes and peaches beautifully. I may say that I was almost raised in a nursery. My father was a nurseryman. I remember one time my father talking to a German farmer about planting out an orchard. He said that fruit trees would not grow on his place. My father said, "That is strange, there are some very good orchards around here." The man replied, "I have planted fruit trees three years in succession and the sheep ate them off every time." It is a difficult matter to produce certain varieties of fruit on some soils. The varieties of plums, grapes and peaches that have done well in or near your locality are usually the best to invest in when setting out a young orchard. I think you will find that each province, each district, each fruit growing section, has varieties of fruits different from other sections. You have to find out for yourself the varieties that are most adapted for your own particular soil. I have made a careful study of the matter, and I believe that everyone has to be governed by his own conditions of soil and climate in choosing varieties. You cannot take the word of the station here as to what varieties will do for you.

I believe that our best varieties of fruits have come from the native stock. Of these kinds it is of value to you to know what has done best at this experiment station; then you can apply the results in a general way to your own section. Many of our best fruits have been obtained by hybridizing and crossing the wild fruits of the forest. Take the Concord grape. This species did not come from Europe or any other foreign country. It is one of our native varieties. These are the fruits that are most successful There is a good work for the young men who leave this College, in bringing out what is in our native fruits. A great deal can be done in raising seedlings, in hybridizing, and crossing. I have just come from Russia, a country from where we have brought many varieties this last few years. I have spent a number of weeks there in finding out what they have that would be an improvement on our own varieties I find that there is very little there that is worth bringing out to plant. Of course their fruits would be more adapted to your section than ours, as your climate is more nearly like the climate of Russia than ours. Some years ago an agricultural college brought out several varieties of Russian apples, plums, cherries and pears. A certain person, who I believe is an authority upon the subject, wanted to put me on a scheme, just when I was starting out in business for myself. He said that he had obtained a very superior kind of pear from Russia, one that was hardy, free from disease, first class in quality and beautiful in appearance. He told me to grow these and get a big stock ready for the market by the time the pear became well known, and as a result I would be a rich man. I firmly believed that the man was telling the truth, and yet that variety has been a complete failure. I have seen in the last twenty years a complete coming round to where we started from in regard to the question of apples. In western Iowa where I used to live, many Russian varieties were grown twenty years ago, but now they are going back to the old native varieties.

I just came to see what you were doing here, and to gain as much information along this line as I could. I hope you will call upon me or permit me to help you in any way that I can. This whole question of horticulture and fruit growing is one on which I am a kind of a crank. We do not make anything like the full use of our opportunities. We have been doing something with a large variety of strawberries, but find it very hard to get results from them that will apply definitely to every locality. I am glad to find that horticulture is getting a good foothold at this institution. I think that in ten or fifteen years you will find that you can do a great deal more in horticultural work than you think you can.

Now there is another point on which I want to touch for a moment. It is the marketing of fruit after you do get it. The mother country means a great deal to you, yet if the United States can sell their apples there for ten cents a barrel less, they will get their money. England wants the produce, but she is going to buy on the cheapest market. There is no use in taking England anything that is not in first class shape. Now to do this you have to grow good sorts and you have to pick them properly. Then have perfect arrangements made for selling your produce.

CO-OPERATIVE EXPERIMENTS IN AGRICULTURE.

C. A. Zavitz, B.S.A., Agricultural College, Guelph, Director of Experiments.

The co-operative experiments in agriculture, conducted throughout Ontario in 1896, have been more extensive than those of any previous year. No less than eleven thousand one hundred and twenty-four plots have been used for the experiments during the year 1896. These plots were located on two thousand two hundred and sixty different farms, and were mostly confined to the Province of Ontario. A few experiments were conducted in each of the other provinces of the Dominion of Canada, and in some of the states of the American Union. No experimental material was sent outside of Ontario except to ex-students of the College who were members of the Experimental Union.

As there are a number who, at this time, are not familiar with all the work which is being carried on by the Experimental Union, I will give a short outline of the work of the Association before presenting the results of the experiments conducted in 1896.

The Ontario Agricultural and Experimental Union has been in existence for eighteen years. It was, therefore, started at the time when our Agricultural College was in its infancy. For the first six or seven years nearly all the work which was accomplished by the Association was to meet at the Agricultural College each year for the holding of the annual meeting. This gave an opportunity for a re-union of the ex-students of the College, but also for meetings of a practical nature in which agricultural subjects of much interest were discussed. As time went on, however, a system of co-operative experimental work in agriculture was started in a small way. In 1886, a number of ex-students of the College were written to and asked if they would conduct experiments upon their own farms. Twelve complied with the request, and seeds, etc., were furnished them for experimental purposes. Eight out of the twelve furnished reports, which are given in the report of the Experimental Union for that year. The work has steadily increased from that time to the present, as will be seen by the table here presented.

Co-Operative Experiments, 1886–1896.

Years.	Experiments.	Experimenters.
1886	1	12
1888	1	90
1891	12	203
1892	12	754
1893	13	1,204
1894	14	1,440
1895	15	1,699
1896	16	2,260

It will be seen that both the number of experimenters and the number of experiments have increased year by year, until in 1896 there were sixteen distinct experiments, which were conducted on two thousand two hundred and sixty different farms throughout Ontario.

The sixteen experiments which were conducted in 1896 represent nearly all the farm crops which are grown in Ontario. The plots required for each experiment number from one to six. In order to conduct the sixteen experiments of the past years, sixty-seven separate plots would be required. No one experimenter, however, conducted all these experiments; in fact, each experimenter was supposed to conduct not more than one experiment in the year. The following circular which was sent to all those who desired to join in the work in 1896, gives some excellent information in regard to the work as it is being conducted at the present time. The following is the circular:

Agricultural College, Guelph, March, 1896.

Dear Sir,—The members of the Ontario Agricultural and Experimental Union, along with other interested farmers over Ontario, are conducting a system of co-operative experiments in Agriculture. This work was started upon its present plan in the spring of 1886 with twelve experimenters, who received the grains and fertilizers, carried out the necessary instructions, and reported their results at the end of the season. For the first two or three years the experiments were confined almost entirely to the ex-students of the Agricultural College, but as many other farmers expressed a desire to join in the work the invitation was extended to them also, and material was sent to those who applied on the condition that they would be careful to follow the necessary instructions and report the result of their tests after harvest. The work has steadily increased since its commencement, and during the past four years the Union has been unable to supply the material to the full number of applicants, owing to the demand being so great. In 1891 there were 2,642 plots; in 1892, 5,688 plots; in 1893, 7,181 plots; in 1894, 7,721 plots; and in 1895 upwards of 9,000 plots were used for these co-operative tests over Ontario. Reports of successful and valuable experiments were received during the past year from every county in Ontario.

The members of the Committee on Agricultural Experiments are pleased to state that for 1896 they are again prepared to distribute in every township of Ontario material for experiments with fertilizers, fodder crops, roots and grains. Upwards of 1,000 varieties of farm crops have been tested at the Experiment station, Guelph, within the past ten years. These consist of nearly all the Canadian sorts, and several hundred new varieties imported during the past ten years from different parts of Europe, Asia, Africa, Australia, and the United States. Some of the kinds have done exceedingly well and are now being distributed over Ontario in small quantities. Great care is exercised in sending out really choice varieties.

Prosperous farmers do not find very great difficulty in conducting these experiments successfully, but care certainly needs to be exercised in every instance, and when this is done the experimenters are far more than repaid for all the time and labor expended. Each experimenter gleans information from his own work and also has the benefit of the report of similar experiments from other parts of Ontario. The results of carefully conducted experiments are presented in a summary form to the annual meeting of the Union, held in December, at the Agricultural College, Guelph, and are afterwards printed more fully, along with the proceedings of the meeting, as an Appendix to the Report of the College. Each experimenter is invited to this annual gathering of the Union, and also has forwarded to his address a copy of the report, which is distributed by the Department of Agriculture, Toronto, in March or April of each year.

Each person who wishes to join in the work may choose any one of the experiments for 1896, fill out the accompanying form of application, and return the same to the Director of the Co-operative Experiments in Agriculture at as early a date as possible. The material will be furnished in the order in which the applications are received until the limited supply becomes exhausted. A sheet containing the instructions for conducting the various tests, and the blank forms on which to report the results of the work, will be sent to each experimenter at the time the fertilizers or seeds are forwarded. All material will be furnished entirely free of charge to each applicant, and the produce of the plots will, of course, become the property of the person who conducts the experiment. In return, *the Committee desires to ask that each experimenter will sow all the plots belonging to the particular experiment which he has chosen for 1896, and* *that he will be very careful and accurate in his work, and forward to the Director a complete report of the results obtained from the tests, as soon as possible after the plots are harvested.*

No. of experiments.	Name of experiments for 1896.	No. of plots required for each.	Size and shape of each plot.
1.	Testing nitrate of soda, superphosphate, muriate of potash, mixture, and no manure with oats	5	2 rods x 1 rod
2.	Comparing the advantage of nitrate of soda over no fertilizer with Rape	2	2 rods x 1 rod
3.	Ascertaining the relative value of four varieties of Millet	4	2 rods x 1 rod
4.	Growing three fodder crops	3	1 rod x 1 rod
5.	Growing Lucerne as a crop for green Fodder	1	2 rods x 4 rods
6.	Growing Crimson Clover as a crop for Hay	1	2 rods x 4 rods
7.	Testing six leading varieties of Fodder Corn	6	1 rod x 1 rod
8.	Testing five leading varieties of Turnips	5	1 rod x 1 rod
9.	Testing five leading varieties of Mangels	5	1 rod x 1 rod
10.	Testing five leading varieties of Carrots	5	1 rod x 1 rod
11.	Testing five leading varieties of Spring Wheat	5	1 rod x 1 rod
12.	Testing five leading varieties of Barley	5	1 rod x 1 rod
13.	Testing five leading varieties of Oats	5	1 rod x 1 rod
14.	Testing four leading varieties of Peas	4	1 rod x 1 rod

Material for No. 1 experiment will be sent by express, and for each of the others it will be forwarded by mail. All fertilizers and seeds will be sent in good time for spring seeding, providing the applications are received at an early date. The supply of material being limited, those who apply first will be surest of obtaining the desired outfit. It might be well for each applicant to make a second choice for fear the first could not be granted. The experiments selected should be indicated by using the numbers shown in the left hand column of the table given above.

Particular varieties need not be mentioned as all the kinds to be distributed are those which have done exceptionally well upon the trial plots at the Experiment Station.

Yours truly,

C. A. ZAVITZ,

Director of Co-operative Experiments in Agriculture.

It will be seen that each person had an opportunity of choosing the experiment he desired. It, however, gave an opportunity for us to observe which class of farm crops were the most sought after, and which were the least desired. Besides the experiments given in the foregoing table, there were two others, namely, one with potatoes and one with winter wheat. Therefore, fifteen of the experiments of 1896 were with spring crops, and only one was a winter crop. As there was no special choice in the autumn of the year the largest number of applications which were received, were for the five varieties of winter wheat; the second largest demand was for oats; the third largest for corn; fourth largest for peas; and the fifth largest for mangles. Only a limited number of potato experiments were conducted. The following table shows quite clearly the number of tests which were made with each experiment in 1896.

No.	Experiments.	Number of		
		Plots in each experiment.	Experiments.	Plots.
1	Fertilizers and Oats	5	74	370
2	Fertilizers and Rape	2	11	22
3	Varieties of Millet	4	30	120
4	Mixtures for Fodder crops	3	39	117
5	Lucerne or Alfalfa	1	127	127
6	Crimson Clover	1	114	114
7	Varieties of Fodder Corn	6	264	1,584
8	" " Turnips	5	104	520
9	" " Mangles	5	150	750
10	" " Carrots	5	110	550
11	" " Spring Wheat	5	89	445
12	" " Barley	5	78	390
13	" " Oats	5	305	1,525
14	" " Peas	4	230	920
15	" " Potatoes	6	70	420
16	" " Winter Wheat	5	630	3,150
	Total of fifteen Experiments	**67**	**2,425**	**11,124**

In most instances there was a sufficient amount of seed to supply the demand, but in some cases the demand was greater than is indicated in the above table, as some of the material became exhausted before the full number of applications were filled.

The co-operative work in agriculture would be of but little value indeed if it did not have the experimental department of the Ontario Agricultural College at its back. The experiments conducted at the College forms the foundation of the whole system, and the Experimental Union forms an excellent channel by which the results of the experiments at the College can be brought in a very practical way before the farmers of Ontario, and forms an excellent avenue through which the leading varieties of farm crops can be secured by the farmers. All the varieties which were distributed in 1896, were those which have been tested for three years in succession in the experimental department, and many of them had been tested for seven and eight years in succession, along with a great many other varieties. In order to secure the varieties which are now being distributed, about one thousand varieties of farm crops have been carefully tested in the experimental department. I wish to draw your attention to the two ways in which leading varieties of crops are distributed from the Agricultural College. Small lots are sent out for experimental purposes in connection with the Experimental Union, as has just been described. Some of the leading varieties, which are grown in the fields of the farm proper, in connection with the College, are sold at moderate prices by the farm superintendent in large quantities; therefore, any person when applying for grain or potatoes should write to William Rennie, Farm Superintendent, if he requires to purchase seed in bulk, and should write to the Experimentalist for small samples for experimental work.

Besides the experiments which have been conducted in agriculture during the past eleven years, others have been conducted in horticulture, dairying, etc., for a shorter length of time, the results of which are being reported at the various sessions of this meeting.

The past season has been rather a severe one in some respects in connection with the co-operative experimental work, as a considerable injury was caused by grasshoppers, army worm, unfavorable weather in some localities, etc. As seventy per cent. of the experimenters, however, reported their results, we feel that the year's work has been a good one. The thirty per cent. who have not reported will of course be dropped from the list, and new experimenters will be added who apply for material in the spring of 1897.

We have very carefully examined all the reports which have been received, and have discarded every report which showed any signs whatever of inaccuracy. If any experimenter did not conduct an experiment with the full amount of material which he received; if he did not use plots exactly uniform in size and exactly according to directions; if he did not give the exact reports of the yields, etc., from the different plots, the reports were placed to one side, and were not used for the summary. We have, therefore, included in the summary, which is to be considered at this time, results which we believe are from carefully conducted experiments. While these summaries should be of great value to the farmers of Ontario as a whole, still those who have conducted the experiments have obtained much additional information regarding the results of their own experiments as adapted to their own individual circumstances.

In the report of the co-operative experiments in the past, the individual results of all the experiments have been presented. As the number of experiments has now become so large, it is considered desirable to withhold the results of the separate experiments, as conducted throughout Ontario, and only present the names of the successful experimenters, mentioning the county in which such experiment was conducted, and also the special experiment that was conducted in each instance. The experimenters deserve much credit for so successfully conducting the various experiments during the past year. The farmers of Ontario owe much to these experimenters for the valuable reports which they have furnished, and which are presented in a summary form at this time.

LIST OF SUCCESSFUL EXPERIMENTERS.

The following list gives the names of those who furnished satisfactory reports of carefully conducted experiments in 1896:

Number.	Experimenters.	Post office address.	County.	Experiment.
1	Best, J. H.	Balmoral	Haldimand	Fertilizer with oats.
2	Canfield, T.	Siloam	Ontario	"
3	Knight, A	Elginburg	Frontenac	"
4	Kernighan, J. N	Benmiller	Huron	"
5	Kennedy, A.	Flesherton	Halton	"
6	Kosmack, F.	Northcote	Renfrew	"
7	Munro, M.	Lancaster	Glengarry	"
8	Newton, W	Violet Hill	Dufferin	"
9	Ross, T. E	Guthrie	Simcoe	"
10	Swan, Geo	Stanleydale	Muskoka	"
11	Steele, A	Ferguson	Middlesex	"
12	Telford, G	Merrickville	Lanark	"
13	Wright, E	Bath	Addington	"
14	Weir, W	Spencerville	Grenville	"
15	Weeks, A. W	Glencoe	Middlesex	"
16	Bruce, D. A.	South Zorra	Oxford	Fertilizer with rape.
17	Brenton, Joel	Corbyville	Hastings	Millets.
18	Hellyer, A	Kenilworth	Wellington	"
19	Priddle, Jno	Frogmore	Norfolk	"
20	Watson, Jno	Port Perry	Ontario	"
21	Clipsham, M	Sparrow Lake	Muskoka	Fodder crop.
22	Dixon, W. L	Bunessan	Grey	"
23	Elford, F. C	Holmesville	Huron	"
24	Fraser, Jas	Burnstown	Renfrew	"
25	Gibbs, Isaac	Tenby Bay	Algoma District	"
26	Hollingworth, John	Beatrice	Muskoka	"
27	Jacobs, J	Wayside	Lanark	"
28	Mocre, W. M	Oakville	Halton	"
29	McGowan, R. C	Blyth	Huron	"
30	Nisbett, H. G	Lakehurst	Peterboro'	"
31	Patterson, W	Birtle	Manitoba	"
32	Pegg, J	Kolapore	Grey	"
33	Boxendale, Wm	Grand Valley	Dufferin	Lucerne.
34	Bishop, W	Doe Lake	Parry Sound	"
35	Barry, J	Queensboro'	Hastings	"
36	Bradley, G. R.	Manotick	Carleton	"
37	Doherty, W.	Kinmount	Victoria	"
38	Duffett, W. S	Adolphustown	Lennox	"
39	Hodgins, Geo	Osnabruck Centre	Stormont	"
40	Hodgins, A. S.	Osnabruck Centre	Stormont	"
41	Julien, Henry	Thamesville	Kent	"
42	Julien, J. A.	Thamesville	Kent	"
43	Johnson, C. G.	Osnabruck Centre	Stormont	"
44	Laveck, P.	Maynooth	Hastings	"
45	Lawrence, W. G	Palmerston	Wellington	"
46	Mannen, J. F	Weir	Wentworth	"
47	McGregor, W. C	Tilbury	Kent	"
48	Neelin, M.	Dwyer Hill	Carleton	"
49	Neville, C. W	Newburg	Lennox	"
50	Petrie, A.	Fergus	Wellington	"
51	Patton D., jr.	Paris Station	Brant	"
52	Rankin, S.	Fairview	Perth	"
53	Scott, W. S	Osnabruck Centre	Stormont	"
54	Thompson, W.	Enniskillen	Durham	"
55	Way, W. J	Merlin	Kent	"
56	Willan, R. J	South Monaghan	Northumberland	"
57	Brown, J. F	Thistletown	York	Crimson clover.
58	Bell, L. G.	Qu'Appelle	Assiniboia, N.W.T.	"
59	Best, J. H.	Balmoral	Haldimand	"
60	Chambers, E	Port Colborne	Welland	"
61	Deachman, R. J	Gorrie	Huron	"
62	Ewing, W	Paisley	Bruce	"

List of successful experimenters—*Continued.*

Number.	Experimenters.	Post office address.	County.	Experiment.
63	Hodgins, H. B	Osnabruck Centre	Stormont	Crimson clover.
64	Howell, T. F	Brantford, Box 293	Brant	"
65	Holton, C.	Blytheswood	Essex	"
66	Haylow, J	Oriel	Oxford	"
67	Hodgins, A. R	Osnabruck Centre	Stormont	"
68	Hull, G. S	Kerwood	Middlesex	"
69	Ireland, Wm	Midlothian	Parry Sound Dis.	"
70	Jamieson, H.	Pembroke	Renfrew	"
71	Jacobs, H.	Parkersville	Parry Sound	"
72	Lewis, Geo	Ballymote	Middlesex	"
73	Morley, Thos	Whalen	"	"
74	McAsh, Jno	Varna	Huron	"
75	McPhee, Hugh	Crewe	"	"
76	Widdifield, J. W	Siloam	Ontario	"
77	Wilson, W. J.	Dunbar	Dundas	"
78	Waldie, A.	Acton West	Halton	"
79	Zavitz, H. V	Coldstrea	Middlesex	"
80	Armstrong, G	Avonmore	Stormont	Fodder corn.
81	Armbrust, E.	North Pelham	Welland	"
82	Baxter, J	St. Paul's Station	Perth	"
83	Bell, W	Teeswater	Bruce	"
84	Bowles, W. R.	Randolph	Simcoe	"
85	Cummings, W. J	Spencerville	Grenville	"
86	Chalmers, D.	Palmerston	Wellington	"
87	Frarey, J. H.	Richard's Landing	Algoma District	"
88	Garbutt, J. H.	Peterboro'	Peterboro'	"
89	Gregory, R. W	St. Catharines	Lincoln	"
90	Grantham, H. V.	Mohawk	Brant	"
91	Heard, J. H.	Flesherton	Grey	"
92	Henderson, J	The Ridge	Hastings	"
93	Hamilton, J.	Dickenson	Russell	"
94	Herbst, Geo	Alsfeldt	Grey	"
95	Heacock, F. W	Kettleby	York	"
96	Haines, W. F	Parry Sound	Parry Sound	"
97	Hazen, J. M.	Fairground	Norfolk	"
98	Henry, T.	Fargo	Kent	"
99	Johnson, G. E.	Osnabruck Centre	Stormont	"
100	Jones, J. B	Burnt River	Victoria	"
101	Keil, C. A.	Chatham	Kent	"
102	Keenan, T. A.	Kingston	Frontenac	"
103	King, R. E.	De Cewsville	Haldimand	"
104	Leavens, S. D.	Chisholm	Prince Edward	"
105	Maddock, E. A.	Randolph	Simcoe	"
106	McLeod, Jas	Cornwall	Stormont	"
107	McDonald, J	Mount Dennis	York	"
108	McLaughlin, A.	Fordwich	Huron	"
109	McVannel, D.	St. Marys	Perth	"
110	Moore, C. D.	Peterboro'	Peterboro'	"
111	Madden, Chas	Chepstow	Bruce	"
112	Murphy, S.	Straffordville	Elgin	"
113	Neilson, J. D	Thedford	Lambton	"
114	Paterson, R.	Kirkwall	Wentworth	"
115	Pearson, P. W.	Aurora	York	"
116	Russell, W. W	Uhthoff	Simcoe	"
117	Robertson, G. A	St. Catharines	Lincoln	"
118	Rowand, W. A.	Walkerton	Bruce	"
119	Ross, T. E.	Guthrie	Simcoe	"
120	Schurter, M.	Chepstow	Bruce	"
121	Smillie, A. G	Hensall	Huron	"
122	Steele, W.	Almonte	Lanark	"
123	Stewart, D. A	Nairn	Middlesex	"
124	Stewart, J. W	Thamesville	Kent	"
125	Sisley, E.	Maple	York	"
126	Webster, O. L.	Bellamy	Leeds	"
127	Wheatley, T.	Blackwell	Grey	"
128	Williamson, Geo	Ravenswood	Lambton	"
129	Warren, N. R.	Gamebridge	Ontario	"
130	Armstrong, W. E.	Stanleydale	Muskoka District	Turnips.

List of successful experimenters—*Continued.*

Number.	Experimenters.	Post office address.	County.	Experiment.
131	Anderson, W. J	Tancred	Simcoe	Turnips.
132	Beckett, A	Goulais Bay	Algoma District	“
133	Clark, M. M	Russeldale	Perth	“
134	Hubbs, L. P	Hillier	Prince Edward	“
135	Hymers, G. E	Beaver Mines	Algoma District	“
136	Lyness, J	Princeville	Grey	“
137	Lane, J	Gore Bay	Manitoulin	“
138	McLellan, C. P	Lefroy	Simcoe	“
139	McKee, R. E	Peterboro'	Peterboro'	“
140	Peer, W. E. A	Freeman	Halton	“
141	Shuh, F	Waterloo	Waterloo	“
142	Smithson, W	South Monaghan	Northumberland	“
143	Wadel, J	Cayuga	Haldimand	“
144	Watson, Wm	Perth	Lanark	“
145	Beatson, W. J	Lloydtown	York	Mangels.
146	Campbell, J. A	Simcoe	Norfolk	“
147	Dickson, W	Winchester	Dundas	“
148	Kosmack, A	Vanbrugh	Renfrew	“
149	Monteith, N	Fairview	Perth	“
150	McLean, J. W	Kertch	Lambton	“
151	McLeod, J. W	Cornwall	Stormont	“
152	Rhodes, J. B	Chatham	Kent	“
153	Stork, R	Columbus	Ontario	“
154	Stewart, J. D	Russeldale	Perth	“
155	Saunders, W. J	Owen Sound	Grey	“
156	Stephens, T. W	Aurora	York	“
157	Westgate, H. P	Watford	Lambton	“
158	Bailey, J. T	Severn Bridge	Muskoka	“
159	Bray, D	Huntsville	“	“
160	Clarke, W	Port Sydney	“	“
161	Casselman, E. F	Katrine	Parry Sound	“
162	Davidson, J. F	Peterboro'	Peterboro'	“
163	Dawson, H	Beaver Mines	Algoma	“
164	Jolliffe, Chas	Arnprior	Renfrew	“
165	Kerr, J. W	Gore Bay	Manitoulin	“
166	Millar, J. S	Parry Harbour	Parry Sound	“
167	McLean, J. W	Kertch	Lambton	“
168	Patterson, F. H	Smithville	Lincoln	“
169	Robertson, G. A	St. Catherines	Lincoln	“
170	Smith, J. T	Sterling Falls	Parry Sound	Carrots.
171	Smith, R. O	Ettrick	Middlesex	“
172	Stephenson, Jas	Freelton	Wentworth	“
173	Wilson, Jas	Peterboro'	Peterboro'	“
174	Wismer, A	Jordan Station	Lincoln	“
175	Black, Jas	Rockwood	Wellington	Spring wheat.
176	Bennett, S. G	Midland	Simcoe	“
177	Corefoot, A. R	Red Wing	Grey	“
178	Ewing, Alex	Paisley	Bruce	“
179	Irving, J. C	Vernon River Bridge	Queens, P.E.I.	“
180	Johnston, Jas	Lavender	Peterboro'	“
181	Musclow, Chas	Bancroft	Hastings	“
182	Martineau, J	Alfred	Prescott	“
183	Millson, Ed	Solina	Durham	“
184	Newton, O. E	Violet Hill	Dufferin	“
185	Paull, G	Yeovil	Grey	“
186	Robinson, J	Glen Huron	Simcoe	“
187	Risebrough, M	Mt. Albert	York	“
188	Scott, P	Norwood	Peterboro'	“
189	Saddler, W. E	Mossley	Middlesex	“
190	Thompson, D. H	Waldemar	Dufferin	“
191	Woods, W. J	Mono Centre	“	“
192	Anderson, W. C	Thorndale	Middlesex	Barley.
193	Ash, Robt	Unionville	York	“
194	Alton, H. E	Everton	Wellington	“
195	Baird, Geo	Clinton	Huron	“
196	Blackwood, R	Box 73, Martintown	Glengarry	“
197	Chisholm, J. A	Galt	Waterloo	“
198	Collinson, H. G	Scotia	Parry Sound	“

List of successful experimenters—*Continued.*

Number.	Experimenters.	Post office address.	County.	Experiment.
199	Campbell, P. M	Balderson	Lanark	Barley.
200	Foyston, F	Minesing	Simcoe	"
201	Fitzgerald, W	Verdun	Bruce	"
202	Gunn, J	Edgington	Parry Sound	"
203	Honey, R	Brickley	Northumberland	"
204	Jull, J. H	Mount Vernon	Brant.	"
205	Lawrence, O. A	Sheridan	Halton	"
206	Lamb, W	Paisley	Bruce	"
207	Munroe, A	Powassan	Parry Sound	"
208	Meads, George	Axe Lake	"	"
209	Murray, N. S.	Braemar	Oxford	"
210	Moore, C. D.	Peterboro'	Peterboro'	"
211	Pate, Jas.	Brantford	Brant	"
212	Pickering, J	Lucknow	Huron	"
213	Pearce, I. F	Bowmanville	Durham	"
214	Rowand, W	Walkerton	Bruce	"
215	Stephenson, J. N.	Ingersoll	Oxford	"
216	Strachan, Geo	Big Fork	Rainy River Dist	"
217	Scott, Geo	Osnabruck Centre	Stormont	"
218	Vansickle, O	Trinity	Wentworth	"
219	Anderson, P	Hepworth	Bruce	"
220	Adams, R.	Dunblane	"	Oats.
221	Aitchison, W.	Seaforth	Huron	"
222	Adair, F	Monkton	Perth	"
223	Alton, H. E	Everton	Wellington	"
224	Anderson, J.	Belgrave	Huron	"
225	Betz, A	Mongolia	York	"
226	Burnett, R. F.	Salem	Wellington	"
227	Bowman, C. D	West Montrose	Waterloo	"
228	Braithwaite, R.	Anghrim	Lambton	"
229	Brown, S.	Novar	Muskoka	"
230	Blake, W.	Benmiller	Huron	"
231	Benning, J.	Williamstown	Glengarry	"
232	Clarkson, J. H	Sowerby	Algoma	"
233	Cruikshank, J.	Orangeville	Dufferin	"
234	Cross, J	Caledonia Springs	Prescott	"
235	Comba, W.	Gordonville	Wellington	"
236	Cullis, E	Vandeleur	Grey	"
237	Carroll, T. H.	Marsville	Dufferin	"
238	Doud, F. B	Branchton	Brant	"
239	Dix, Geo.	Arkwright	Bruce	"
240	Doyle, M.	Ayton	Grey	"
241	Drummond, J. M	Keene	Peterboro'	"
242	Donaldson, J	Port Williams	Kings, N.S	"
243	Evans, A. R.	Newmarket	York	"
244	Ford, C. C	Wallacetown	Elgin	"
245	Flemming, S	Stella	Lennox	"
246	Graham, D.	Avonbank	Perth	"
247	Glover, W. D	Ravenshoe	York	"
248	Gardiner, Jas.	Port Sydney	Muskoka	"
249	Hamilton, F. R.	Cromarty	Perth	"
250	Hutchinson, J.	Pond Mills	Middlesex	"
251	Hodgins, E.	Wiarton	Grey	"
252	Herbst, Geo	Alsfeldt	"	"
253	Haid, N.	Hesson	Perth	"
254	Hunter, J	Wyoming	Lambton	"
255	Hudson, H.	Horning's Mills	Dufferin	"
256	Hammil Bros	Lorneville	Victoria	"
257	Jinkinson, S. A.	Ashton	Carleton	"
258	Johnston, J	Oxford Mills	Grenville	"
259	Kersey, Wm	Coleraine	Peel	"
260	Lymburner, M. B	Basingstoke	Lincoln	"
261	Lunn, Thos.	Burtch	Brant	"
262	Loftus, F.	Apto	Simcoe	"
263	Laird, J. W	Orangeville	Dufferin	"
264	Mannen, J. F	Weir	Wentworth	"
265	Morkin, Jno	Whalen	Middlesex	"
266	Munroe, A	Powassan	Parry Sound	"

List of successful experimenters—*Continued.*

Number.	Experimenters.	Post office address.	County.	Experiment.
267	Munroe, A. M	Glanworth	Middlesex	Oats.
268	Munroe, J.	Hubrey	"	"
269	March, F. J	Bethesda	York	"
270	March, W	Bethesda	York	"
271	McComb, J. E.	Arnott	Grey	"
272	McCallum, J	Amulree	Perth	"
273	McNab, W	Adelaide	Middlesex	"
274	McVery, J	Plover Mills	Middlesex	"
275	McMahan, J	Wyoming	Lambton	"
276	McIntyre, D.N	Paisley	Bruce	"
277	Nicholson, S	Sylvan	Middlesex	"
278	Piper, W. J	Salford	Oxford	"
279	Pierce, A	Norwich	Brant	"
280	Parks, W. J	Westfield	Huron	"
281	Pickering, Jas	Lucknow	"	"
282	Price, E	Marsville	Dufferin	"
283	Pierce, W. H	Newcastle	Durham	"
284	Risebrough. M	Mt. Albert	Ontario	"
285	Rose, W	Sunnidale Corners	Simcoe	"
286	Regan, M	Adelaide	Middlesex	"
287	Southam, J	Bury's Green	Victoria	"
288	Stroh, W	Conestogo	Waterloo	"
289	Scott, A	Lakelet	Huron	"
290	Siegner, E	Mildmay	Bruce	"
291	Shanks, J	Hornby	Halton	"
292	Smith, D	Belfountain	Bruce	"
293	Strachan, G	Big Fork	Rainy River	"
294	Sloan, W. A	Ventnor	Grenville	"
295	Smith, J	Ripley	Bruce	"
296	Smith, W. O	Ancaster	Wentworth	"
297	Srigley, J	Pelee Island	Pelee Island	"
298	Tufts, R	Tweed	Hastings	"
299	Tiffin, J. J	Nile	Huron	"
300	Walker, D	Lorneville	Victoria	"
301	Woods, J	Westfield	Huron	"
302	Waterston, R	Clarence	Russell	"
303	Walker, T	Hawthorne	Carleton	"
304	White, R. J	Whitehall	Parry Sound	"
305	Wilson, J	Peterboro'	Peterboro'	"
306	Andrews, J	Durham	Grey	Peas.
307	Aird, W	Baldwin	York	"
308	Alton, H. E	Everton	Wellington	"
309	Bell, J	Lindenwood	Grey	"
310	Brown, A	Fergus	Wellington	"
311	Bannerman, A	Belton	Middlesex	"
312	Bettles, T. S	Porter's Hill	Huron	"
313	Carmichael, A. A	Ivan	Middlesex	"
314	Cullis, W. H	Powle's Corners	Victoria	"
315	Doherty, C	Wildfield	Peel	"
316	Dunnell, J	Bayview	Grey	"
317	Dunn, W. J	Mount St. Louis	Simcoe	"
318	Foreman, W	Port Carling	Muskoka	"
319	Gould, W	Goderich	Huron	"
320	Grigg, J. P	Mt. Brydges	Middlesex	"
321	Hyde, Wm	Kirkwall	Wentworth	"
322	Hughes, J. E	Burk's Falls	Parry Sound	"
323	Hartley, D	Milton West	Halton	"
324	Hardy, W. G	Brinsley	Middlesex	"
325	Hooper, J. F	Wroxeter	Huron	"
326	Jackson, W. J	Playfair	Lanark	"
327	Krueger, C	Williamsford	Grey	"
328	Locke, W. H	Campbellford	Northumberland	"
329	Lunn, J	Burtch	Brant	"
330	Lewis, G	Ballymote	Middlesex	"
331	Landon, J. B	Lansdowne	Leeds	"
332	Livingstone, J	Aurora	York	"
333	Low, R. E	Liskeard	Nipissing	"
334	Lebert, J	Parry Sound	Parry Sound	"

List of successful experimenters—*Continued.*

Number.	Experimenters.	Post office address.	County.	Experiment.
335	Morton, H	Ashton	Carleton	Peas.
336	Mallory, B	Frankford	Hastings	"
337	Mooney, H.	Brussels	Huron	"
338	Mosser, J	Bosworth	Wellington	"
339	Munroe, A.	Powassan	Parry Sound	"
340	McCormick, J. F	Trenton	Northumberland	"
341	McNaughton, W	Balderson	Lanark	"
342	McDonald, M.	Lucknow	Huron	"
343	McTavish, R.	Vernon	Carleton	"
344	McLeod, R. H	Brooksdale	Oxford	"
345	Nickolson, E	Magnetawan	Parry Sound	"
346	Parks, J.	Westfield	Huron	"
347	Pearce, J	Lindsay	Victoria	"
348	Paull, T	Lady Bank	Grey	"
349	Raynor, W.	Palermo	Halton	"
350	Risebrough, M.	Mount Albert	Ontario	"
351	Revel, G.	Orillia	Simcoe	"
352	Sprague, J. A.	Demorestville	Prince Edward	"
353	Snyder, G. A	St. Anns	Lincoln	"
354	Smale, S. C	Oakdale	Lambton	"
355	Stocks, C	Yearley	Parry Sound	"
356	Somerton, F	Pakenham	Lanark	"
357	Snyder, A.	Mount Forest	Middlesex	"
358	Skelly, T. J. M	Colgan	Simcoe	"
359	Leishman, B.	Angus	Simcoe	"
360	Tummins, A.	Winchester	Dundas	"
361	Taylor, F.	Jackson	Grey	"
362	Teskey, J	Croydon	Addington	"
363	Thurman, H. H	Yearley	Muskoka	"
364	Taylor, W. E	Beaverton	Ontario	"
365	Traviss, J	Queensville	York	"
366	Treleaven, J.	Cambray	Victoria	"
367	Upshall, C.	Port Elgin	Bruce	"
368	White, N.	Roebuck	Grenville	"
369	Watermann, F	Bailieboro'	Northumberland	"
370	Wilson, L.	Ingersoll	Oxford	"
371	Whetter, J. R.	Lorneville	Victoria	"
372	Wooddisse, J	Rothsay	Wellington	"
373	Wensley, J	Haliburton	Haliburton	"
374	Worden, W.	St. Paul's Station	Perth	"
375	Walker, A.	Metcalfe	Carleton	"
376	Wilson, W. C	East Oro	Simcoe	"
377	Young, G	Appin	Middlesex	"
378	Binns, J.	Guelph	Wellington	Potatoes.
379	Black, T. J	Hazledean	Carleton	"
380	Booth, W	Uxbridge	Ontario	"
381	Bowman, F. E.	Berlin	Waterloo	"
382	Cunningham, G.	Ardtrea	Simcoe	"
583	Frame, J	Avonton	Perth	"
384	Gingrich, D.	Preston	Waterloo	"
385	Gerrow, J. F	Uxbridge	Ontario	"
386	Hick, W.	Goderich	Huron	"
387	Julien, A	Thamesville	Kent	"
388	Lyness, J.	Priceville	Grey	"
389	Leavens, S. D	Chisholm	Prince Edward	"
390	McKellar, A.	Kertch	Lambton	"
391	McLeod, R. H.	Brooksdale	Oxford	"
392	McDonald, M.	Lucknow	Huron	"
393	McGregor, G. T.	Peepabun	Wellington	"
394	EcEwen, D.	Cobden	Renfrew	"
395	Martin, C. R.	Thornton	Simcoe	"
396	Neilson, J. A.	Lyn	Leeds	"
397	Pollard, A.	Orono	Durham	"
398	Paterson, A. C	Lucknow	Bruce	"
399	Farnell, Mrs	Eganville	Renfrew	"
400	Quinn, J. B.	Dufferin	Frontenac	"
401	Rogers, T.	Mount Forest	Grey	"
402	Rutherford, Jno	Rydal Bank	Algoma	"

List of successful experimenters—*Continued.*

Number.	Experimenters.	Post office address.	County.	Experiment.
403	Suddaby, J. R.	Harriston	Wellington	Potatoes.
404	Wooddisse, J.	Rothsay	"	"
405	Wensley, J.	Haliburton	Haliburton	"
406	Alton, G. W.	Houghton Centre	Norfolk	Winter wheats.
407	Acton, W. J.	Watford	Lambton	"
408	Armstrong, G. B	Teeswater	Bruce	"
409	Brandon, J. H.	Wingham	Huron	"
410	Beacock, W. J.	Caesarea	Durham	"
411	Beacock, J. E.	Blackstock	"	"
412	Bryce, A.	Watford	Lambton	"
413	Brown, D. A.	Lobo	Middlesex	"
414	Benstead, G.	Walnut		"
415	Clow, L. H	Hepworth	Bruce	"
416	Closson Bros.	Highland Creek	York	"
417	Culham, J.	Russellton	Simcoe	"
418	Cumberland, Wm.	Fintona	Simcoe	"
419	Connor, A. C.	Sarginson	Hastings	"
420	Connolly, R.	Ingersoll	Oxford	"
421	Cardiff, M. M.	Brussels	Huron	"
422	Drimnie, D.	Yeovil	Grey	"
423	Davison, W	Paisley	Bruce	"
424	Doyle, A	Sunderland	Ontario	"
425	Device, Jno	St. Thomas	Elgin	"
426	Field, Wm.	Napier	Middlesex	"
427	Facey, J. W	New Hamburg	Oxford	"
428	Forbes, H	Jeannette's Creek	Kent	"
429	Forsyth, A.	Uxbridge	Ontario	"
430	Gorham, M. A	Ridgeway	Welland	"
431	Gillatly, D.	Wyoming	Lambton	"
432	Graham, D. L.	Wallbridge	Hastings	"
433	Grant, Wm.	Granton	Middlesex	"
434	Graham, Jos	Claude	Peel	"
435	Gillatly, Jno	Wyoming	Lambton	"
436	Hilborn, H. A	Bosworth	Wellington	"
437	Haws, J. F.	Hereward	Dufferin	"
438	Hartley, D.	Milton West	Halton	"
439	Hutchinson, J. H	Gooderham	Peterboro'	"
440	Hugill, J. W.	Coboconk	Victoria	"
441	Harcourt, Jno	St. Anns	Lincoln.	"
442	Innis, J	Currie's Crossing		"
443	Julien, A	Thamesville	Kent	"
444	Jardine, A. D	Nottawa	Simcoe	"
445	Jacobs, H	Parkersville	Muskoka	"
446	Johnston, Geo.	Scotland	Norfolk	"
447	Johnston, J. W	Mount Forest.	Grey	"
448	Krick, J	Elcho	Lincoln	"
449	Knowlton, S	Delta	Leeds	"
450	Leigh, W. M	Kirkton	Perth	"
451	Locke, W. H.	Campbellford	Northumberland	"
452	Lemon, J	Walter's Falls	Grey	"
453	Mallard, W. J.	Oxenden	"	"
454	Mallard, D. J	Oxenden	"	"
455	Maddock, J. R.	Randolph	Simcoe	"
456	Maddock, E. A.	Randolph	"	"
457	Mead, L	Mull	Kent	"
458	May, D	Littlewood	Middlesex	"
459	McGowan, R. C	Blyth	Huron	"
460	McAulay, W.	Bellingham	Algoma	"
461	McColl, A	West Lorne	Elgin	"
462	McEwen, R	Mono Mills	Peel	"
463	McVannell, D.	St. Marys	Perth	"
464	McNaughton, K.	Walkerton	Bruce	"
465	McColl, A. J.	West Lorne.	Elgin	"
466	McCullough, H. A	Nantye	Simcoe	"
467	McKellar, A	Kertch	Lambton	"
468	Newton, O. E.	Violet Hill	Dufferin	"
469	Otterbein, M	Blake	Huron	"
470	Parkinson, S	Elimville	"	"

List of successful experimenters—*Continued.*

Number.	Experimenters.	Post office address.	County.	Experiment.
471	Pelton, L. J	Youngsville	Oxford	Winter wheats.
472	Pesha, J	Mosside	Lambton	"
473	Parkinson, W	Oakwood	Victoria	"
474	Richardson, R	Wyoming	Lambton	"
475	Richmond, J	Blyth	Huron	"
476	Ross, Jno	Ilderton	Middlesex	"
477	Russell, W. W	Uhthoff	Simcoe	"
478	Rutherford, T	Campbellford	Northumberland	"
479	Robertson, Thos	Dunsford	Victoria	"
480	Sine, W. T	Sine	Hastings	"
481	Show, F	Little Britain	Victoria	"
482	Sutherland, Chas	Strathroy	Middlesex	"
483	Stacey, Thos	Bluevale	Huron	"
484	Scott, J. A	Castlederg	Cardwell	"
485	Schooley, A	Luton	Elgin	"
486	Seens, J	Bailieboro'	Northumberland	"
487	Smith, J. F	Ancaster	Wentworth	"
488	Slade, Chas	Kincardine	Bruce	"
489	Stevenson, C. R	Fingal	Elgin	"
490	Silverthorne, C	Summerville	York	"
491	Smailes, Jno	Eagle	Elgin	"
492	Stewart, A	Ailsa Craig	Middlesex	"
493	Smith, Jas	Edgar	Simcoe	"
494	Todd, Mrs	Randolph	Simcoe	"
495	Vogan, D	Huntingfield	Bruce	"
496	Watson, Chas	Dromore	Grey	"
497	Wills, Jas	Sonya	Victoria	"
498	Wickie, F. E	Harriston	Wellington	"
499	Williams, L	Munro	Perth	"
500	Wainman, D	Orillia	Simcoe	"
501	Wyckoff, E. L	Tyrrell	Norfolk	"

Nearly all the experiments used for the co-operative work during the past year were carefully conducted in the experimental department at the College in 1896. The results of these tests are included in the summary reports, but are not mentioned in the foregoing list.

RESULTS OF EXPERIMENTS.

The instructions for each experiment, the summary result of the successful experiments in 1896, and the conclusions from each experiment are here presented.

EXPERIMENT No. 1.

TESTING NITRATE OF SODA, SUPERPHOSPHATE, MURIATE OF POTASH, MIXTURE, AND NO FERTILIZER WITH OATS.

1. Upon uniform land which has received no manure for at least four years, mark off five plots, each two rods long by one rod wide.

2. Drive wooden stakes at the four corners of each plot and leave a clean path three feet wide between each two plots.

3. Run a strong cord around each plot and sow the different packages of fertilzers and Siberian oats, as indicated by the labels on the packages.

4. After the plants are up 2 or 3 inches, again run the cord around each plot and cut off every plant outside of the cord.

5 The crops should be cut as soon as they ripen, and, when dry, weighed and threshed by flail immediately on being brought in from the heat of the sun.

Summary Results.

Fertilizers.	Average yield of grain per acre.					Average yield per acre, 5 years (74 tests)	
	1892 7 tests.	1893 20 tests.	1894 18 tests.	1895 14 tests.	1896 15 tests.	Straw.	Grain.
	bush.	bush.	bush.	bush.	bush.	tons	bush.
Mixture	53.0	41.3	48.8	50.3	50.1	1.4	48.7
Nitrate of Soda	47.9	38.6	48.0	49.2	47.8	1.4	46.3
Muriate of Potash	43.9	37.6	43.1	46.5	48.0	1.3	43.8
Superphosphate	42.4	36.2	44.2	48.9	46.4	1.3	43.6
No Fertilizer	40.3	31.4	39.5	41.7	41.4	1.2	38.9

Number one experiment has been conducted over Ontario for five years in succession. Both the oats and the fertilizers were sent from the College to the experimenters during each of these years. In every instance the nitrate of soda and muriate of potash were applied at the rate of one hundred and sixty pounds per acre, and the superphosphate at three hundred and twenty pounds per acre. The mixture was composed of one third the amount mentioned of each of the three fertilizers. The four fertilizers cost about the same amount per acre, namely, nitrate of soda, $4.20, muriate of potash, $4.48, superphosphate, $4.16, and mixture, $4.35. The nitrate of soda was applied when the plants were about two inches in height, and the muriate of potash and superphosphate at the time of sowing the grain.

In the foregoing table it will be seen that not only are the average results given for 1896, but also for each of the four previous years, in which this experiment was conducted. The average yields of straw and grain per acre from each fertilizer for the five years are also given. These figures represent the average of seventy-four carefully conducted experiments.

CONCLUSIONS.

1. The average results obtained by fifteen experiments over Ontario in 1896 show that the fertilizers increased the oat crop as follows:

Mixture—Grain, 8.7 bushels; straw, .19 ton.

Muriate of Potash—Grain, 6.6 bushels; straw, .07 ton.

Nitrate of Soda—Grain, 6.4 bushels; straw, .19 ton.

Superphosphate—Grain, 5.0 bushels; straw, .11 ton.

2. The mixed or "complete" fertilizer gave an average of 21.1 per cent.; muriate of potash, 15.9 per cent.; nitrate of soda, 15.5 per cent.; and superphosphate 12.1 per cent. of oats over no fertilizer.

3. The grain crop was more than doubled on one farm by the use of fertilizers, while on two or three other farms it was influenced only very slightly by the use of the fertilizers.

4. In 33 per cent. of the individual experiments the mixed fertilizer gave higher yields of oats than any of the other fertilizers used in this experiment.

5. For five years in succession the "mixed" fertilizer has given the best average yield of grain per acre, and no fertilizer has given the smallest average yield of grain per acre.

6. In the average of five years' experiments it is found that land fertilized with the mixed or "complete" fertilizer produced 9.8 bushels of oats per acre more than the land which was not fertilized.

7. In the average of five years' experiments, the mixed or "complete" fertilizers gave 25 per cent., and the nitrate of soda 19 per cent. more grain than when no fertilizer was used.

EXPERIMENT No. 2.

TESTING NITRATE OF SODA AND NO FERTILIZER WITH RAPE.

1. Upon uniform land which has received no manure for at least four years, mark off two plots, each two rods long by one rod wide.

2. Prepare the soil for rape in much the same manner as you would that for a root crop.

3. In the latter part of June make eight drills twenty-five inches apart, two rods long, in each plot, and sow the two packages of rape seed upon their respective plots.

4. When the young plants are about two inches high, sow the nitrate of soda upon plot No. 1, after which stir the soil, and continue cultivation as for a root crop.

5. About the 20th of October cut the rape and immediately weigh the crop from each plot.

Summary Results.

Fertilizer.	Yield of green rape per acre.					Average yield per acre. 5 years. 6 tests.
	1892 1 test.	1893 1 test.	1894 2 tests.	1895 1 test.	1896 1 test.	
	tons.	tons.	tons.	tons.	tons.	tons.
Nitrate of Soda	20.0	9.2	15.2	18.3	12.1	15.0
No Fertilizer	18.0	4.0	14.8	16.8	15.9	12.9

Number two experiment has now been conducted for five years in succession throughout Ontario. The same sized plots have been used in each of the years. The only fertilizer used in connection with this experiment was nitrate of soda. In the tests made with fertilizers and rape in the Experimental department at the College, it has been found that nitrate of soda has given decidedly the best results, therefore this was the one selected for the co-operative experiment. The nitrate of soda has been used at the rate of eighty pounds per acre. It would cost about $2.20 for this amount of nitrate of soda. The variety of rape used in every instance was the Dwarf Essex.

In the foregoing table the results for the experiment of 1896 are given, and also the results of the experiments for 1892, 1893, 1894 and 1895. It will be seen from the figures at the right hand side of the table that the average yield per acre of green rape for the five years is also given.

CONCLUSIONS.

1. For five years in succession, the application of Nitrate of Soda at the rate of 80 lbs. per acre has increased the yield of rape in the co-operative experiments by an average 2.1 tons per acre.

2. Rape can be grown successfully over Ontario and the average yield of the green crop is about 14 tons per acre.

3. There is the least demand for the rape experiment of all the experiments offered for co-operative work.

EXPERIMENT No. 3.

TESTING FOUR LEADING VARIETIES OF MILLET.

1. Upon soil prepared as for corn, sow all the varieties upon four uniform plots, each two rods long by one rod wide.

2. Drive wooden stakes at the four corners of each plot and leave a clean path three feet wide between each two plots.

3. Late in May or early in June, run a strong cord around each plot and sow the different varieties upon their respective plots, and inside the cord. Aim at seeding one inch deep.

4. After the plants are up two or three inches, again run the cord around each plot and cut off every plant outside of the cord.

5. The crops should be cut as soon as the heads are in appearance, and immediately weighed when in the green condition.

Summary Results.

Varieties.	Yield of green millet per acre					Average yield. 5 years. 20 tests.
	1892 4 tests.	1893 2 tests.	1894 5 tests.	1895 5 tests.	1896 4 tests.	
	tons.	tons.	tons.	tons.	tons.	tons.
Salzer's Dakota	8.1	9.3	6.1	9.3	5.8	7.7
Golden Wonder	5.8	7.1	5.7	8.3	5.7	6.5
Common	5.2	5.8	4.0	6.5	4.3	5.2
Hungarian	....	....	3.3	5.2	4.3	....

As in the case of the first two co-operative experiments, number three experiment has also been conducted under similar lines for five years in succession. In 1892 and in 1893 the Salzer's Dakota, Golden Wonder and Common varieties were tested throughout Ontario. In 1894, 1895 and 1896 the same three varieties were tested, and also the Hungarian Grass was added to the list. The results, therefore, for the five years, can be compared very nicely, and the yields per acre during each of those years can be summarized in such a way as to give the average results in a very concise form.

CONCLUSIONS.

1. The varieties of Millets tested over Ontario during the past five years hold the same relative position in yield of crop per acre in each of the five years.

2. Salzer's Dakota Millet gave an average increase of green fodder of 55.8 per cent. in 1892; 53.6 per cent. in 1893; 53.2 per cent. in 1894; 43.1 per cent. in 1895, and 34.9 per cent. in 1896 over that of the Common Millet in the co-operative experiments.

3. In the average of five years' experiments, the Salzer's Dakota Millet gave an increase of green crop per acre of 18.5 per cent. over that of the Golden Wonder Millet and 48.1 per cent. over that of the Common Millet.

EXPERIMENT No. 4.

TESTING THREE FODDER CROPS.

1. Prepare for sowing the packages of seeds upon three uniform plots, each plot being exactly one rod square.

2. Drive wooden stakes at the four corners of each plot and leave a clean path three feet wide between each two plots

3. Run a strong cord around each plot and sow the different packages upon their respective plots and inside the cord.

4. After the plants are up two or three inches, again run the cord around each plot and cut off every plant outside the cord.

5. The crops should be cut as soon as the heads are well out and the grain is in the milk stage and immediately weighed in the green condition.

Summary Results.

Mixtures.	Comparative value for farm use as indicated by the experimenters themselves.	Average yield of green crop per acre. 13 tests.
		tons.
Oats, 1½ bus. per acre Peas, 1 bu. per acre	100	7.4
Oats, 1½ bus. per acre Peas, ½ bus. per acre Tares, ½ bus. per acre	91	7.3
Oats, 1½ bus. per acre Tares or vetches, 1 bu. per acre	77	6.9

An experiment was conducted throughout Ontario in 1896 for the first time by using three mixtures of grain for the production of green fodder, oats and peas forming one mixture; oats and tares another; and oats, peas and tares the third. A considerable amount of interest was taken in this experiment, and a large proportion of those who conducted the experiment furnished us with complete reports. The Siberian oats, Prussian Blue peas, and the common tares or vetches were used for this experiment.

The average yield per acre of thirteen carefully conducted experiments are given in the above table. The figures in the centre column of the table represent the average opinion of the experimenters, in response to a question asking for their opinion of the various mixtures by taking all things into consideration, the most popular being represented by one hundred.

CONCLUSIONS.

1. Oats and peas formed a cheap mixture of grain for seed, and the green crop produced proved more satisfactory than that of either oats and tares, or oats, tares and peas.

2. Mixed grain sown at the rate of two and one-half bushels per acre gave an average yield of 7 1/5 tons of green feed per acre in 1896.

3. Oats and peas gave the highest yields of green crop in 62 per cent. of the individual experiments; oats, peas, and tares in 23 per cent; and oats and tares in 15 per cent.

EXPERIMENT No. 5.

Growing Lucerne as a Crop for Fodder.

1. Select a plot four rods long by two rods wide, conveniently situated to the stables, and in a position that it may remain unbroken for a number of years.
2. Drive wooden stakes at the four corners of the plot.
3. Run a strong cord around the plot, and sow the lucerne seed inside the cord. A light seeding of grain might be sown with the lucerne seed.
4. After the plants are up two or three inches, again run the cord around each plot and cut off every plant outside the cord.
5. The lucerne crop should not be cut the first year, unless the crop is heavy, and then not closely.

Summary Results.

Variety	Average length of roots. (24 tests.)	Average number of days required for germination.	
		1896. (24 tests.)	Average four years. (82 tests.)
	inches.		
Lucerne or Alfalfa	11.1	10.3	10.9

The lucerne for No. 5 experiment was sown broadcast at the rate of eighteen pounds of seed per acre. This experiment has been conducted for six years in succession, but only a partial report is given in the above table. As it takes several years to prove whether or not lucerne is successful when grown upon various soils, the most valuable part in connection with this experiment is yet to follow. We hope to correspond with all the experimenters who have received lucerne within the past six years, and ascertain from them whether or not the crop is proving a success, asking each to give a careful description of the soil and subsoil on which the lucerne is growing.

CONCLUSIONS.

1. Lucerne seed sown on sandy soil in the spring of the year produced some plants whose roots measured from 33 to 36 inches in length by the 25th of September of the same year.

2. Lucerne is slow in growth during the first year after seeding, and no crop can be expected until the second year.

3. As lucerne is a perennial plant, it requires several years to obtain the most valuable results respecting this experiment.

EXPERIMENT No. 6.

Spring Seeding of Crimson Clover.

1. Measure off a piece of land exactly four rods long and two rods wide and cultivate the ground so as to have a fine seed bed.

2. Drive four stakes at the four corners of the plot.

3. Run a strong cord around the plot and sow the Crimson Clover seed alone, inside the cord.

4. After the plants are up 2 or 3 inches, again run the cord around each plot and cut off every plant outside of the cord.

5. The crop should be cut when in bloom, and immediately weighed on being cut when in the green condition.

Summary Results.

Variety.	Average.		Height of plants.		Yield of green crop per acre.	
	Number of days from seeding until blooming.	Length of roots.	1896, (18 tests).	Average 2 years.	1896, (14 tests).	Average 2 years, (54 tests).
		inches.	inches.	inches.	tons.	tons.
Crimson Clover...........	63	7.0	15.6	13.4	4.97	4.66

For two years in succession a very simple experiment has been conducted with Crimson Clover in order to obtain information in regard to this crop throughout Ontario. Many inquiries have been received in regard to Crimson Clover, and the demand for seed for an experiment has been quite large. The seed was sown at the rate of twelve pounds per acre. The above table gives the results of the yield of green crop per acre in 1896, and also for the average of two years from those experiments in which Crimson Clover was cut and weighed.

CONCLUSIONS.

1. The average date of sowing the Crimson Clover seed was May 3rd, and the average date on which the plants began to flower was July 5th.

2. The average date of cutting the Crimson Clover was August 9th, at which time the roots gave an average length of 7 inches.

3. In the average of five years' experiments with Crimson Clover at the College, the yield of hay has been about 1 1-10 tons per acre, and in the co-operative experiments over Ontario for two years the average yield of green crop has been 4 2-3 tons per acre.

EXPERIMENT No. 7.

Testing Six Leading Varieties of Corn.

1. Prepare for sowing all the varieties upon six uniform plots, each plot being exactly 1 rod square.

2. Mark out each plot into five rows both ways, allowing 3 feet 4 inches between the rows.

3. Plant each variety of corn upon its respective plot. Drop six kernels at each of the places where the lines touch, and thus make twenty-five hills of each variety.

4. When the corn is about 4 inches high, thin out to four plants per hill.

5. Cut each variety before frost, and at the time when its stage of growth corresponds to the roasting condition of field corn, or when the grain is partly glazed. Weigh the whole crop from each plot as soon as cut, and then husk, weigh and count the ears, and examine the condition of the grain.

Summary Results.

Varieties.	Average results at O. A. C. — Stage of ripeness when cut about September 15, 4 years.	Average results at O. A. C. — Yield per acre, 6 years. — Ears.	Average results at O. A. C. — Yield per acre, 6 years. — Whole crop.	Average results over Ontario, 1896. — Height of crop.	Average results over Ontario, 1896. — Yield per acre. — Ears.	Average results over Ontario, 1896. — Yield per acre. — Whole crop.
		tons.	tons.	ins.	tons.	tons.
Cloud's Early Yellow Dent	Late milk	3.2	19.5	103	4.3	18.0
Mammoth Cuban (Yellow Dent).	Nearly firm dough..	3.5	17.3	99	4.3	16.6
Wisconsin Earliest White Dent .	Dough to firm dough	3.5	15.5	100	3.7	16.0
Rural Thoroughbred White Flint	Nearly late milk....	2.1	19.8	88	3.7	15.5
Salzer's North Dakota	Firm dough to ripe .	3.1	16.0	84	3.8	13.2
Compton's Early	Ripe	3.3	14.3	81	3.6	13.2

Twelve varieties of corn have been distributed in connection with the co operative experiments within the past five years. Six varieties being used in the test in each year. The varieties which give the best satisfaction in the co-operative experiments in one year are continued in the following year, and those which gave unsatisfactory results are dropped from the list, and their place is taken by others in the following year. The varieties selected in every instance are those which have given the best satisfaction in connection with the experiments conducted in the experimental department at the Agricultural College.

As the varieties sent out during each of the past five years are not the same for the individual years, the results of all the varieties cannot be presented in a summary report as well as in the case of experiments numbers one, two and three. This report, therefore, has only the six varieties which were distributed in 1896 included in the above table. These represent two of the best large varieties which have been tested in the experimental department of the College, two of the best medium ripening varieties, and two of the best early varieties. Besides the average results of the co-operative experiments for 1896, the average yield per acre of ears and of whole crop of each variety as produced in the experiments conducted at the College for six years in succession are given as a basis of comparison. No less than fifty valuable reports of the corn experiment were received in 1896, the average results of which will be found in the foregoing table.

CONCLUSIONS.

1. In the co-operative experiments over Ontario in 1896, the Cloud's Early Dent Corn appeared to be well suited to Southern Ontario; the Mammoth Cuban and Wisconsin Earliest White Dent to Central Ontario, and the Salzer's North Dakota and Compton's Early to Northern Ontario.

2. The individual experiments show that no one variety of corn is well adapted to all parts of Ontario.

3. The variety of corn which will produce the largest total yield per acre and the largest yield of grain per acre among the varieties that will mature in any locality is one of the best corns for that locality.

4. The Cloud's Early Yellow Dent variety of corn has been tested over Ontario for three years in succession, and has occupied first place in yield of whole crop in each of these years.

5. The Thoroughbred White Flint variety of corn gave a low yield of green crop per acre in 1896 as compared with that of former years.

6. The three varieties of Dent corn gave larger yields per acre of whole crop than the three varieties of Flint corn in the co-operative experiments of 1896.

EXPERIMENT No. 8.

Testing Five Leading Varieties of Turnips.

1. Prepare for sowing all the varieties upon five uniform plots of exactly the same shape and size.

2. Each plot may consist of (*a*) eight drills, 16 feet 4 inches long; or (*b*) four drills, 32 feet 8 inches long; or (*c*) two drills, 65 feet 4 inches long.

3. The drills should be twenty-five inches apart.

4. Sow all the seed of each variety as evenly as possible.

5. Thin the young plants in the drills to an average of ten inches apart, leaving 157 roots of each variety.

6. When harvesting be careful to weigh and count the roots correctly and record the results neatly.

Summary Results.

Varieties.	Class.	Average weight per root.	Yield of roots per acre, 1896. (15 tests.)
		lbs.	bus.
Jersey Navet	Fall turnips	2.57	1,098
Purple Top Munich	Fall turnips	2.13	939
Buckbee's Giant	Swede turnips	2.09	882
Hartley's Bronze Top	Swede turnips	2.03	874
Carter's Elephant	Swede turnips	2.02	863

Thirteen varieties of turnips have been tested in connection with the co operative work within the past five years, five varieties being used in the experiment of each year. Of all those which have been sent out, two varieties have been tested for five years in succession, one variety for four years, one variety for two years, and each of the other varieties for one year. In 1896, two varieties of fall turnips and three varieties of swede turnips made up experiment eight. These were successfully tested on fifteen distinct farms. Not only were the weights of the different varieties reported by the different experiments, but also the number of roots produced on each plot. Each experimenter endeavored to leave exactly the same number of each, when thinning the plants, but in some instances there would be a slight variation in the number on the different plots at the time of harvesting. By dividing the yield of each plot by the number of roots on the plot, the average weight per root has been obtained. This along with the yield per acre gives good information. In the foregoing table the average weight per root, and the average yield per acre of each variety are given.

CONCLUSIONS.

1. The fall turnips gave larger yields of roots per acre than the Swede turnips in the co-operative tests in 1894, 1895, and 1896.

2. The Jersey Navet variety of fall turnips gave the largest average yield of roots per acre among the five varieties of turnips tested over Ontario in 1896, and also among the thirteen varieties of fall turnips grown at the Agricultural College for six years in succession.

3. The Buckbee's Giant and Hartley's Bronze Top varieties of Swede turnips have each given good results in the experiments at the College and in the co-operative experiments over Ontario.

EXPERIMENT No. 9.

Testing Five Leading Varieties of Mangels.

For instructions see Experiment No. 8.

Summary Results.

Varieties.	Average weight per root.	Yield of roots per acre. (13 tests.)
	lbs.	bus.
Evans' Improved Mammoth Saw Log	3.74	1,477.1
Simmers' Mammoth Prize Long Red	3.50	1,352.1
Carter's Warden Prize Orange Globe	2.81	1,069.3
Carter's Champion Yellow Intermediate	2.72	1,035.7
White Silesian Sugar Beet	2.53	1,004.3

For number nine experiment, two varieties of long red mangels, one variety of intermediate mangels, one of globe mangels, and one of sugar beets were used in 1896. Twelve varieties of mangels and sugar beets have been distributed within the past five years. Of this number, four varieties have been sent out for three years at least. As in the case of turnips the average weight per root as well as the yield of roots per acre is given in the summary results.

CONCLUSIONS.

1. The two long varieties of mangels gave decidely greater yields of roots than the intermediate or globe variety of mangels or than the variety of sugar beets.

2. The sugar beets grow considerably under ground and require much more labor in harvesting than any of the varieties of mangels.

3. The Evans' Improved Mammoth Sawlog and the Simmers' Mammoth Prize Long Red varieties of mangels gave the largest yield of roots, and the White Silesian Sugar Beet gave the smallest average yield among the varieties tested over Ontario in both 1895 and 1896.

EXPERIMENT No. 10.

Testing five Leading Varieties of Carrots.

1. Prepare for sowing all the varieties upon five uniform plots of exactly the same shape and size.

2. Each plot may consist of (*a*) eight drills, 16 feet 4 inches long; or (*b*) four drills, 32 feet 8 inches long; or (*c*) two drills, 65 feet 4 inches long.

3. The drills should be twenty-five inches apart.

4. Sow all the seed of each variety as evenly as possible.

5. Thin the young plants in the drills to an average of four inches apart, leaving 392 roots of each variety.

Summary Results.

Varieties.	Average weight per root.	Average yield of roots per acre. (18 tests.)
	lbs.	bus.
Pearce's Half Long White	1.09	987.5
Large White Belgian	1.00	907.9
Large White Vosges	.93	863.2
Mitchell's Perfected	.84	763.6
Guerande	.75	697.9

Three varieties of white carrots and two varieties of yellow carrots were included in the co operative experiments in 1896. The seed of all the varieties of carrots was secured in Ontario. Within the past five years, the Union experiments with carrots have included eight different varieties. The three varieties, other than those in the foregoing table, were the Improved Short White, Danver's Orange and Carter's Orange.

CONCLUSIONS.

1. The Pearce's Half Long White variety of carrots, which took the lead in piont of yield in fifty-six per cent. of the co-operative experiments in 1896, is very similar to the Steele's Improved Short White variety of carrots which took the lead in fifty per cent. of the co-operative experiments in 1892; in forty-two per cent. in 1893; in fifty-five per cent. in 1894; and in sixty-three per cent. in 1895.

2. The white-fleshed variety of carrots gave better yields of roots than the yellow-fleshed varieties in 1893, 1894, 1895, and 1896.

. The Guerande was the easiest to harvest, and the Large White Belgian was the hardest to harvest owing to the difficulty in removing the roots of the latter from the ground.

4. The eighteen successfully conducted experiments with carrots were located in ten different counties throughout Ontario.

EXPERIMENT No. 11.

Testing Five Leading Varieties of Spring Wheat.

1. Prepare for sowing all the varieties upon five uniform plots, each plot being exactly one rod square.

2. Drive wooden stakes at the four corners of each plot and leave a clean path three feet wide between each two plots.

3. Run a strong cord around each plot and sow the different varieties upon their respective plots and inside of the cord.

4. After the plants are up 2 or 3 inches, again run the cord around each plot and cut off every plant outside of the cord.

5. The crops should be cut as soon as they ripen, and, when dry, weighed and threshed by flail immediately on being brought in from the heat of the sun.

Summary Results.

Varieties.	Comparative average value of varieties as stated by Experimenters.	Average yield per acre.	
		Straw.	Grain. (18 tests).
		tons.	bus.
Herison Bearded	100	1.10	13.7
Bart Tremenia	92	1.09	13.2
Wild Goose	76	1.10	13.1
Wellman Fife	81	1.06	12.8
Pringle's Champion	65	1.00	12.0

Eleven varieties of Spring wheat have been used in the co-operative experiments within the past five years. Besides the five varieties enumerated in the foregoing list, the following kinds have been distributed for one or more years: Red Fern, Haynes' Blue Stem, Maintoulin, Rio Grande, Holben's Improved, and McCarlin.

Of the varieties used in the experiments in 1896, the Herison Bearded was imported by the experimental department of the Agricultural College from France; the Bart Tremenia from Sweden; the Pringle's Champion from Germany; the Wellman Fife from the United States, and the Wild Goose variety was obtained in Ontario. Each of these varieties have been grown in the experimental department of the College for at least five years in succession.

CONCLUSIONS.

1. The Herison Bearded variety of Spring wheat gave the largest average yield of grain per acre in twenty-nine co-operative experiments in 1893; in nineteen, in 1894; in thirteen, in 1895; and in eighteen, in 1896.

2. The Herison Bearded was the most popular variety of Spring wheat tested throughout Ontario in 1896.

3. Both the Herison Bearded and the Bart Tremenia varieties of spring wheat gave larger yields of grain per acre than the Wild Goose variety, which is known throughout Ontario to be a good yielder, but a wheat of inferior quality.

4. The yield of spring wheat in the co-operative experiments was lower in 1896 than for several years previous.

5. The Herison Bearded is one of the very best varieties of spring wheat among all those tested at the Agricultural College for eight years in succession. It is a good yielder, weighs well, and gives general satisfaction.

EXPERIMENT No. 12.

Testing Five Leading Varieties of Barley.

For instructions see experiment No. 11.

Summary Results.

Varieties.	Comparative average value of varieties as stated by Experimenters.	Average yield per acre.	
		Straw.	Grain. (28 tests).
Mandscheuri	100	1.38	39.8
Oderbrucker	84	1.33	34.7
California Brewing	61	1.26	29.7
Purple	66	1.40	28.3
Kinna Kulla	48	1.36	25.0

No less than sixteen varieties of Barley have been tested over Ontario in connection with the "Union" work since the spring of 1892. Along with the five varieties grown in 1896, the following eleven sorts make up the sixteen: Common (6-rowed), Hallett's Pedigree, Improved Cheyne, French Chevalier, Hungarian (hulless), Guymalaya (hulless), Highland Chief, Black (hulless) Duckbill, Two-rowed Italian, and Guy Mayle (hulless).

The five choice varieties grown in 1896 were all imported by the Agricultural College a few years ago. They were imported from the following countries: Mandscheuri from Russia; Oderbrucker from Germany; California Brewing and Purple from the United States, and the Kinna Kulla from Sweden. Each of these varieties have been grown in the experimental department of the Agricultural College from four to eight years in succession.

The Mandscheuri, Oderbucker, and California Brewing varieties of barley are all six-rowed, the Kinna Kulla is a two-rowed variety, and the Purple is a hulless variety.

CONCLUSIONS.

1. The Mandscheuri variety of Barley gave the largest average yield of grain per acre in the co-operative experiments for each of the years 1892, 1893, 1894, 1895, and 1896.

2. The six-rowed varieties of Barley have surpassed the two-rowed and the hulless varieties for five years in succession.

3. The Mandscheuri variety of Barley are surpassed by no other variety in seventy-five per cent. of the co-operative experiments over Ontario in 1894, in sixty-four per cent. in 1895, and in sixty-eight per cent. in 1896.

4. The Mandscheuri variety of Barley was the most popular of the five kinds of Barley tested over Ontario in 1896.

EXPERIMENT No. 13.

TESTING FIVE LEADING VARIETIES OF OATS.

For instructions see experiment No. 11.

Summary Results.

Varieties.	Color of grain.	Comparative average value of varieties as stated by Experimenters.	Average yield per acre.	
			Straw.	Grain. (89 tests.)
			tons.	bus.
Oderbucker	white.	88	1.4	56.6
Siberian	white.	100	1.5	56.1
Bavarian	white.	90	1.6	54.4
Joanette	black.	75	1.5	54.3
Poland White	white.	78	1.4	52.2

The following eleven varieties of oats have been distributed for co-operation experiments over Ontario within the past five years: Siberian, Bavarian, Joanette, Poland White, Oderbrucker, White Tartarian, Besthorne, Danebrog, Lincoln, White Schonen, and Golden Giant. The first four of these varieties have been grown at the Agricultural College for eight years in succession, and have been distributed over Ontario for five years in succession.

The Ontario Agricultural College imported the Oderbrucker oats from Germany, the Siberian oats from Russia, the Joanette and the Poland White oats from France, and the Bavarian oats were secured in Ontario. The importations were made in 1889 by securing small quantities of each of these varieties along with over two hundred other varieties of grains. The quantities were increased by sowing the crops obtained from small plots one year upon larger plots the following season.

CONCLUSIONS.

1. The Siberian variety of Oats, which stands second in yield of grain per acre in 1896, gave the largest average yield of grain per acre in 78 experiments conducted in 1895; in 121 experiments, in 1894; in 105 experiments, in 1893; and in 125 experiments, in 1892.

2. The Joanette, which stands fourth in the list of 1896, occupied third place in yield per acre in each of the years 1895, 1894, 1893 and 1892.

3. The Joanette is the shortest strawed variety of oats among those used in this experiment, and is only suited for good strong land.

4. Although the Oderbrucker gave an average of half bushel of oats per acre more than the Siberian in the co-operative experiments of 1896, still, the Siberian was reported by the experimenters as being the best general purpose oat of those under test.

5, The Poland White variety proved to be earlier in maturing than any of the other four varieties of oats.

EXPERIMENT No. 14.

TESTING FOUR LEADING VARIETIES OF PEAS.

For instructions see Experiment No. 11.

Summary Results.

Varieties.	Color of grain.	Comparative average value of varieties as stated by experimenters.	Average yield per acre. Straw.	Average yield per acre. Grain. (73 tests).
			tons.	bus.
Early Britain	brown.	98	1.09	28.5
Chancellor	white.	90	1.06	27.6
Egyptian	white.	60	1.14	27.4
Prussian Blue	blue.	100	1.21	26.7

The Early Britain variety of peas was imported from England and the Chancellor from the United States by the Agricultural College. The Egyptian was imported from Egypt and from the United States. The Prussian Blue peas have been cultivated in Ontario for several years.

Owing to the difference in the size and in the growth of the four varieties of peas, the rate of seeding per acre of each variety was as follows: Chancellor, 2 bushels; Prussian Blue, 2½ bushels; Early Britain, 3½ bushels, and Egyptian, 3½ bushels.

CONCLUSIONS.

1. The Early Britain, which gave the largest yield of grain per acre in the co-operative experiments over Ontario in 1896, stands the highest in yield of grain per acre among thirteen varieties of peas grown at the Agricultural College for six years in succession.

2. Each of the three new varieties of peas which were distributed in 1896 for the first time yielded more than the Prussian Blue variety.

3. The Chancellor is an early variety, which weighs well, and is well suited for rich land.

4. The Prussian Blue variety of peas possesses a long straw, and is apt to grow too much straw on rich land.

EXPERIMENT No. 15.

Testing Six Leading Varieties of Potatoes.

1. Prepare for planting all the potatoes received upon uniform plots of equal size.

2. One row 66 feet long is required for each variety. If the rows are placed side by side, a distance of 30 inches should be allowed between the rows.

3. First count the potatoes, and then cut them in such a way that there will be exactly 66 pieces of each variety.

4. Plant the pieces one foot apart in the row.

5. Count the number of hills of potatoes before digging the crop.

Summary Results.

Varieties.	Table quality, determined immediately after harvesting 100-best.	Percentage of crop marketable.	Average yield per acre. (28 tests).
			bus.
Empire State	100	94	367.8
Pearl of Savoy	96	91	339.7
American Wonder	88	92	316.4
Tonhocks	76	80	268.0
Irish Daisy	57	84	266.6
Burpee's Extra Early	89	84	266.2

Previous to the year 1894 the co-operative experiments with potatoes were conducted by a committee appointed to look after the horticultural work. As the committee on agricultural experiments was in a much better position to take charge of this work, and as it was the desire of the director of the Horticultural Committee to carry on tests with varieties of small fruits, the experiments on potatoes were transferred from the Horticultural Committee to the Committee on Agricultural Experiments.

Besides the six varieties mentioned in the foregoing table, the Summit, Rural New Yorker No. 2, White Star and Freeman varieties of potatoes have been tested in the co-operative experiments within the past three years.

CONCLUSIONS.

1. The Empire State gave the largest average yield of potatoes per acre in the co-operative experiments throughout Ontario in 1894, in 1895, and in 1896. It has also given the highest average yield of potatoes per acre among thirty-nine varieties grown at the Agricultural College for six years in succession.

2. The Empire State and the American Wonder produced a larger percentage of marketable potatoes than either of the four varieties of potatoes included in this experiment for 1896.

3. The Empire State variety of potatoes was reported upon very favorably indeed in regard to table quality, and the Irish Daisy was reported as being very poor in table quality.

4. The Tonhocks and the Burpee's Extra Early varieties of potatoes were the first of the six varieties to reach maturity.

5. There was a difference of over one hundred bushels per acre in the average yield of the best potatoes as compared with the poorest yielding potato in this experiment.

EXPERIMENT No. 16.

Testing Five Leading Varieties of Winter Wheat.

1. Select a portion of uniform soil and mark off five plots, each one square rod. Allow a path three feet wide between each two consecutive plots.

2. Drive stakes at the four corners of each plot.

3. Sow the different varieties upon their respective plots. It is an advantage to run a strong cord around each plot and sow inside the line.

4. After the grain is up three or four inches, again run the cord around each plot and cut off any plants that happen to be outside the line.

Summary Results.

Varieties.	Average yield per acre.	
	Straw.	Grain.
	tons.	bus.
Dawson's Golden Chaff	1.29	26.9
Jones' Winter Fife	1.45	26.4
Pride of Genesee	1.30	25.0
Early Red Clawson	1.27	24.9
Surprise	1.27	23.8
American Bronze	1.31	23.7
Early Genesee Giant	1.20	23.1
Bulgarian	1.20	21.3
Jones' Square Head	1.12	20.2

The nine varieties of winter wheat which were sent out in the autumn of 1895 were divided into two sets, with five varieties in each set, the Dawson's Golden Chaff being used in every set. By having one variety included in all the tests, a basis of comparison was formed by which all the varieties could be compared with one another. The grain was sown at the rate of one and one-third bushels per acre, upon plots exactly uniform in size and shape.

CONCLUSIONS.

1. In average yield of winter wheat per acre Dawson's Golden Chaff stood highest among eleven varieties tested over Ontario in 1893, nine varieties in 1894, nine varieties in 1895, and nine varieties in 1896, also among fifty-three varieties grown at the Agricultural College for five years in succession.

2. In the co-operative experiments for 1896 Dawson's Golden Chaff, Jones' Winter Fife and Pride of Genesee gave the best yields on heavy soils, and Jones' Winter Fife, Dawson's Golden Chaff and Surprise on light soils.

3. Pride of Genesee, Dawson's Golden Chaff and Jones' Winter Fife made the best appearance in the spring of 1896.

4. Early Genesee Giant, Early Red Clawson, Dawson's Golden Chaff and American Bronze possessed the stiffest straw in 1896.

5. Pride of Genesee, Jones' Winter Fife, Bulgarian and American Bronze produced the greatest length of straw.

6. Dawson's Golden Chaff, Bulgarian and Pride of Genesee were the least, and the Surprise, Early Genesee Giant and American Bronze were the most affected by rust.

7. Early Red Clawson and Dawson's Golden Chaff were the first to mature, and the Pride of Genesee, Early Genesee Giant and Bulgarian were the last to mature.

8. Dawson's Golden Chaff, Surprise and Early Red Clawson produced the plumpest grain, and Jones' Winter Fife and American Bronze the most shrunken grain.

9. Dawson's Golden Chaff was decidedly the most popullar variety with the experimenters in each of the past four years, and in 1896 it was chosen by about fifty per cent. of the farmers who sent in full reports as being the best among the varieties tested.

10. Six varieties of winter wheat have been tested over Ontario for three years in succession, with the following average results in bushels of grain per acre: Dawson's Golden Chaff, 31.8; Jones' Winter Fife, 29.2; Early Genesee Giant, 28.5; Early Red Clawson, 28.4; American Bronze, 27.8; Surprise, 27.8, and Bulgarian, 27.2.

11. Reports of successful experiments with winter wheat have been received this season from twenty-seven counties in Ontario, sixteen of which are situated east and eleven west of the City of Guelph.

12. The principal failures in the winter wheat experiments not included in this report were caused by winter killing, grasshoppers, accidents, etc., and in some instances by the experimenters not conductiug the tests in exact accordance with the instructions given.

13. Of the two hundred and eighty-four experimenters who have reported the results of their tests for 1896 only three speak of wishing to discontinue the co-operative experimental work, and much interest has been manifested throughout.

14. Varieties which have given good average results in the experiments at the College for a few years have also given good satisfaction throughout Ontario.

HOW BEST TO INCREASE AND MAINTAIN THE FERTILITY OF THE SOIL

By Prof. Chas. E. Thorne, Director Agricultural Experiment Station, Wooster, Ohio.

As agriculture is the basis of all human industry, and as a prosperous agriculture can only be built upon a fertile soil, it is evident that the maintenance of the fertility of the soil is one of the most important of all economic problems.

That a soil may be speedily reduced in fertility, under an improvident system of husbandry, and that the original fertility of a once fertile soil may be restored, although sometimes slowly and laboriously, are matters of common observation. My recollection goes back to within half a century of the first settlement by the white man in that part of Ohio in which I was raised, and I recall old fields which had been thrown out as exhausted and permitted to grow up in weeds and briars, while new fields were laboriously hewn from the forest; but as the pressure for land became more intense, these old, worn out fields were again brought under the plow, and under a more enlightened husbandry have been made to produce crops equal to those yielded by virgin soil.

The history of British agriculture furnishes a most valuable object lesson on this point: Fleta, written near the close of the 13th century, gives the average yield of wheat in England as 10 to 12 bushels per acre, and the quantity of seed as not less than two bushels. At the end of the 17th century the average yield "on the well-tilled and dressed acre" was 20 bushels, according to a writer of that period. In 1771 Arthur Young estimated the average yield at 3 quarters, or 24 bushels, while the present average is estimated at 28 to 30 bushels. It seems, therefore, that there has been an increase in average yield of about 3 bushels per century.

In Ohio, the average yield for the 20 years, 1850-69, was 11.6 bushels; for the next 20 years it was 13.6 bushels, indicating a rate of increase fully equal to that shown in England.

In England, the increase for the first 5½ centuries at least, must be ascribed altogether to better husbandry, including better tillage, better drainage and larger use of the manure of animals; for it is only within a comparatively recent period that the use of the so-called commercial fertilizers has played any important part in British husbandry. Indeed, a writer in a recent issue of the Journal of the Royal Agricultural Society states that it was rare, even fifteen years ago, to hear such fertilizers spoken of otherwise than unfavorably.

In Ohio also the increase in production must be ascribed chiefly to the same causes which operated in England; for while commercial fertilizers have been used largely in parts of the State for twenty years past, there has been as large an increase in similarly located sections where the dependence was altogether upon animal manures.

Nor are the cases of England and Ohio by any means exceptional. Wherever good husbandry has been followed, and the natural sources of fertility systematically provided for and made use of, there has been no decline in the productiveness of the soil, and lands which have been in cultivation not only for centuries but for milleniums are still yielding harvests equal to or better than those freshly brought under the plow.

It is therefore abundantly proven that the maintenance of fertility by the methods indicated is altogether practicable. The real point at issue is to learn to what extent we may call to our aid the discoveries of modern science, in reducing the cost of and making more effective the empirical methods of our forefathers, or whether we may substitute for these methods others yet more effective.

While we have been disappointed in the expectation, raised by the discoveries of the earlier chemists, that chemical analysis was to be the X ray which should reveal clearly and definitely the plant producting capacity of a given soil, and the food requirements of a given plant, yet it must be conceded that chemistry has done much for us in both these directions, and as we learn to read the revelations of chemistry by the assisting lights of geology and biology, we are slowly and laboriously, but surely, working out the problem of plant nutrition, and it now seems safe to formulate a few general principles as being sufficiently established to justify building upon them a scheme of farm management.

1. The carbon of green-leaved plants is absorbed directly, and practically exclusively, from the atmosphere, through the medium of the foliage. At least the soil supply of carbon is a matter of minor importance.

2. The oxygen of such plants is chiefly absorbed in like manner by the foliage, or taken up by the roots in combination with hydrogen in the form of water, although a minor and comparatively unimportant source of oxygen and hydrogen may be found in the breaking-up of nitrates and ammonia.

3. The nitrogen of such plants is obtained invariably from the soil, either directly, from compounds of nitrogen with oxygen, hydrogen or mineral or organic compounds, such as nitric acid, ammonia, nitrates and humus, or indirectly, through symbiotic growth of micro organisms living in the soil, which have the power of assimilating the free nitrogen of the atmosphere, this symbiotic growth being apparently confined almost altogether to leguminous plants.

4. The mineral constituents of such plants are taken directly from the soil, being absorbed by the roots in the form of solution in water.

5. The ten or more mineral elements found in the ash of plants will be furnished in abundance by practically all soils, provided there be present a sufficient quantity of available phosphoric acid and potash and sometimes also of lime.

6. The various elementary substances found in plants are combined with each other in certain definite proportions, varying for different species, but held within very narrow limits for each species, and the growth of the plant is measured and limited by the least abundant of the various elements required for its growth.

Reducing these principles to their lowest terms, and stating them in general form, we may say that the plant will secure a full supply of carbon, provided other nutrients are furnished; that the supply of oxygen and hydrogen are chiefly dependent upon the water supply; that the supply of nitrogen may be regulated by the use of mineral nitrates or ammonia salts, or the setting up in the soil of those conditions which favor the growth of nitrogen-working micro-organisms, and that, having provided a full nitrogen supply, we may control the growth of the plant by giving or witholding phosphoric acid and potash.

The water supply of plants is a matter of supreme importance, for not only does water comprise three-fourths or more of the actual weight of cultivated plants when growing, but it is the vehicle in which all the mineral and nitrogenous constituents of plant food are carried to their destination. In performance of this function it is constantly passing through the plant, being absorbed by the roots and transpired by the foliage, it being estimated that more than 300 pounds of water must thus pass through the plant for the deposition of a single pound of dry substance in the plant, and thus the question of the maintenance of the water supply, by irrigation in arid regions and by tillage and drainage in all regions, becomes one which cannot be neglected; but as this question relates rather to the utilization, than to the maintenance of fertility I must pass it by with a mere reference.

The nitrogen supply takes rank next to the water supply in importance; for it is this supply which may be most quickly exhausted by an improvident husbandry, and which is the most expensive to replace by artificial methods.

In our fertilizer markets the price demanded for a pound of nitrogen is eighteen to twenty cents or more—two to four times as much as is asked for a pound of phosphoric acid or potash—and as nitrogen is found in larger quantity in most cultivated plants than either phosphoric acid or potash, it will be seen that the cost of furnishing this constituent of plant food in artificial fertilizers must be a serious matter.

To illustrate: a bushel of wheat, with its average proportion of straw, saying nothing of the roots and stubble, contains about two pounds of nitrogen, worth forty cents, at the average price of mixed commercial fertilizers, and potash and phosphoric acid to the value of ten cents more; from which it will be seen that whatever increase in yield we may produce by the use of these fertilizers, at recent prices of wheat and fertilizers respectively, must be very dearly bought, even though every particle of the fertilizing materials applied to the soil be found and appropriated by the plant—something which is, to say the least, very improbable.

On this point the experiments at Rothamsted, that greatest experiment station in the world, have given us most valuable information. In these experiments the wheat under fifty years continuous culture has recovered, under the most favorable conditions, about one-third of the nitrogen applied in the fertilizer. In experiments made by the Ohio station, extending over a much shorter time—seven years instead of fifty—the recovery of nitrogen by wheat in continuous culture has been thirty-six per cent. of that applied. In the case of phosphoric acid and potash the recovery at Rothamsted has been about thirty-one per cent. of each, and in the shorter experiment at the Ohio station about thirteen per cent.

In other words: Instead of being able to produce a bushel of wheat by the addition of two pounds of nitrogen and a pound and two-thirds of phosphoric acid and potash combined—the quantities found by analysis in a bushel of wheat with its straw—it has required about six pounds of nitrogen and three to eight pounds each of phosphoric acid and potash, the whole costing about two dollars.

When I speak on this subject in Ohio I am not permitted to forget that private individuals have been able to make a much better showing for fertilizers than our station;

but it is a singular fact that the experiment stations with their force of trained experimenters and appliances for exact work, all tell practically the same story. All get an increase of crop from the use of properly compounded fertilizers, and when that crop is sufficiently valuable, as, for instance, potatoes at sixty cents per bushel, the increase has paid a handsome profit on the fertilizer; but a bushel of potatoes contains only about one-eighth of a pound of nitrogen and one-fifth of a pound of phosphoric acid and potash, or three and a half cents' worth of all, a fact which altogether changes the status of the case. At sixty cents a bushel we have found a handsome profit in the use of fertilizers on potatoes; at forty cents the money spent for fertilizers has been recovered; but at twenty cents the profit often turns to loss.

When we consider that the plant food in the soil *must* be of very slow solubility in order that it may not at once be washed away by heavy rains, and when we reflect upon the observed fact that when we apply certain forms of soluble plant food, such as superphosphate, for instance, a large portion of it is immediately converted into an insoluble, or very slowly soluble condition, by reactions within the soil, we must see how absurd it is to expect to realize in the growth of a single season, or even in many seasons, the entire quantity of plant food we may apply.

But, accepting the fact, which seems to be demonstrated beyond question, that the entire amount of plant food applied in a fertilizer will not be returned in the crop, the question arises, especially in view of the light which recent discoveries have thrown upon the methods by which the inert nitrogen of the soil is converted into assimilable form, through the agency of nitrifying organisms, and upon the still more interesting problem of the assimilation of free nitrogen through the agency of symbiotic growth, may we not hope to be able to dispense with purchased nitrogen and accomplish the end in view by the growth of leguminous crops and the addition of phosphoric acid and potash only?

The experimental answer to this question involves the culture of crops in rotation and rotations require years for their completion. In our country the most complete experiments in rotative cropping at the present date are those of the Pennsylvania State College Experiment Station, in which corn, oats, wheat and clover are grown in a four course rotation, each crop being represented each season, the corn and wheat crops receiving manure and fertilizers of varying composition. The results of the first twelve years' work in this experiment gave no better proportionate return in money value, from the plots dressed only with the mineral fertilizers than from those which have received nitrogen in addition.

The similar experiments of the Ohio station have not yet gone far enough to justify conclusions, but the results thus far are not encouraging; yet in a shorter rotation of potatoes, wheat and clover, the specially favorable effect of the minerals upon potatoes thus far may lead to a more profitable return.

Of all the work, the world over, bearing upon this question, that in Agdell Field at Rothamsted is the most complete. In this experiment, Swedish turnips, barley, clover or beans, and wheat have been grown in a four course rotation for forty-eight years. Taking the average results of courses two to nine, for the section on which the turnips were fed off on the land, as reported in the Rothamsted Memoranda, we find an average increase in each of eight crops, for 350 pounds of superphosphate, applied to the turnip crop alone, of seven and a half tons of turnips, ten bushels of barley, two bushels of beans, 1,140 pounds of clover hay, eight and an eighth bushels of wheat and 1,700 pounds of straw, this increase carrying about three-fifths as much phosphoric acid as that applied in the fertilizer. If we should value the turnips at $2 per ton, the straw at $3 and the other produce at the average prices for the last five years in Ontario markets, we should have a total value for the increase of about $35, or ten times the cost of the fertilizer, nearly half of which would be found in the turnips.

The wonderful effect produced upon the turnip crop by superphosphate was one of the chief factors in bringing artificial fertilizers into general use in England. The turnip crop, thus fertilized, became the pivotal crop in English agriculture, being fed in connection with the straw from the home grown wheat, barley and beans, and oil cakes imported from America, in the production of the world-renowned English beef and mutton, and in the making of the richest of manures to be returned to the already fertile English soil.

On another plot of this Agdell field a fertilizer has been used containing large quantities of nitrogen and potash, in addition to the same dressing of superphosphate. The result has been an increase of almost double the value of that received from the superphosphate alone; but when the additional cost of the fertilizer is deducted, the net increase is found to be less than that from superphosphate alone.

Here we have a suggestion which I think we may well consider carefully. In such a system of agriculture as that which has hitherto prevailed in England, in which the growing of wheat and of meat and milk-producing animals have been leading features, we should expect the soil eventually to show signs of depletion in phosphoric acid; add to this the observed fact that the manure of the barnyard regularly shows a deficiency of phosphoric acid, as compared with nitrogen and potash, and I think we can readily understand why phosphatic manures should produce a marked effect upon the crop.

Agriculture is much younger in Ohio than in England; but this effect of phosphates is very strongly marked in Ohio, especially in those regions of the state where dairying and wheat growing have been the chief agricultural industries, and this has led to a large consumption of this class of fertilizers in our state; for when the so-called "phosphate" of the fertilizer sack is not a simple superphosphate it is that with the addition of a pinch of so-called "ammonia" and sometimes with another pinch of potash.

In many cases these phosphates have almost displaced the use of barnyard manure; they have generally been used without any intelligent idea of the laws governing their rational use, and many farmers have learned to their cost that the land, after a few years' cropping under phosphates, becomes hard and compact, and it grows yearly more difficult to secure a stand of clover. I fact the abundant supply of phosphoric acid has caused the crops to draw heavily upon the accumulated store of organic nitrogen; the humus has been exhausted from the soil, and clover fails to find the requisite material for successful growth. For while wheat may be grown indefinitely, and even with increasing yields, in a soil exhausted of humus, except that furnished by its own roots, as shown conclusively in the Rothamsted experiments, yet clover must have humus to prosper. This point again is well illustrated at Rothamsted. In Agdell Field, only two crops of clover were secured during the first thirty-two years of the rotation described, although it was sown in nearly every course, and in order to bring a leguminous crop into the rotation, it was necessary to grow beans; but in a rich garden soil on the same farm, clover has been continuously grown for over forty years.

How far this failure of clover may have been due to the exhaustion of the combined nitrogen or mineral constituents within range of the roots, and how far to the exhaustion of the organisms which have been shown by recent research to be necessary for the fixation of free nitrogen by clover is, as Lawes and Gilbert suggest, an unsettled point; the fact remains, however, that the presence of humus seems to be necessary to the existence of these organisms, as well as necessary to the storing of combined nitrogen within the soil.

Another function of humus is shown in the familiar experience that clover is heaved out much worse on soils comparatively destitute of this constituent. This was forcibly illustrated at the Ohio station last winter. A part of the tract, now comprised in the station farm, has been occupied by its owners ever since its reclamation from the forest, and kept in a fair condition, while a part has been occupied by tenants for many years, and farmed on the hand-to-mouth system. Clover was sown on lands of both descriptions in the spring of 1895, and everywhere a good stand was secured, notwithstanding the severe drouth of that summer, but the March freezes of this year almost totally destroyed the clover on the impoverished farms, while a fair stand was left on the well kept land Whether the function of humus in this case is a purely physical one, so altering the texture of the soil that it is less subject to the influences which result in what are called "heaving out," or whether it produces a stronger plant, better able to resist the destructive effect of the frost, does not affect the question at issue. It is probable that both classes of effects are produced.

I have more than once alluded to the function of clover and other legumes in securing supplies of nitrogen, that costliest of all the constitutents of fertility, from sources inaccessible to the cereal crops. Before this audience I do not need to enter into a detailed history of the steps by which modern science has uncovered and revealed to us the methods through which this function is accomplished, but I think we have abundant proof that clover cannot secure all its nitrogen in this manner, but must have a part of its nitrogenous food furnished in some other form If, therefore, we would secure from the clover the full effect of its nitrogen storing function we must surround it with all the conditions necessary to the full exercise of that function.

In some of our experiments in the use of fertilizers on cereal crops grown in rotation with clover, there has been a sufficient gain in the hay crops to make up the losses on the grain crops and pay the cost of the fertilizer. In one test more nitrogen was formed in the increase of crops than was applied in the fertilizers, nearly as much potash, and about one-fifth as much phosphoric acid, more than half the total recovery being found in the hay. In this test the total increase from chemical fertilizers has been much larger than from manure, and yet the fact remains that at the ordinary cost of manure on the farm it has been the cheapest fertilizer for immediate effect, saying nothing of the great difference in residual value.

Reviewing now the points which I have touched upon—for in a half hour's talk it is only possible to barely touch upon a few of the more salient points of this great question—I think we must admit that neither theory nor experimental evidence give any encouragement to the expectation that the fertility of the soil may be economically maintained by the use artificial fertilizers alone, in connection with the growth of the cereal crops which comprise the great bulk of our agriculture, whatever may be said as to the use of such fertilizers in the production of special crops of higher relative value than the cereals.

Both theory, and the great experiments at Rothamsted, suggest the supplementing of the manure of the barnyard by a carrier of phosphoric acid, and the valuable experiments of your Ontario Experimental Farms encourage this method of manuring, but in order to carry out this method it is evident that the keeping of live stock must be extended to the utmost practicable limit.

When, however, I talk upon this question in Ohio, I am met with the assertion that it is impossible to make enough manure to supply the demands of our crops; that the free ranges of the west have overstocked our cattle markets and left no room for Ohio; that the Canadians have cut us out of our market for dairy products; that the abolition of the wool tariff has ruined our sheep industry, and that the hog is a poor manure maker anyway. In view of these complaints, which, I apprehend, are not heard in Ontario, I place before you the following table, showing the number of each of the several kinds of live stock per thousand acres in farms in England, Ontario and Ohio in 1895:

LIVE STOCK PER 1,000 ACRES IN FARMS.

Country.	Millions of acres in farms.	Cattle.	Sheep.	Swine.	Horses.
England	24	186	648	103	49
Ontario	22	98	92	59	29
Ohio	20	63	150	72	40

England, it will be observed, had just twice as many cattle per thousand acres in farms in 1895 as Ontario, and three times as many as Ohio; England, free trade England, had four times as many sheep as Ohio, and seven times as many as Ontario; England had 50 per cent. more hogs than Ohio, and nearly twice as many as Ontario. England had a few more horses than Ohio, and nearly twice as many as Ontario. England and Ontario had more of all kinds of live stock in 1895 than in 1894, Ohio had fewer of all kinds except hogs.

I have already called attention to the increase in yield per acre in England, from a point level with the yield of the virgin soil of Ohio to a present yield more than twice as great as that of Ohio. Fifty years ago wheat sold at fifty to sixty cents per bushel in the interior markets of Ohio; two-year-old cattle at $6 to $7 per head, and sheep at $1 to $1.25 each. In 1895 and the earlier months of 1896 wheat again sold at fifty cents per bushel, but good two-year-old cattle have not in recent years sold at less than $25 to $35 each, or four times the earlier price, while sheep are still double the price of fifty years ago, notwithstanding the great depression in sheep husbandry on our side of the lake.

Surely, then, the outlook for the meat producer is not less hopeful than that of the grower of bread grains, and when we consider the factors of fertility maintenance in the light of our present knowledge, we must conclude that the safe and sure road for the American farmer has been blazed by the cattle growing, weight guessing, beef eating Briton.

And must we confess, then, that science has nothing better to offer the farmer of to-day than the blind guidance of guess-work, which has led the British farmer through centuries of halting, stumbling progress to his present position?

By no means! Science is explaining to us the causes of observed phenomena, and is thus enabling us to walk in clear light where our fathers groped in darkness. For milleniums the farmer had observed the beneficial effect of manure and clover, but it remained for the chemist of this century and the bacteriologist of to-day to show the farmer how to improve the quality of manure by selection of cattle foods; how to preserve the manure from unnecessary waste, and how to supplement and extend its effect by the culture of nitrogen-storing plants and the use of fertilizing minerals and by-products.

If these materials, which science has placed at our disposal, are as yet too costly to be used as a complete substitute for the manure of the barnyard, this is no fault of science. On the contrary, science and invention are every day cheapening the processes of their manufacture and exploitation, and there is good reason to expect them to become each year more economically available to the farmer.

In advocating the use of barnyard manure, however, we must not lose sight of the fact that its fertilizing constituents, as shown by chemical analysis, are not so immediately available to plants as are those of the best forms of chemical fertilizers. This point is well illustrated in the Rothamsted work:

In Broadbalk Field of these experiments, Plot 16 received for thirteen years, 1852-64, an annual dressing of 200 pounds sulphate of potash, 100 pounds each of the sulphates of magnesia and soda, 392 pounds superphosphate and 800 pounds ammonium salts. The average yield for this period was thirty-nine and one-half bushels of grain and 5,220 pounds of straw, the yield of the continuously unfertilized plots during the same period being fifteen and one-half bushels of grain and 1,708 pounds of straw, showing a total immediate increase from the fertilizers of 310 bushels of grain and 45,656 pounds of straw. The fertilizer was then discontinued for nineteen years. Before the end of this period the yield of this plot had sunk to the level of the continuously unfertilized plot, and the total increase during the nineteen years was sixty bushels of grain and 6,517 pounds of straw.

On "Hoos Field" of the same farm barley has been grown continuously during the same period. On Plot 7 of this field, barnyard manure was applied continuously for the twenty years 1852-71, at the rate of fourteen long tons per acre. The average yield for this period was forty-eight and one-quarter bushels of grain and 3,164 pounds of straw per acre on the manured plot, against an average of twenty bushels of grain and 1,316 pounds of straw on the continuously unmanured land, the total increase due to the manure during the twenty years being 566 bushels of grain and 35,560 pounds of straw.

The manure was then discontinued on half of Plot 7, being kept up as before on the other half. For the next twenty years the average yield of the unmanured half was thirty and one-quarter bushels of grain and 1,848 pounds of straw per acre, against a yield on the continuously unmanured land of thirteen and one-quarter bushels of grain and 770 pounds of straw, the total residual increase during this period for the previous twenty years manuring being 341 bushels of grain and 15,400 pounds of straw.

But the residual effect is by no means exhausted, as the crop of 1894, the twenty-third crop since the manure was discontinued, was more than double that on the continuously unmanured land.

Lawes and Gilbert estimate that the fourteen long tons of manure used in these experiments carried to the soil annually about 200 pounds of nitrogen. On the basis of this estimate the following table has been compiled, showing the approximate total quantities of the constituents of fertility applied to the wheat in the chemical manures in thirteen years and to the barley in barnyard manure in twenty years, and recovered in the total increase from each:

FERTILIZING CONSTITUENTS RECOVERED IN INCREASE OF CROP AT ROTHAMSTED.

Fertilizing constituents.	Nitrogen.	Phosphoric acid.	Potash.
	lbs.	lbs.	lbs.
Applied in chemicals	2,496	832	1,300
Recovered in immediate increase	708	221	346
" residual "	123	40	55
" total "	831	261	401
Applied in manure	4,000	2,600	3,400
Recovered in immediate increase	946	352	919
" residual "	476	191	410
" total "	1,422	543	1,329
Percentage recovered in immediate increase—			
From chemicals	28	26	26
" manure	23	13	27
Percentage recovered in total increase—			
From chemicals	33	31	31
" manure	35	22	39

To sum up: My study of the problem under consideration leads me to the following conclusions:

(1) We cannot expect to recover in increase of produce the entire amount of nitrogen, phosphoric acid and potash applied in a fertilizer, any more than we can expect to recover, in animal products, all the protein, carbohydrates and fat given in a feeding stuff; and therefore if such fertilizers are to be used with economy it must be in the production of crops of higher relative value than the cereals.

(2) When the fertilizing constituents of barnyard manure become as costly as those in commercial fertilizers, as, for instance, when such manure is purchased at a high price or is hauled a long distance, its use is no more to be commended than that of commercial fertilizers, unless it shall be demonstrated that manure has a more favorable effect upon clover than chemicals, by encouraging the growth of the nitrogen working micro-organisms of the soil.

(3) So long as the product of stock feeding, whether in meat, wool or dairy products, can be made to pay the cost of the food consumed and the care of the animals, thus leav-

ing no charge against the manure except that of drawing it to the field, it must be regarded as beyond comparison the cheapest source of fertility, since the theoretical value of a ton of manure is from two to three dollars as compared with the cost of commercial fertilizers and its immediate value is not less than one-half to two-thirds that of the best forms of such fertilizers.

(4) I conclude that at present the margin of profit in meat production is not narrower than in cereal production, and that he who cannot produce enough manure to keep up the fertility of the soil must own this inability either to lack of capital to handle the necessary live stock; to inability to personally supervise the management of such stock, or to lack of personal adaptation to such management; for certain it is that the successful handling of live stock, under present conditions, involves a business tact and a scientific training which are not found on every farm, and the attainment of which requires an amount of intellectual labor which too many farmers are unwilling to undergo.

ANNUAL SUPPER.

In the evening following the close of the meetings of the Agricultural and Experimental Union, the annual supper of the officers, students and ex-students was held.

Extracts from the After-dinner Speeches.

President Mills: I am glad to see that the great majority of students who come from the farm return to it. That question is often asked, are you fitting your young men for the professions or for the farm. After examining the statistics of the ex-students, I find that most of the young men who came from the farm have returned to it with a greater interest in farm work, and that many from the city have become successful farmers and horticulturists. Some of our students have gone to the North-west, where farming can be carried on with less capital than in this Province, and when students are not able to able to start here we are glad to have them there.

While our young men are nearly all agriculturists, I am glad to see that some are journalists and editors. Some are special investigators in natural science, twelve or fifteen being in the United States at the present time. I hope that others will follow this line of investigation.

We are endeavoring to advance with the times. Every time you ex-students return you will see evidence of progress; you will see that we are advancing, not retrogressing. And we shall continue to advance so long as we have not only a practical man, but a liberal-minded man as Minister of Agriculture, to second our efforts in every worthy enterprise. The present Minister has certainly done a great deal for this institution, and also a great deal to check strong prejudice against it.

J. J. Ferguson, B. S. A.: Farmers do not understand the object of this institution, which is specially for them; but as they become acquainted with the workings of it, they change their attitude toward it. The testimony of ex-students is far stronger than that of all others. The large number present here to-night is a vast evidence of the nature of the work the College is doing. This is one of the strongest points of evidence that can be brought forward. I have yet to find the student in any part of the country with which I am acquainted, who is not well satisfied with his course taken here. Every student I have met this last two years is loud in his praises of this institution, and of the benefits he received here. Those who manage affairs here have the best interest of the College at heart, but they are not in the same position to bear testimony of the value of the course as are the ex-students. It is the testimony of these that carries weight.

J. B. Reynolds, B. A.: In regard to its educational influence, how can the College be brought before the people? I will speak of two means only by which this may be accomplished. One is through the channel of correspondence and publications, the other is the practical learning of the teaching of the College on the agricultural population. In no other institution be it high school or university, is there any better attainments realized than at this College. Speaking of the influence of the College, I have a splendid object lesson before me. I do not wish to speak in flattery when I say, and you will admit, that this great gathering, most of whom are ex-students, cannot fail to have its effect on the agriculture of the future. I say the influence of this College is a great object lesson in this meeting to-night. Of course while these ex-students speak very modestly of themselves, still we know the influence that they are exerting throughout the country.

I believe the scientific farmer is going to be the farmer of the future. I thoroughly believe, and do not hestitate in making the statement, that if farming is to be made a success in this country it has to be done on a scientific basis. More intensive farming will have to be engaged in. At the present time a farmer who owns one hundred acres and has two sons, sends one to college to prepare him for a profession, simply because he thinks that the two boys cannot gain a livelihood on the hundred acre farm. I believe that the farming of the future will enable both these boys to remain on the farm, for if properly directed each will find ample room for all his energies on the fifty acres.

PROF. J. H. PANTON: To counterbalance low prices and fickle markets, we need improved methods in tilling the soil. We are studying the art of farming more now than we have done in the past. We must work along scientific lines. More cultivation of the soil is necessary now than there used to be. I can remember the time when a person went to the field to cultivate only to kill weeds. Now we find that cultivation not only kills weeds but conserves moisture; and there is always plenty of moisture given to us by kind Providence if we will only conserve it. We also should be careful about getting pure seed, which will also greatly lessen the amount of labor. How often I have samples of grain sent to me by farmers who want to know what weed seeds are in them. If all farmers understood the nature of all these seeds, they would be more careful in the selection of their seed. Therefore, I say, that improved methods of agriculture must be adopted. We must produce an article of much better quality in the future. At one time quality was not taken so much into consideration, but times have changed and men look at quality more than quantity. Whatever we have to sell must be put up in the best possible form, so that it will take the eye. Those who have tried it have found it very satisfactory.

Another thing that has to be taken into consideration is better business methods. Farmers are now becoming more business-like. There was a time when they could be successful with almost any business method; but to-day it is by watching the little things that they attain success. To do this properly exact business methods are necessary.

Besides better methods in business, another step is education. There is more necessity now for educating the farmer than there ever has been. Scientific education is the war cry now. And where is this to be given? We have begun here at the college, and we want more agricultural science in our rural schools. Some of us have worked a little in this direction. If we would introduce something in the way of educating along agricultural lines in the rural and city schools, by the study of botany and chemistry and such sciences, it would cultivate a love for agriculture, and a desire in young men to go further into the science which lays at the foundation of agriculture, which would bring the young men of our province to this institution in far larger numbers.

PROF. C. E. THORNE: Some years ago I had the pleasure of attending the Michigan Agricultural College, and I look back on those few months as being the turning point in my life. I received a likening for study, and it was there I acquired the habit of observation which has been with me all my life through. Let me assure all you young men that the very important line of work which you are following while here will be the principle of your success. Upon this lay your foundation, and you will find your profit in nothing less, and your enjoyment largely increased while carrying on the various kinds of work on the farm.

It has been well said this evening that the agriculture of our day is at a turning point; but when we compare the agriculture of the future with that of the past it is evident that a radical change must take place. In order to be successful, a farmer must have a taste for the work. Let me encourage you therefore in scientific investigation, and in scientific methods of study.

HON. SIDNEY FISHER: I spent twenty-five years of my life on a farm; but it does not seem very long since I was a student myself; but a student under very different conditions and circumstances from those in which you are placed. From my earliest recollections, it was my desire to be a farmer; what put it into my head I cannot tell, except for the fondness for animals. I went to England to college, and there I passed three or four of the happiest years of my life, in one sense, and yet in another they were useless years. I went to college determined to be a farmer. I learned a great deal which I am glad to know; yet at the same time I was very deficient in that eduction which I would have received in these College halls, and received an education which necessarily almost led me into one of the learned professions, instead of leading me to the farm. You have far better opportunities than I had. Young men who wish to become farmers have great advantages in this beautiful Province of Ontario, in which is situated this magnificent institution, which makes Canadians throughout the entire Dominion envy this Province. Here you have practical training and receive a scientific education, such as will be useful to you in after life.

Reference has been made to-night to the Minister of Agriculture for your Province being a practical man. I am glad to know this. We need more of such men in this country. I am pleased with the wonderful progress that this institution has made. When the ex-students return to it, they get ideas which enables them to keep abreast of the times. There has been a great deal of prejudice against men of scientific education. Science is simply knowledge, and can be applied to the practical business of life. Some people think that time spent in the study of scientific agriculture is a waste of time; but the successful men of to-day are those who can bring a scientific education to bear on the practical conditions and circumstances of every-day life. Practical application is absolutely necessary.

It has been said to-night that the conditions of agriculture are changing. In years gone by almost any man could farm. All he had to do was to plow the ground and sow the grain; then wait for the crop. But the soil is not so fertile to-day and the soil requires more careful treatment, and more knowledge in its treatment is absolutely necessary. To-day this College and similar colleges are the sources from which this knowledge must come. Years ago people with educational attainments were very scarce—even people who could keep books and write well were scarce. In later years people have rushed into this employment; and we find that this class of people in our large cities have hard work to make a bare living.

I cannot speak too highly of these Agricultural Colleges, and only wish that we had more of them in other parts of this country. Here you have agriculture taught practically in this beautifully equipped College. It is a new development in comparison with our high schools and universities, but it is only a response to the demands of the people of the country. I hope that the effect of this College will be felt all over the country, and that you will continue to send men out who are well equipped to carry on their life work. For some years I have found that our greatest difficulty in connection with our dairy and agricultural associations is the lack of men to go out and teach our own people. Agriculture is being neglected in our public schools, and our teachers are not capable of teaching it. We cannot have agriculture taught in our public schools until we furnish our teachers with a scientific education, and such institutions as these are the centres where such an education can be given.

HON. JOHN DRYDEN: One of the speakers in his remarks said he came into the room to-night with feelings of gladness and also feelings of jealousy. That remark of his leads me to say that I came into the room to-night with feelings of pride and feelings of jealousy. I do not know that I ever had more pride in my life than when I walked into this room to-night. Dr. Mills has, no doubt, also felt the same feeling. Never before have I evidenced more of the feeling of pride in connection with this institution than I have done to-night.

When I look into the faces of these students and ex-students, the thought comes to me that I am looking into the faces of some of the future statesmen of this country, and this helps me to say what I am going to say.

The reminiscences which we have had to-night, some of which are new to me, were very interesting indeed. Some of these remind us of the struggle which this institution has had in the past. But as this institution exists to-day I am proud of it; proud to think we have such an institution in this beautiful Province. And I am not only proud of it, but I am proud to know that I had some little part in bringing about what you have here to-day.

I am now speaking probably to some students who have never heard my voice before, and I say that I have done everything that it was possible for me to do for this institution. I am proud to know that so many farmers' sons are here taking advantage of the instructions given here, and proud and glad to hear those ex students express their feelings of gladness at the advantages which they have derived from the institution, and their pleasure at seeing the many improvments that are being made.

I think I have feelings of jealousy because I see the advantages that you are deriving here which were not my privilege when I was young. What a use I could have made of the opportunities which you have here. In those days no such advantages could be given to young farmers; but here you can get in two or three years what it has taken me twenty-five or thirty years to acquire by observation and experience. Now, you young men get the advantage of all this at the very beginning. I am glad that it is so, and we shall endeavor to carry on the equipment of the institution, even greater in the future than in the past.

I may say that I understand some of the difficulties that a young man will meet when he leaves college and enters upon his life work; but remember that your work will tell better than words. Show the people that you can do better practical work after receiving a scientific education than you could before.

I have honored this institution in the best way I know how; that is by choosing one of its graduates to take charge of my four hundred acre farm in the county of Ontario. I did it because he is a scientific man, and I am not so much afraid of his success as some of our farmers would be. I know the value of such a course of study as you get here, and have got that knowledge by bitter experience; and, therefore, I am glad to have a man who has both the practical and scientific side of agriculture. He has obtained these at this institution, and has the power to put them into practice. I do not expect that he is going to do everything right; but I am not afraid of his science interfering with his practice.

I urge upon every young man present to take advantage of his opportunities while you are here. Take advantage of all the societies connected with the institution—the literary society, and the Young Men's Christian Association—and I assure you that it will all be a benefit to you in after life.

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