TWENTY-FIFTH ANNUAL REPORT

OF THE

ONTARIO AGRICULTURAL COLLEGE

AND

EXPERIMENTAL FARM

1899.

(*PUBLISHED BY THE ONTARIO DEPARTMENT OF AGRICULTURE, TORONTO.*)

PRINTED BY ORDER OF

THE LEGISLATIVE ASSEMBLY OF ONTARIO.

TORONTO:
WARWICK BRO'S & RUTTER, PRINTERS.
1900.

ONTA

(PUBL

THI

TWENTY-FIFTH ANNUAL REPORT

OF THE

ONTARIO AGRICULTURAL COLLEGE

AND

EXPERIMENTAL FARM

1899.

(*PUBLISHED BY THE ONTARIO DEPARTMENT OF AGRICULTURE, TORONTO.*)

PRINTED BY ORDER OF

THE LEGISLATIVE ASSEMBLY OF ONTARIO.

TORONTO:
WARWICK BRO'S & RUTTER, PRINTERS.
1900.

ONTA

To the Honorabl

Sir,—I have
Agricultural Coll

In this Repo
heads :

TWENTY-FIFTH ANNUAL REPORT

OF THE

ONTARIO AGRICULTURAL COLLEGE

AND

EXPERIMENTAL FARM

FOR THE YEAR 1899.

GUELPH, December 30th, 1899.

To the Honorable JOHN DRYDEN,
Minister of Agriculture:

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

In this Report the work of the year 1899 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, ONTARIO.

HON. JOHN DRYDEN, Toronto, Ont.

Minister of Agriculture.

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

CONTENTS.

PART IX.

PART X.

PART XI.

PART XII.

PART XIII.

PART XIV.

PART I.

REPORT OF THE PRESIDENT.

PRACTICAL EDUCATION.

Before proceeding to report on the special lines of work in which we are engaged, I wish to express in a word my gratification at the rapidly increasing interest which the people of this Province, and I might say of the Dominion, are taking in the subject of *practical* education,—domestic, industrial, and technical. After long and varied experience of scholastic and academic methods, the people are beginning to realize, as President Eliot of Harvard has said, that function and environment should ultimately determine education—that courses of study and methods of training should have reference to the work and surroundings of after-life, and should vary accordingly. Public opinion in this Province has not yet formulated the changes which it desires in the substance and methods of Canadian education; but it has resolutely come to the conclusion that, for economic and other reasons, it would be a mistake to go on educating the rank and file of our boys and girls, from five to sixteen or eighteen years of age, without any direct reference to the domestic duties or principal industries of the Canadian people.

During the past generation we have made rapid progress in education. We have spent large sums of money on schools and colleges, have raised the standard of qualification for teachers, and have endeavored to improve our methods. No doubt we have made real progress, on which we have congratulated ourselves from time to time; but as the scholastic ideal has become more difficult to reach and the scholastic demands on time have increased, our education has drifted farther and farther from the practical realities of every-day life. Of our girls especially, it may be truthfully said that we are educating them as if they were all destined to be teachers or ladies of leisure, with servants to wait on them and do their bidding from the day they leave school.

At length, however, a reaction has set in and we have a strong and rapidly growing demand for a more practical education in all classes of schools,—simple lessons in nature study and practical talks on housekeeping, with a thorough training in sewing, patching, darning, etc., in the public schools; more advanced lessons in nature study, a good course on domestic science, and continued practice in needlework, with suitable instruction in cutting and fitting simple garments in the high schools; and ample provision for manual training and technical education in all the larger centres of population.

These are some of the things which the people of this country need and are beginning to demand. The call has gone forth and the leaders of public opinion are beginning to move. Note the generous action of Sir William McDonald, of Montreal, in starting sample manual training schools in the different provinces of the Dominion, and the speeches of the Hon. G. W. Ross on technical education before the Board of Trade in Toronto and on domestic economy at the opening of the Institute of Domestic Science in Hamilton. Note also the reference to technical education in the speech of the mover of the address in reply to the speech from the throne in our Legislative Assembly a few days ago. We are pleased to see the demand and the first indications of response; and we hope soon to see the stately stepping of some one who is progressive enough, wise enough, and strong enough to crystalize into legal enactments the will of the people in this matter.

Work at the College.

The work at the College has gone on as usual during the past year, nothing specially noteworthy having occurred. Good work has been done in the different departments; and unbounded confidence in the growth and prosperity of the College has been noticed in the institution, among the ex students, and in a rapidly widening circle outside.

The usual number of excursionists under the auspices of the Farmers' Institutes (about 30,000) visited the College in the month of June—a result due, no doubt, to the increasing interest of the farmers in the work of the College, and to the well-known fact that they are made welcome and waited upon by the officers of the institution.

At the meeting of the Experimental Union in December, the 25th anniversary of the College was celebrated with pride and enthusiasm by officers, students, ex-students, and a number of visitors. The President reviewed the history of the College from the beginning to the present time, and a number of prominent men delivered appropriate addresses, including John I. Hobson, Esq., Chairman of the College Board; Hon. Sheriff Drury, ex-Minister of Agriculture; C. C. James, Deputy Minister of Agriculture; and Prof. Robertson, Commissioner of Agriculture for the Dominion. The President's address (which appeared in *The Farmer's Advocate* of the 1st December, 1899) will be found in the report of the Experimental Union for the year.

Attendance of Students.

The attendance of students during the past year has been the largest in the history of the College. In fact, it has been considerably larger than can be accommodated in the present buildings,—237 having registered in the regular course and 129 in the dairy course, or a total of 366. One hundred and three new students have entered for the regular course since the beginning of the present session in September, and the total number in this course has been fifty one in excess of the present dormitory accommodation.

Ages and Religious Denominations.

The limits in age and the average happen to be the same as last year, ranging from 16 to 31 years and averaging 20 years. The dairy students, as usual, were somewhat older. The religious denominations were as follows: *Regular Course*,—87 Methodists, 77 Presbyterians, 30 Episcopalians, 20 Baptists, 8 Roman Catholics, 5 Congregationalists, 3 Disciples, 2 Christian Association, 2 Christadelphians, 1 Mennonite, 1 Greek Orthodox, and 1 Friend; *Dairy Course*,—64 Methodists, 30 Presbyterians, 17 Episcopalians, 7 Baptists, 4 Roman Catholics, 2 Congregationalists, 2 Lutherans, 1 Salvation Army, 1 Plymouth Brother, and 1 Evangelical.

Analysis of College Roll (*General Course*).

(1) From Ontario.

Algoma	1	Middlesex	10
Brant	4	Norfolk	1
Bruce	1	Northumberland	1
Carleton	6	Ontario	5
Dufferin	4	Oxford	9
Dundas	7	Parry Sound	2
Durham	2	Peel	2
Elgin	3	Perth	5
Essex	1	Peterboro'	4
Frontenac	1	Prescott	2
Glengarry	2	Prince Edward	2
Grenville	1	Renfrew	2
Grey	2	Russell	1
Haldimand	3	Simcoe	9
Halton	4	Stormont	2
Hastings	3	Victoria	3
Huron	12	Waterloo	6
Kent	1	Welland	6
Lambton	4	Wellington	14
Lanark	3	Wentworth	6
Leeds	2	York	13
Lennox	3	Toronto	12
Lincoln	7		197
Manitoulin Island	2		
Muskoka	1		

(2) From Other Provinces of the Dominion.

Manitoba	1	Prince Edward Island	3
Northwest Territories	1	Quebec	5
New Brunswick	2		22
Nova Scotia	7		
British Columbia	3		

(3) From Other Countries.

Bermuda	1	Jamaica	3
England	8	Asia Minor	1
Scotland	2		
United States	3		18

Total in general course. 237

The full College roll will be found with the appendices to this report, published in a separate volume.

County Students.

By an Act of the Legislature, each county council in the Province has power to send one student free of tuition. Of those on the roll in 1899, sixty were nominated by county councils, and as a consequence were exempt from the payment of tuition fees. The counties and districts which exercised the power of nomination last year (42 in number) were the following: Addington, Algoma, Brant, Carleton, Dufferin, Dundas, Durham, Elgin, Essex, Glengarry, Grenville, Grey, Haldimand, Halton, Hastings, Huron, Lambton, Lanark, Lennox, Lincoln, Middlesex, Muskoka, Norfolk, Northumberland, Ontario, Oxford, Parry Sound, Peel, Perth, Peterboro', Prescott, Prince Edward, Renfrew, Simcoe, Stormont, Victoria, Waterloo, Welland, Wellington, Wentworth, and York.

New Buildings and Alterations Needed.

The increase in the attendance of students has created the necessity for new buildings and some alterations in the buildings already provided. There is urgent need of about thirty additional dormitories; the physical laboratory has become too small for practical work with students in soil investigations and other branches of physical research; and the laboratory used in common by the horticulturist and biologist is now wholly inadequate for the work of the biological department in botany, zoology, and entomology. The classes are so large that they cannot be properly handled in either of these laboratories. Hence the repetition of last year's request for increased accommodation.

What has been suggested is as follows:

(1) That the portion of the main building now occupied by the library, library annex, and museum be converted into dormitories, which would furnish rooms for 45 additional students.

(2) That a large new building, costing about $35,000, be erected for the library, reading-room, a medium-sized assembly-room, the museum and geological cases, and an insectary for practical work in entomology, with class-room, offices, and laboratories for the department of biology, the library wing being fire-proof.

This would provide all that is required at present, except an addition to the physical laboratory.

English.

Most of the students at the college—and some of the very best—enter without having learned to speak and write good English. Hence we are still compelled to give a considerable amount of time to that subject. We do not aim at elegance, but we make an honest effort to secure clearness, correctness, and strength. We hope the time may soon come when we can insist on a higher standard for matriculation.

Physics.

The work in physics is increasing from year to year. In fact there is an unlimited field for investigation in soil physics; and our professor of physics has commenced several important experiments, but having to teach and work in the laboratory six or seven hours a day, he has very little time for systematic, continuous research. Hence I have recommended the appointment of a fellow in the department.

Biology and Geology.

We do not attempt an extensive course in geology, but a general outline of the subject, with special emphasis on Canadian geology, economic minerals, and soil formation. The lectures on this subject are given by the professor of biology.

In botany the course is broad and thorough, taking in all the branches of the subject and giving special attention to economic plants, noxious weeds, and injurious fungi, such as smut, rust, apple scab, etc. In zoology an outline of the animal kingdom is given, with more or less laboratory practice; and the work on entomology deals as thoroughly as possible with the beneficial and injurious insects found in the Province.

During the past year the work in the department, under Prof. Lochhead and his assistant, M. W. Doherty, has gone on as usual, notwithstanding the lack of room and the fact that Prof. Lochhead had to give a considerable amount of time to outside investigation of the San José Scale and to the fumigation of nursery stock in the Province.

Chemistry.

In addition to the ordinary class room and laboratory instruction, work has been done on two or three practical lines:

(1) An experiment in growing certain varieties of grain in cylinders, to test the relative effects of surface and subsoil watering, with a view to determining the importance of frequent surface cultivation for the preservation of soil moisture in dry weather.

(2) The analysis of sugar beets from different parts of the Province, in order, if possible, to settle the question as to the feasibility of manufacturing beet-root sugar in Ontario.

(3) The analysis of varieties of wheat and the making of bread therefrom, to determine the gluten content and actual value of each variety from the baker's standpoint.

(4) Digestion experiments, to determine the feeding value of Lucerne, cut at different stages of maturity. The results of these experiments will be found in a bulletin on Lucerne prepared and sent to the Department of Agriculture a short time ago by Robert Harcourt, the Assistant Chemist.

An account of these experiments, excepting the last, will be found in Dr. Shuttleworth's report (Part V of this volume), and also a description of a very valuable invention made by Dr. Shuttleworth while in Germany, whereby much more accurate and reliable analyses of plants of all kinds can be made than were possible with the apparatus previously used.

Veterinary Science.

Our veterinary department furnishes a good course of instruction, with considerable practice in the examination of horses for blemishes, the diagnosis of disease, and the administering of medicine. The work in this department during the past year has been much the same as usual; and the only thing specially noteworthy is that some of the time hitherto devoted to veterinary anatomy has been transferred to horse-judging; and the change in this respect has proved a popular one among the students, because they think it will assist them in determining the value of horses for their own use and in judging at the local fairs and exhibitions.

An account of the year's work and of the treatment of certain ailments among the live stock will be found in Part VI of this volume.

Dairy Department.

An extra course of three weeks in butter-making was given in the dairy school last year. The course began on the 1st December and was intended for makers throughout the Province, students in the regular college course, and others who could not attend during the longer session of twelve weeks, commencing on the 4th of January. This extra course was very well patronized, and the attendance at the school for the year was larger than usual, amounting to a total of 129.

During the remaining eight months of the year (when the school was closed), a considerable amount of experimental work in butter-making and cheesemaking was done, with special attention to the curing of cheese at different temperatures. For a full account of the work, see Part VII of this report.

Farm Department.

Some of the crops on the college farm were not so good as usual last year. The fall wheat was a complete failure, having been winter-killed to such an extent that scarcely a stalk was left. The other crops were fair, but not so heavy as in some previous years. Consequently the amount of feed for farm stock is somewhat less than was expected,—a circumstance which will be felt more than at other times, owing to the fact that we had not the usual sale of surplus stock last fall.

To our great regret, Mr. Wm. Rennie resigned his position as Superintendent of the farm 1st of October last. Having spent exactly six years at the college, and having in that time had an opportunity to fence most of the farm, clear up the broken portions, and illustrate his methods of cleaning and cultivating land, he decided to retire from the position, which he had found to be one constant anxiety, much labor, and great responsibility. During Mr. Rennie's stay with us he revolutionized the college farm, having cleaned it, improved its appearance, and increased its fertility; and, now that he is gone, I may be permitted to say that William Rennie is one of the very best cultivators of the soil to be found in this or any other country, and one of the most pushing and faithful workers I have ever met, devoting himself late and early, with untiring energy, to the duties of his position—never doing anything to glorify William Rennie but always willing to incur unpopularity, if need be, in the faithful and unflinching discharge of his duty. May he enjoy his well-earned repose!

As a young man, G. E. Day, B.S.A., discharged the duties of Professor of Agriculture and Experimental Feeder; and now, after time for development and more extended experience. he has taken entire charge of the Department of Agriculture (lectures, farm management, and experimental feeding), and it is hoped that he may be able to carry on successfully the work so well begun by Mr. Rennie.

For an account of the experiments in feeding cattle, sheep, and swine, see Part VIII.

Horticulture.

The scope of the work in the Horticultural Department has been enlarged a good deal within the last few years. The orchards and small fruit plantations have been considerably extended and many variety tests have been made, including raspberries, blackberries, currants, gooseberries, strawberries, tomatoes, and a number of ornamental plants, especially geraniums and coleus.

The greenhouse branch, I need scarcely say, is one of the strong arms of the department. It furnishes the means of practical instruction in botany and horticulture during the winter months—almost the only months which we have for the purpose, as the farmers of the Province cannot spare their sons during the spring and summer months, when there are plenty of plants outside. If we could get our students in spring and summer, we should not need more than one or two greenhouses; but as it is we have to incur the expense of keeping up a full set of houses.

For an account of the work and experiments in the department, see Part IX.

Bacteriology.

By permission of the Minister of Agriculture, the Professor of Bacteriology went to Europe last summer to pursue certain lines of investigation further than was possibly in this country, intending to learn the methods and do a certain amount of work in the bacteriological laboratories in England (London and Cambridge), Switzerland, Denmark, Germany, Austria, France, and Italy. In his absence, the work was taken charge of by Malcolm N. Ross, B.S.A., fellow in the department, and was kept well in hand until Mr. Ross suddenly enlisted and left with the first section of the second contingent for

South Africa. Since Mr. Ross's departure, the laboratory (with the manufacture of tuberculin, etc.) has been in charge of Dr. E. W. Hammond, who came to us highly recommended by Prof. Adami, of McGill University.

During the year, Mr. Ross has spent a good deal of time on the investigation of roup in fowl, the bacteriology of cheese-curing, starters for cheese-making and butter-making, the causes of bitter milk, gassy curd, etc., and has given the results of his work in Part X of this report.

Field Experiments.

The work in field experiments at the College and throughout the Province has been carried on vigorously during the year. We have about forty-four acres devoted to testing of varieties of grain, corn, roots, potatoes, grasses, clovers, forage plants, fodder mixtures, etc., and to experiments in the selection of seeds, date of seeding, methods of cultivation, kinds of manure, and other things bearing on questions which arise from time to time among the farmers of the Province.

The work on the College experimental grounds is carried out very systematically, and the varieties which give the best results in tests of five or six years' duration at the College are sent out by the Experimentalist to be further tested by ex-students and others throughout the Province. Last year 3,845 co-operative experimenters, with 12,035 plots, assisted in this work—some in every county in the Province. The counties which sent the greatest number of satisfactory reports were the following:

Western Ontario—Grey, Huron, Bruce, Middlesex. *Central Ontario*—Simcoe, Ontario, Muskoka, Parry Sound District. *Eastern Ontario*—Hastings, Renfrew, Prince Edward, and Carleton.

For a full account of the work in the department, see the Report of the Experimental Union for 1899 and Part XI. of this report.

Poultry.

The continuity of the work in the Poultry Department was interfered with to some extent by a change in the management last spring. The present manager, W. R. Graham, B.S.A., entered on his duties on April 17th, when it was too late to control the hatch of early chickens for the year. Consequently he is not wholly responsible for the results of the year's operations; and it is due to him to say that the overdraft for the purchase of stock, etc., was not on account of purchases made by him.

Since Mr. Graham took charge he has given a good deal of attention to practical experiments in egg production, the preservation of eggs, the use of the cramming machine and the rearing, feeding and dressing of birds for home and foreign markets; and in order to assist him in his efforts to give the work of the department a distinctively practical bearing, we have erected a cheap but commodious incubator and brooder house for hatching and rearing early chickens to be fed for the British market.

For a brief account of the work done in the department during the last eight months, see Part XII. of this report.

Bee-Keeping.

Arrangements for lectures and experimental work in apiculture were made for 1899 as for some years past, but on the 22nd July Mr. R. F. Holtermann, who has had charge of the work, sent in his resignation, informing us of his decision to give up business and at once engage in evangelistic work. It was then too late to plan or undertake new experiments, and as a consequence we have to report only a brief account of the lectures as given by the new lecturer, Mr. H. R. Rowsom, in Part XIII. of this volume.

Gymnastic and Military Drill.

Most of our students devote a short time to gymnastic exercises during portions of the fall and winter terms. None of them are required to take military drill, but for years

past a considerable number have voluntarily taken a somewhat thorough course of training in rifle and battery practice, and I think the effect on their physique, manners, and general bearing has been clearly beneficial.

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, and nine of them were successful. A fair proportion of first and second year students gained a respectable standing in our College examinations; but the percentage of failures is still very large, resulting in some cases from idleness, but in most instances from a lack of early training in the elementary branches of an English education.

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

Bachelors of the Science of Agriculture.

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

Buchanan, J.	Hensall, Huron, Ont.
High, A. M.	Jordan Station, Lincoln, Ont.
Hutt, W. N	Southend, Welland, Ont.
Jarvis, C. D	Guelph, Wellington, Ont.
Mallory, F. R.	Frankford, Hastings, Ont.
Marshall, F. R.	Westbrook, Frontenac, Ont.
Murdoch, G. H.	Bobcaygeon, Victoria, Ont.
Price, W. J	Marsville, Dufferin; Ont.
Raynor, M	Rose Hall, Prince Edward, Ont.

Recipients of Associated Diplomas.

*Brokovski, A. J	Battleford, N. W. T.
Crerar, A. H	Molesworth, Perth, Ont.
Crow, J. W	Ridgeville, Welland, Ont.
Fawell, L. A	DeCewsville, Haldimand, Ont.
Goble, F. W	Woodstock, Oxford, Ont.
Hutchison, J. R	Escott, Leeds, Ont.
Hutton, G	Easton's Corners, Grenville, Ont.
Ketchen, J. B	Brooklin, Ontario, Ont.
Kidd, C	Cookstown, Simcoe, Ont.
§Lewis, E. R	Burford, Brant, Ont.
Linklater, W	Stratford, Perth, Ont.
McCarthy, J. D	Norwood, Peterboro', Ont.
McIntyre, G. A	Renfrew, Renfrew, Ont.
McMillan, E. J	New Haven, P.E.I.
Mortureux, C. E.M	Quebec, Quebec.
Peters, C. R	Elmhurst, N.B.
‡Reid, R. H	Reaboro, Victoria. Ont.
Robertson, J. A	Blantyre, Grey, Ont.
Semple, W. C	Tottenham, Simcoe, Ont.
Stewart, A	Ivan, Middlesex, Ont.
§Vanatter, P. O	Ballinafad, Wellington, Ont.
†Wilson, R	Fordwich, Huron, Ont.

* To take a supplemental examination in Chemisty.
§ " " " Literature
‡ " " " Chemistry and Entomology.
† " " " Physics.

First-Class Men.

The work of the College is divided into four departments; and all candidates who obtain 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 1899, arranged alphabetically:

First Year.

Harris, G. S., Toronto, Ont., in two departments; Natural Science and Mathematics.
Mills, P. G., Sussex, N.B., in one department; Mathematics.
Murray, J., Avening, Ont., in one department; Mathematics.
Pickett, B. S, Vittoria, Ont., in three departments; Natural Science, English, and Mathematics.
Russell, J. McK., Freeman, Ont., in three departments; Natural Science, English, and Mathematics.

Second Year.

Linklater, W., Stratford, Ont., in three departments; Agriculture and Live Stock, Natural Science, and English and Mathematics.
McMillan, E. J., New Haven, P.E I., in three departments; Agriculture and Live Stock, Natural Science, and English and Mathematics.
Putnam, G. A., Guelph, Ont, in one department; English and Mathematics.
Robertson, J. A., Blantyre, Ont., in one department; Natural Science.

Scholarships.

Scholarships of $20 each in money were awarded for groups of subjects in first year work as follows:

Highest standing, with a minimum of 40 per cent. of the marks for each subject and an aggregate of 75 per cent. of the total number of marks allotted to the subjects in the group—

I. Agriculture, dairying, veterinary science, and poultry.—*Not awarded.*
II. Botany, bee-keeping, and horticulture.—*J. McK. Russell.*
III. Physics, chemistry, geology, and zoology.—*B. S. Pickett.*
IV. English literature, mathematics, book-keeping, and drawing.—*J. Murray.*

Prizes.

Prizes were given as follows:

Essay on "Farm Hygiene"—$10 in books to *C. E. M. Mortureux.*

First place in general proficiency on first and second year work, theory and practice—$10 in books to *E. J. McMillan.*

Highest standing in general proficiency, with first class honors in one department, at University Examinations for B.S.A. degree—$10 in books to *W. J. Price.*

Cost of Agricultural Colleges.

In my report of last year, I ventured to state and undertook to prove that a strong and well equipped agricultural college requires a larger expenditure on capital and maintenance accounts than an equally strong and aggressive arts college or university. I think there can be no doubt about the correctness of the statement, and my reason for referring to the matter again is that I find some of our legislators still inclined to compare us in work and expenditure with the high school rather than with the arts college or university—I say "arts," because nearly everything done in Canadian universities beyond what is covered by the word "arts," is provided for without charge on university funds.

After years of observation, the leading states of the American Union are gradually coming to the same conclusion regarding the relative needs of agricultural and arts colleges. I could quote a score or more in support of my contention; but I shall refer to only three or four:

Agricultural College of the State of Wisconsin—

Annual expenditure, apart from erection of buildings	$60,000
Amount of salaries paid annually for a portion of the course.	28,000

Instruction in English, mathematics, and the natural sciences being furnished free by the State University at the same place:

Agricultural and Mechanical College of Iowa—

Annual expenditure, apart from buildings	$100,000
Annual salary bill	50,000

Four of the principal buildings cost as follows: Main building, $80,000; Agricultural Hall, $45,000; Morrill Hall, $38,000; and Margaret Hall, $50,000—nearly paid for by direct taxation. This was prior to January, 1899; and the following information, received a few days ago from a member of the staff of that institution, indicates the present attitude of the State Legislature:

"Our Legislature has been very liberal with us this year, much more so than with the State University; and, as it may interest you, I may say that they have passed a tax levy by which we get one-tenth of a mill on all taxes raised in the State for a period of five years, which gives us about $53,000 a year. They limited the maximum under this head to about $55,000 a year. In addition to this, we are getting for support and repairs, $31,500, for two years, and this will likely be increased. The buildings provided for are—engineering, $75,000; horse barn, $7,500; President's house, $7,500; and for the purchase of stock, $10,000"—all this for a college that has a regular income of $100,000 a year.

Agricultural and Mechanical College of Michigan—

Annual expenditure, apart from buildings	$108,900
Annual salary bill	42,500

This institution has a large number of expensive buildings and is still adding to its equipment. The State Legislature gave it $95,000 for a ladies' building last year.

The Legislature of Minnesota is still more liberal in voting money for its Agricultural College; but I must not occupy space with further quotation of figures.

Ontario Agricultural College and Experimental Farm—

Total maintenance expenditure of all departments of College, Farm, Dairy School, and Experimental Station	$57,433 56
Salary bill (included in total)	25,038 00

Financial Statement.

No profit and loss statement for the Farm Proper has been made out, because there was a change of superintendents on the 1st October, and we had not an opportunity to bring the Superintendent and Ex Superintendent together to make out such a statement. In the statement on the following pages I give the results of only the cash transactions for the year.

Ontario Agricultural College,
Guelph, December 30th, 1899.

JAMES MILLS,
President.

FINANCIAL STATEMENT FOR 1899.

I. COLLEGE EXPENDITURE.

(a) *College maintenance.*

1. *Salaries and wages*	$21,090 38	
2. *Food*:		
Meat, fish, and fowl	4,946 09	
Bread and biscuit	917 54	
Groceries, butter and fruit	5,039 57	
3. *Household expenses*:		
Laundry, soap, and cleaning	125 45	
Women servants' wages	1,907 61	
4. *Business department*:		
Advertising, printing, postage, and stationery	1,247 88	
5. *Miscellaneous*:		
Maintenance of chemical laboratory	367 29	
" physical laboratory	246 84	
" biological laboratory	244 35	
" bacteriological laboratory	318 63	
Library and reading room, books, papers, and periodicals	1,091 82	
Scholarships	100 00	
School assessment	140 40	
Unenumerated	478 34	
		$38,262 19

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

Furniture and furnishings	$867 08	
Repairs and alterations	1,254 29	
Fuel	3,155 91	
Light	1,056 23	
Sewage disposal	394 23	
		6,727 74
		44,989 93

College Revenue.

Fees	$ 2,336 45	
Balance on board accounts after deducting allowances for labor	6,086 78	
Gas used by students in laboratories	100 00	
Supplemental examinations	20 00	
Analysis of soil and water in chemical laboratory	25 00	
Chemicals and breakage in chemical laboratory	67 11	
Breakage in physical laboratory	7 85	
" bacteriological laboratory	10 10	
Refund of books lost by students	5 00	
Sale of oil to other departments	46 71	
" tuberculin	11 45	
" starters	2 30	
" old horse	32 00	
" scrap iron	6 95	
Contingencies—fines, breakage, etc	157 91	
		8,915 61
Net expenditure of College for year		$36,074 32

II. FARM EXPENDITURE.

(a) *Farm Proper.*

1. *Permanent improvements*—fencing, new water basins in stable, etc		$218 49
2. *Farm maintenance*:		
Salary of Superintendent (9 months)	900 00	
Wages of foreman and men	2,987 31	
Purchase of live stock—steers for feeding, etc.....	1,749 95	
Maintenance of stock	539 75	
Seed	181 70	
Binding twine	31 88	
Repairs and alterations (blacksmithing, etc.)	389 12	
Furniture and furnishings	185 97	
Tools and implements	95 66	
Advertising, printing, postage, and stationery	61 60	
Fuel and light	26 76	
Contingencies	121 77	
		7,271 47
		7,489 96

Cash Revenue of Farm Proper.

Sales of cattle:		
24 steers—34,400 lbs. @ $5.50	$1,892 00	
3 bulls—$87, $77, $42	206 00	
5 grade cows—2 at $40, 2 at $30 50, 1 at $50.....	191 00	
6 " calves—4 at $1 50, 1 at $2, 1 at $5	13 00	
8 pure bred calves (sale of 1898)	370 25	
Sales of pigs:		
7 pigs—1,615 lbs. at $5.00.....	80 75	
8 " 1,840 " 4.65.....	85 56	
6 " 1,015 " 4.10.....	41 61	
21 " 3,975 " 4.00	159 00	
6 " 1,232 " 3.90.....	48 04	
3 " 631 " 3.75.....	23 66	
1 " 235 " 3.50.....	8 22	
8 " 2,793 " 2.75.....	76 80	
11 old boars	19 97	
41 pigs (sale of 1898).....	437 05	
Sales of sheep—25 sheep and lambs at $3 to $12	172 35	
" wheat—50 bush. at 65c.....	32 50	
" " 169½ " 66c.....	111 87	
" " 53.23 " 68c.....	36 28	
" " 190¾ " 69c.....	131 62	
" barley—202½ " 65c,40 bags at 20c,25 bags at 10c	142 15	
" oats—142.21 " 50c,31 bags at 20c,33 bags at 10c	80 80	
" peas—56.34 " 80c, 14 bags at 20c, 5 bags at 10c	48 55	
" potatoes—78 19 " 80c,18 bags at 20c,22 bags at 10c	68 45	
" wool—202 lbs. (unwashed) at 10c	20 20	
" " —230 " " at 12c	27 60	
" milk—2,945 lbs. at 67c. per 100	19 73	
" " —2,154 " at 68c. "	14 65	
" " —2,026 " at 70c. "	14 18	
" " —2,074 quarts at 4c.	82 96	
" hides—3 hides.....	5 63	
" old fence posts and boards.....	7 75	
Rent of pasture	5 00	
Service of animals	168 00	
		$4,843 18

Net expenditure of Farm (allowing nothing for feeding of dairy stock, supplies to College, etc.)		$2,646 78

(b) Field Experiments and Experimental Feeding.

1. *Field Experiments.*

Salary of Director	$1,500 00	
Foreman	400 00	
Teamsters	532 50	
Wages of laborers	2,272 76	
	$4,705 26	
Seeds	344 82	
Manure and special fertilizers	139 80	
Furnishings and repairs (blacksmithing, etc.)	314 54	
Printing, postage, and stationery	126 65	
Tools and implements	69 87	
Purchase of horse	125 00	
Contingencies	19 16	
Net expenditure on field experiments		$5,845 10

2. *Feeding Experiments.*

Stock for feeding	$1,069 80	
Maintenance of stock	741 79	
Experimental feeder	360 00	
Repairs and alterations	32 10	
Postage and stationery	8 00	
Contingencies	8 65	
	$2,220 34	

Revenue.

Sales of cattle—12 steers, 16,915 lbs. @ $5	$845 75		
" pigs— 5 pigs, 882 lbs. @ $4.65	41 00		
" " —37 " 5,409 lbs. @ $4.37½	258 75		
" " — 5 " 840 lbs. @ $4.12½	34 70		
" " —42 " 5,982 lbs. at $4.00	239 28		
" " — 6 " 797 lbs. @ $3.75	29 89		
" " — 5 " 992 lbs. at $3.50	34 73		
" Sheep—13 sheep, 1,570 lbs. @ $5.00	78 50		
		$1,562 60	
Net expenditure on experimental feeding			$657 74

III. DAIRY DEPARTMENT.

(a) Dairy School.

Wages of instructors	$1,518 30	
Engineer (3 months)	90 00	
General helper (3 months)	90 00	
Board of engineer (3 months)	32 14	
Cleaning, painting, repairs, etc	287 01	
Dairy appliances— separators, vats, etc	631 32	
Expenses of cheese and butter judges	6 00	
Expenses inspecting factories	37 65	
Books, magazines, papers, etc	8 50	
Advertising, printing, postage, and stationery	112 95	
Fuel and light	313 97	
Purchase of milk for use in school	3,303 55	
	$6,431 39	

Revenue.

Sales of butter—9,113½ lbs. @ 20 to 23c	$1,990 05	
" cheese—13,192¼ lbs. @ 7 to 10½c	1,059 40	
" skim-milk—19,410 lbs. @ 10c	19 41	
" whey—part make	10 00	
" cream—1½ qts. @ 20c	30	
		$3,079 16
Net expenditure of dairy school		$3,352 23

(*b*) *Experimental Dairy.*

Salary of butter maker		$558 72
" cheese-maker (9 months)		500 00
" engineer and assistant in experimental work (9 mos.)		270 00
" cattleman and assistance in milking		520 37
Temporary assistance		35 00
Purchase of milk for experimental work		1,508 74
Purchase of cows		394 53
Feed and fodder		577 53
Furniture, furnishings, and repairs		901 73
Advertising, printing, postage, and stationery		58 40
Laboratory expenses		17 49
Fuel and light		302 19
Contingencies		267 13
		$5,911 83

Revenue.

Sales of butter—5,100 lbs. @ 14 to 22c	$1,965 64	
" cheese—13,482 lbs. @ 6 to 11½c	1,276 01	
" milk—38,756 lbs. @ 75 to 97c per 100	364 45	
" " —1,566 qts. @ 4c	62 64	
" skim-milk—68,230 @ 10 to 15c per 100	70 64	
" whey—season's make	37 50	
" cream—120 qts. @ 15c	18 00	
" " —96½ qts. @ 20c	19 30	
" cattle—16 cows	440 00	
" calves—2 pure-bred calves	30 00	
" " 12 grade calves	30 95	
" separator	25 00	
" wagon	45 00	
" appliances—3 vats and 2 curd knives	25 75	
		$4,410 88
Net expenditure of experimental dairy		$1,500 95

IV. POULTRY DEPARTMENT.

Salary of manager	$633 33
Temporary assistance	11 40
Purchase of stock	181 10
Feed, etc	235 94
Furnishings, repairs, etc	299 20
Fuel and light	68 94
Contingencies	71 42
	$1,501 33

	Revenue.		
Sales of poultry—106 birds @ 50c to $5	$130 25		
" dressed poultry—9 pairs	5 25		
" " —36 chickens, 130 lbs. @ 8c	10 40		
" eggs for setting—40 $\frac{8}{12}$ doz. @ $1.00	40 70		
" " —61 $\frac{2}{12}$ doz. @ 1.50	91 75		
" eggs—249½ doz. @ 11 to 25c.....	34 45		
		$312 80	
Net expenditure of poultry department.....			$1,188 53

V. HORTICULTURAL DEPARTMENT.

1. *Permanent improvements*—new iron staging in greenhouse			124 35
2. *Maintenance*—			
Salary of head gardener and foreman.....		$650 00	
" assistant gardener and florist		528 00	
" assistant in greenhouses		291 78	
Teamster		348 00	
Wages of laborers.....		1,417 71	
Manure and fertilizers.....		92 01	
Seeds, bulbs, plants, and trees		251 90	
Implements, tools, furnishings, repairs, etc.		613 58	
Fuel and light		407 84	
Contingencies		176 37	
		4,777 19	
	Revenue.		
Sale of berries—454½ boxes @ 4c.	$18 18		
Sale of vegetables.....	2 95		
Incidentals	9 05		
		30 18	
			$4,747 01
Net expenditure of department (nothing having been allowed for fruit, vegetables, etc., supplied to the College).....			$4,871 36

VI. MECHANICAL DEPARTMENT.

Salary of foreman (9 mos.)	$524 97	
Extra carpenter and builder	699 96	
Tools	48 88	
Fuel and light	22 74	
Expenditure of mechanical department.....		$1,296 55

SUMMARY.

Total net expenditure:		
I. College and government buildings.....	$36,074 32	
II. Farm:		
1. Farm proper.....	2,646 78	
2. Field experiments	5,845 10	
3. Experiments in feeding	657 74	
III. Dairy department:		
1. Dairy School	3,352 23	
2. Experimental Dairy	1,500 95	
IV. Poultry Department.....	1,188 53	
V. Hort. Department—gardens, orchards, lawn, arboretum, etc	4,871 36	
VI. Mechanical department	1,296 55	
Total net expenditure in 1899.....		$57,433 56

Total sum voted for 1899, $57,967.

$1,188 53

124 35

$4,747 01

$4,871 36

$1,296 55

57,433 56

PART II.

RESIDENT AND ENGLISH MASTER.

To the President of the Ontario Agricultural College:

SIR,—I beg to submit the following report of my work during the past year.

My chief duties in the residence have been presiding in the dining-hall of the college, superintending students' studies, inspecting the college furniture, and seeing that rules and regulations have been carried out.

Regarding the dining-hall, I am pleased to be able to report that a very fair degree of order and decorum has been maintained, the students generally having shown a disposition to accept advice, and act on the suggestions that have been given from time to time. With the accommodation and service that we have in connection with the boarding department, the conditions are probably as satisfactory as could be expected.

In superintending students' studies, I have visited the students' rooms at least once each evening, and have seen that the study-period has been favourable to close application. With few exceptions, the students have been careful to observe the regulations of the college regarding study. With reference to the effect of systematic study, I may say that many students, who, on entering the college, found it difficult to read and think continuously during the period set apart for study, have developed, through practice, considerable power of application.

Regarding the college furniture, I am glad to be able to report that in only one or two instances have I had to deal with cases of wanton defacement; and that there has been very little damage of any kind. The fact that there has been such slight damage is very gratifying, as the care of the college property has been felt as a great responsibility.

With reference to discipline, I wish to say that a majority of the students have manifested a spirit of self-government which has made it comparatively easy to maintain order in the residence. It has been my constant aim to encourage this spirit of self-government in every way; for I have thought that moral education lies mainly along the line of self-government.

My class-room work comprises lectures in English Grammar, Composition, Mathematics, Drawing, and Book-keeping. In giving instruction in these subjects, I have met from three to four classes each day during the two terms.

Our work in English has been practical in its bearings, only such technical points as seemed indispensible having been introduced. Special attention has been given to syntax as being, from a practical point of view, the most important part of grammatical study. The writing and correction of fortnightly essays, and the punctuation of typical sentences, have also formed an important part of our work in English.

The course in mathematics has also been very practical, comprising the measurement of land, lumber, timber, masonry; mensuration, with special reference to the properties of the triangle and circle, and the determination of the cubical contents of such solid figures as the sphere, the cylinder, prisms, and the cone and pyramid, with their frusta; a pretty thorough drill in vulgar fractions and decimals; and a fairly extensive course in commercial arithmetic.

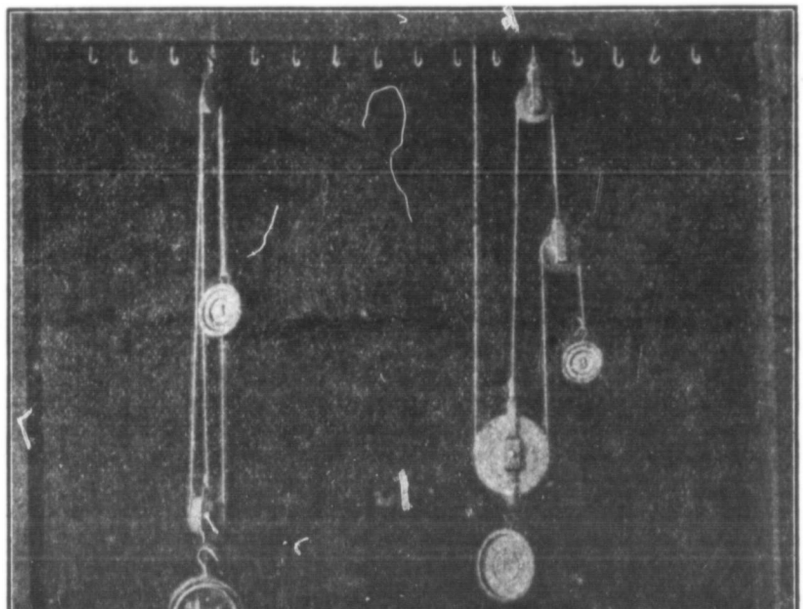
The work in drawing comprises the drawing of plans of barns and outbuidings, some drawings original, others from models; and geometrical drawing, comprising figures, such as might occur in connection with the mechanics of the farm.

The course in book-keeping comprises commercial forms, business correspondence, and the keeping of practical accounts.

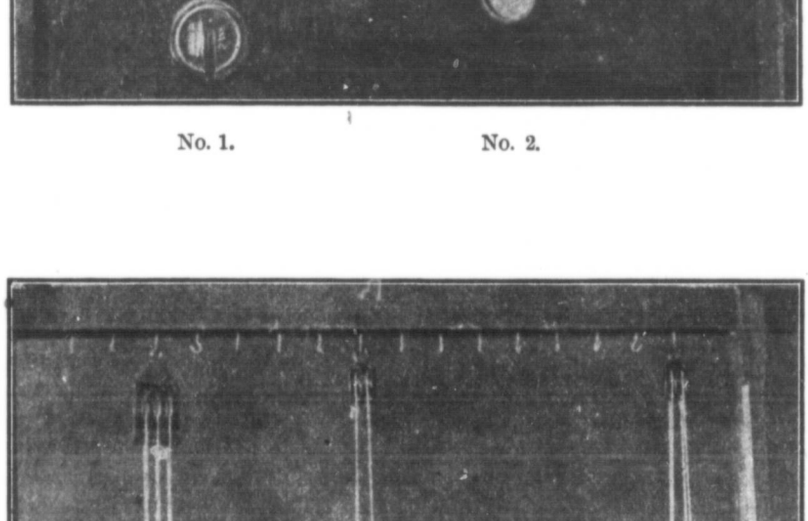
Respectfully submitted,

I. N. BECKSTEDT,
Resident and English Master.

ONTARIO AGRICULTURAL COLLEGE,
GUELPH, Dec. 30th, 1899.



No. 1. No. 2.



No. 3. No. 4.

PART III.

PROFESSOR OF PHYSICS.

To the President of the Ontario Agricultural College:

SIR,—I have the honor to present herewith my report on the work in the departments of English literature and physics.

ENGLISH LITERATURE.

Under this head I have but little to report. The students in all classes continue to show an encouraging interest in the study of English literature for its own sake, for its liberalizing and culturing influences. We are, I think, doing all that should be done in this study. But we are decidedly weak in two regards, one of them coming especially within my department. I refer first to the instruction and practice given in the writing of essays, and secondly to the preparation and delivery of speeches. In the past we have done very little in the former, and nothing in the latter. Much more time than is at present given to practical instruction in composition could profitably be spent on that subject. I try to keep before the minds of the students, as an ultimate object, the preparation of articles and papers for the agricultural press and for institute lectures. But this cannot be done without much practice on their part and much drilling and correcting on the part of the teacher.

As to practice in speaking, the College Literary Society is to be highly commended for the initial step it has taken in this matter. Last year the society offered five prizes for a public contest in oratory. The number of the competitors, and the excellence of the speeches delivered, showed that we have exceedingly good material at the college for the making of good public speakers. It seems to me that the college should second the efforts of the literary society by affording some kind of instruction in this important accomplishment. And the most feasible plan that occurs to me is to establish seminary classes in connection with each department of instruction. Each professor might, say once a month, assign a topic to be discussed at some subsequent lecture period, naming certain members of the class as leaders in the discussion. In that way their powers of expressing might be cultivated in connection with practical themes, and thus we might pave the way for each student to take a similar part in larger spheres and on wider questions.

INSTRUCTION IN PHYSICS.

FIRST YEAR.—*Mechanics* comprises a study of various mechanical appliances, such as pulleys, levers, jacks, and their application to the work of the farm. Often implements are allowed to stand out of doors all the year round for want of space in the implement shed or elsewhere. All the implements on the farm may be stored in a small shed, if the whole space is utilized. By means of proper appliances implements may be hoisted and suspended from the ceiling. By similar means, grain, meat, barrels of fruit, and other heavy things may be handled with ease, and thus many a hard lift saved.

In the instruction in mechanics each student is required to study many different kinds of labor-saving devices, and to find out the advantages and uses of each. This work is done in the winter term, and consists partly of lectures in the class-room but mostly of practical work by the students themselves.

Two handy appliances for raising implements, carcases, etc.—No. 1 consists of a sheaf at the top containing two pulleys, and a single pulley below. It will be seen that one pound balances three pounds: that is, a weight of 300 pounds can be raised by a force of little over 100 pounds. This appliance will raise an object from the floor to the ceiling.

With three separate pulleys on hand, No. 2 is a very convenient arrangement for raising weights a short distance. It will not raise an object more than half way to the ceiling, but is more powerful than No. 1, the advantage being 4 to 1.

No. 3 is a very useful system of pulleys. It consists of two sheaves, each containing 3 pulleys. A single long rope serves. It is powerful—6 to 1—and will raise an object to any desired height.

No. 4 is an excellent model of an arrangement for hoisting large implements to the ceiling of an implement shed. It consists of 2 pairs of sheaves, each sheaf containing 2 pulleys. By this means two men can hoist almost any implement to the ceiling with ease.

SECOND YEAR.—*Surveying*, comprises a six weeks' course in measuring land areas of regular and irregular shapes, chaining over hills and past obstructions, erecting perpendiculars, and taking levels previous to laying drains. This is mainly outside practical work, done in the fields or on the lawn during October and part of November.

The Physics of Liquids and Gases.—This opens the very large question of conveying water from springs, wells and other sources, to farm buildings and to the farm house. The various methods are discussed,—the pump, the windmill, the siphon, the hydraulic ram, and the suitability of each method to the different circumstances that may be found. In this connection I discuss with the class some questions relating to water-conveyance that have been received from farmers in this Province, and in this way we cover, in a practical fashion, a variety of circumstances and the best method of dealing with each.

Also, under this head come some of the most important questions in soil physics, such as the moisture of the soil, soil air, and the relation of drainage, cultivation and fertility to these two essentials. In illustration of these questions, a series of experiments is conducted by each student, one afternoon a week throughout the winter term.

Electricity.—In the winter term the subject of electricity receives some attention, chiefly in the direction of electrical machinery.

THIRD YEAR.—The third year work in this department consists mainly of advanced reading, lectures, and practice along the same direction as in the second year, with additional work in weather and meteorology observations, and a series of experiments in soil temperatures, a sample of which experiments is given later in my report. Also the special students in agriculture make complete examinations of some typical soils, experimenting with a view to determine the behavior of these soils towards water, air, and the heat of the sun, and making a physical analysis to show the amount of sand, clay, and humus, the condition of the humus, whether immediately available for plant food or not, and the texture of the soil generally. And the special students in dairying receive a course in the physics or dairy products, and in the principles of refrigeration, cold storage, and the control of temperature and moisture in the cheese room.

THE INFLUENCE OF SURFACE CULTIVATION ON THE MOISTURE OF THE SOIL.

This work is a continuation of the experiments described in the report of last year. Two plots, to all appearances identical in their conditions, were chosen for the experiment, the surfaces being subjected to different treatments. We took the plots in hand after they had been cultivated and harrowed ready for seeding. The surface of the one plot was first rolled, and throughout the season was kept smooth and compact, while the surface of the other was first carefully loosened and pulverized to the depth of about three inches. This operation on the second plot was repeated through the entire season whenever a crust was observed to have formed. It was noticed particularly that a crust would form frequently when there had been no rain since the previous cultivating. An ordinary dew is sufficient to form a perceptible crust.

Although these plots contained each only one square rod and were side by side, yet we found, on taking the first sample for the determination of moisture, that the subsoils were quite dissimilar, varying from a fairly compact nature to one quite loose and open. As a consequence of this difference in the subsoils, the per cent. of moisture at the beginning of the experiment, determined before the plots were prepared finally, was as follows: No. 1, surface, 26.7 per cent.; subsoil, 18 per cent. No. 2, surface, 25.05 per cent.; subsoil, 15 per cent. On account of this large difference, we at first thought it advisable to choose another locality, but finally decided to continue the work on this spot, and to choose for our cultivated plot No. 2, with the poorer subsoil, and determine to what extent surface cultivation can overcome natural disadvantages.

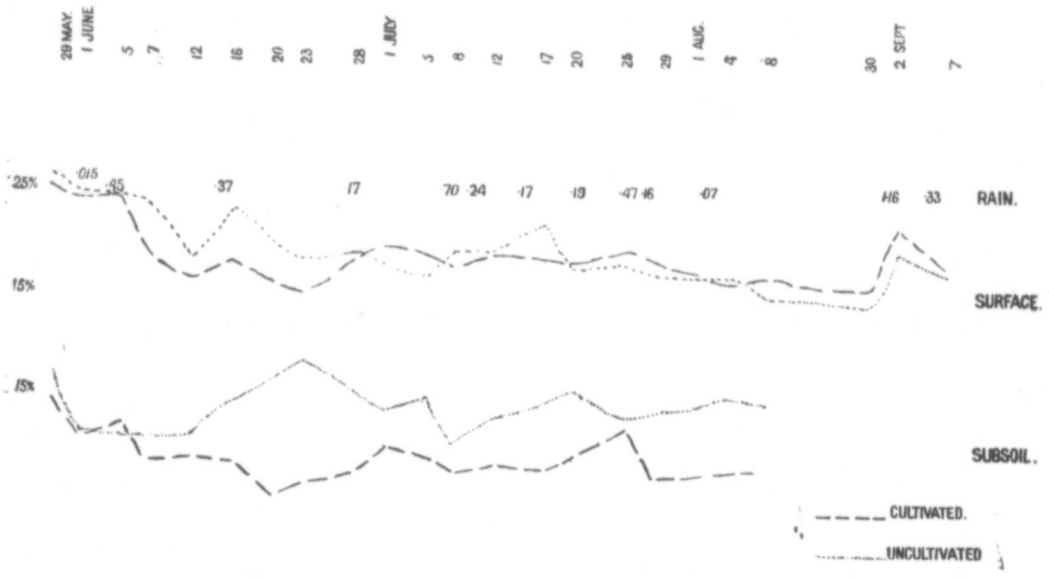
No. 1 plot, then, receives no cultivation after it has first been rolled. The surface is kept firm and smooth. It has a good subsoil, capable of holding a large supply of water, from which the surface will draw in dry weather.

No. 2 plot is cultivated frequently, the object of cultivation being to prevent the formation of a crust and to keep the surface fine and loose, and thus to prevent the water

from below from finding its way to the surface and evaporating. But this plot has a very open, sandy subsoil, with a low water-holding power, and hence the surface of this plot has a much poorer reserve from which to draw in time of drouth.

The results are presented in a graphic form in the accompanying chart. The dotted lines represent the curves of moisture for the surface and subsoil of the uncultivated plot, and the short strokes show the curves for the cultivated plot. The dates on which the determinations were made are recorded in the line across the top, and the second cross-line of figures are the amounts of rainfall for the season.

The lower diagram contains the subsoil curves for the two plots. The per cent. of moisture varies mainly from 5 to 15 per cent., and the superiority of the subsoil of plot No. 2 is quite apparent from the diagram. This subsoil containing a much larger amount of moisture throughout the entire season, on account of its texture, the surface soil above it has a greater reserve from which to draw during a dry spell. This constitutes the superior advantage of plot No. 2, and, other things being equal, plot No. 2 should contain a much larger per cent of moisture, especially in a dry spell, since No. 1 has a very poor reserve supply on which to depend.



Noting now the upper diagram, we observe that No. 2 begins with a higher per cent. of moisture, and keeps the advantage during the month of June. On June 28th a slight rainfall has a depressing effect on the uncultivated plot, while careful cultivation on the other plot succeeds in preventing evaporation, and on July 1st, for the first time, the cultivated plot comes to the fore. Between July 5th and 17th considerable rain falls, and the more compact subsoil belonging to No. 2 helps in preventing this water from leaching away. Consequently, at this period the curve of No. 2 comes again to the top, but it soon loses this advantage, and after August 4th, and all through the extreme drouth of August, the curve of No. 1 stands above the other. Without surface cultivation, the opposite would undoubtedly have been the case.

These results confirm those of last year as to the importance of frequent shallow cultivation during dry weather.

We find also that where the crop has not a good retentive subsoil, from which to draw reserve supplies of moisture in dry weather, surface cultivation will partly or wholly compensate for this deficiency

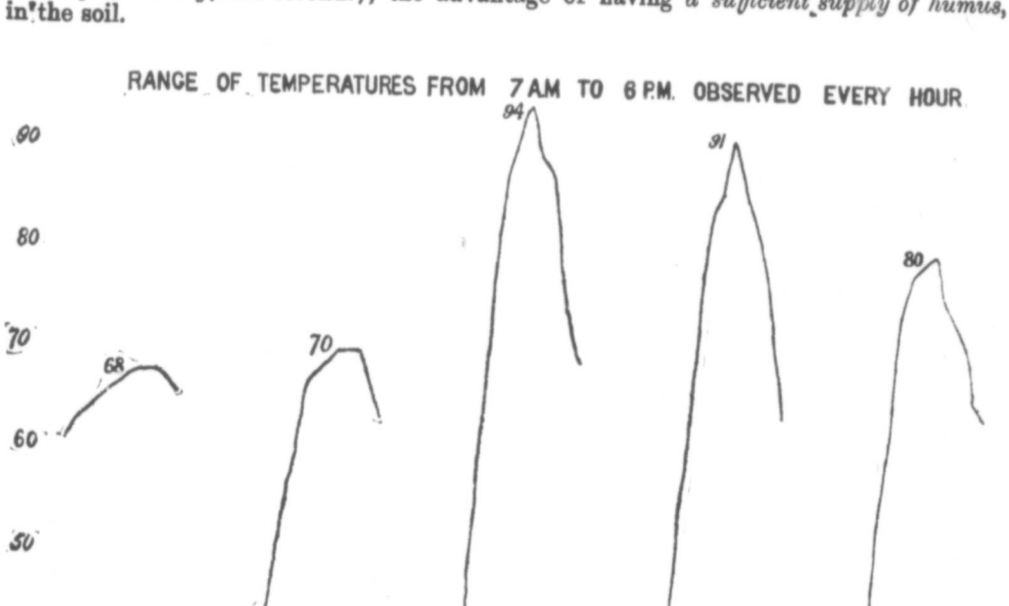
In practicing surface cultivation it is important to stir the soil as soon as possible after a shower, else, the mulch being destroyed by the rain that has fallen, evaporation will go on so rapidly as to leave the soil, in a very short time, drier than before the rain.

Some Observations on Soil Temperatures.

The accompanying chart shows the results of one day's observations on soil temperatures. It is given here for the sake of two practical conclusions that may be drawn from it.

Some soils in large pans were set in the open air, near a large body of water, and the temperatures of the soils, the air, and the water, were observed each hour, beginning at 7 a.m. and concluding at 6 p.m. They were all exposed to the action of the sun's rays. The water rose from 61 to 68, reaching 68 at 2 p.m. It then fell to 66 by 6 p.m. The air rose from 44 to 70, reaching its highest at 2 p.m., and then fell by 6 o'clock to 63.5. The soils all began at the same temperature as the air, namely 44 ; all the soils reached their maximum at one o'clock, and from that time declined rapidly. The highest temperature reached by the dark soil was 94, by the light colored soil 91, and by the wet soil 80.

The practical points illustrated by the above differences are : *first*, the advantage of *thorough draining*, and secondly, the advantage of having *a sufficient supply of humus*, in the soil.



Quick Germination.—Badly drained land remains wet and therefore cold for a long time in the spring. This wetness prevents early seeding, and prevents quick germination after seeding. This year, in connection with our co-operative work, we have demonstrated, in a number of tests, that early sprouting is followed by a better crop than late sprouting. Our chart shows that a dry soil goes from 11 to 14 degrees higher than a wet soil under the same circumstances. Heat is necessary to rapid germination. Hence to insure a *quick germination*, the *surplus water* must be *drained* from the soil in the spring.

Secondly other things being equal, the *dark soil will be warmer* than the light-colored soil. In our diagram, we see that the dark soil rises 3 degrees higher than the other, both being dry. Now the *dark color* is imparted by the *vegetable matter* in the soil, and the light color indicates an absence of humus or vegetable matter. And while humus is added to the soil principally because of the plant food it furnishes, it can be seen that it confers other important benefits in helping to warm the land in the spring, and hence in hastening germination.

Protection from Lightning.

A correspondent calls our attention to the fact that considerable destruction of property is being wrought by lightning, and inquires as to the steps being taken by a community in insuring proper protection from this source of danger.

The relative destruction of property in the country districts is immensely greater than in the towns. Isolated barns and houses, with few or no trees near to avert or divide the force of the stroke, are much more liable to be struck than town buildings. On August 12th, severe thunderstorms passed over various parts of the Province, and the detailed reports of the same, as given in two of the Toronto daily papers, are as follows:

Near Lindsay, barns containing grain from 100 acres struck and burned. Victoria Road, barn and contents struck and burned.

Penetanguishene, lumber yard struck and partially burned.

Alliston, two large barns struck and burned with the year's crops.

Woodstock, barn struck and destroyed; the last of the season's grain just gathered in.

Near Barrie, barn struck and burned.

Near Colwell, residence struck and burned.

These are eight instances of destruction of property by lightning; six of them are barns. As these accounts are all that could be found relating to destruction of property in the two dailies of August 14th, it is fair to assume that 75 per cent. of the buildings struck in two days' storms, over an area including Woodstock, Barrie and Lindsay, are barns very likely isolated, and most if not all of them filled with the season's unthreshed grain.

In addition to these cases, a number of lives were destroyed, of men and cattle, on the same days and by the same agency. The distribution of these fatalities is both serious and interesting.

Near Lindsay, Township of Ops, some cows and sheep killed; Cameron Village, eleven sheep killed.

Near Picton, one person killed and two others severely shocked while in the field drawing in grain.

Near Brougham, one person killed while standing under a tree, seeking shelter from a storm.

In these there are no instances of fatality in a town, but all occurred either in the open field, or near objects which drew down the death-dealing bolt. On the same occasion several trees in the town of Barrie were struck, but there is no account of persons or buildings being struck. The apparent inference from the two events above recorded is that a tree may be a protection, if it is not too close.

Are Barns More Liable to be Struck when Filled than when Empty?

There is good reason for believing, from actual statistics and for other reasons, that barns filled with hay and unthreshed grain afford an easier path for a lightning discharge than empty barns do. According to a report of the United States Weather Bureau, the loss of barn property in the month of August is very much greater than in any other month of the year, although thunderstorms are not much, if any, more prevalent in August than in any other summer month. And August, both in the Northern States and in Canada, is the month of overflowing barns.

Is any Sort of Protection from Lightning Effective?

From the instances given above it may be inferred that buildings grouped together are mutually protective. The neighborhood of trees is also a safeguard if the trees are not so close to the building or person as to cause a side-flash. To be in the neighborhood of a tree may be safety, to be too near it or under it is danger.

Regarding protection of buildings by lightning rods, Sir William Thompson—Lord Kelvin—one of the greatest living authorities on this question, says: "We have strong reason to feel that there is a comfortable degree of security, if not of absolute safety, given to us by lightning conductors made according to the present and orthodox rules."

Professor Oliver Lodge, in his book "Lightning Conductors and Lightning Guards," says: "Almost any conductor is probably better than none, but few or no conductors

are absolute and complete safeguards. Certain habits of lightning-rod practice may be improved, and the curious freaks and vagaries of lightning strokes in protected buildings are intelligible without any blame attaching to the conductor; but this is very different from the contention that lightning rods are unnecessary and useless. They are essential to anything like security."

In a bulletin published by the United States Weather Bureau, the case of the Washington monument is cited as follows: "Eight years have now passed since the alterations were made, and the monument stands uninjured. Unquestionably, standing as it does 555 feet high, in the centre of flat, well-watered ground, it constitutes a most dangerous exposure for lightning flashes. No better illustration of the value of lightning conductors can be asked.

Professor Lodge gives the following rules for the erection of lightning conductors:

1. That iron is the best metal to use in conductors.
2. That conductors should be continuous, and that all unavoidable joints should be soldered.
3. That several points are preferable to a single point, hence ordinary barbed wire, as affording innumerable points, is recommended.
4. That greater surface than is usual with present practice, should be given to earth connections.
5. That periodic inspection is most important.

What Insurance Men say About Lightning Rods.

By corresponding with a large number of insurance companies in this Province, the writer has elicited some rather valuable opinions and facts regarding the protection of farm buildings by lightning conductors. The majority of these companies believe that lightning rods are a safeguard if properly put up, but add that they are often either badly installed or are allowed to get out of repair. All the companies corresponded with were unanimous in stating that they made no reduction in rates in favor of buildings protected by lightning rods. So that, whatever may be the possibilities of lightning rods as safeguards, the disregard of principles and the lack of thoroughness on the part of those who have had the work to do have made the system, in the eyes of practical men, of doubtful utility.

Summary.

1. An isolated object is more liable to be struck than a group of objects.
2. Barns are most likely to be struck when filled with grain or hay.
3. Trees afford protection to objects standing lower, unless the trees are too close.
4. Lightning conductors, when properly installed and kept in good repair, afford a good degree of security.
5. The essentials of a good lightning conductor are:—(*a*) numerous points—either as terminals or as projections of conductors. These give constant relief to the electric strain in the atmosphere and tend to prevent the accumulation of a destructive charge; (*b*) a continuous metallic conductor, with as few joints as possible. Unavoidable joints should be soldered perfectly. Imperfect joints, like ice on the overhead wire of an electric railway, cause flashes, and these flashes may set fire to the building; (*c*) a good earth connection, that is, the lightning rod should be conducted to moist earth below the perpetual moisture line. A good earth connection can be made by using a wire rope as conductor, opening out the ground end of the wire into a brush and spreading the brush over as large an area of earth as possible; or by splicing to the main conductor below the ground surface a number of wires running in different directions, so that one or more of them may be sure to be in contact with good earth.
6. Before intelligent farmers can be expected to expend their money in purchasing lightning rods, they must receive a reliable guarantee that the work will be properly done. A feasible arrangement might be the appointment of a county or township inspector, employed by the municipality to inspect in that municipality.

Report of Precipitation and Temperatures for the Year 1899.

The highest temperature recorded at the college for the year was 95° on August 19th. The lowest was 20.5° below zero, on February 12th.

The amount of precipitation for the year, including rain and melted snow, was very nearly 20 inches. Below is a table giving the precipitation for each month, and the highest and lowest temperature.

Month.	Temperatures.				Precipitation.
	Highest.	Date.	Lowest.	Date.	
January	48	5	−10	11	.68 inch.
February	46	27	−20.5	12	.77
March	61	22	1	21	2.00
April	80	29	18	4	1.00
May	78	1	31.5	15	3.10
June	86	5	42	10	.64
July	89	3	49	30	1.93
August	95	19	43	9	.24
September	85	17	28	23	3.00
October	76	13	25	3	4.10
November	57	18	22	12	.73
December	52	1	−13.5	30	1.58

Cold Storage and Refrigeration.

The time has come when the students in dairying and horticulture especially should be instructed in the principles of cold storage and refrigeration. If our graduates are to assume responsible positions in the fields of labor, in which, at the college, they have made a special study, they must be more or less familiar with modern methods of storing, preserving and marketing perishable products. In dairying and fruit-farming cold storage has become more or less of a necessity. Any instruction that is to be given in this matter, so far at least as the principles are concerned, must be given in the Department of Physics. I therefore take this opportunity of recommending that a refrigerating plant be installed adjacent to the college proper, to be used for the following purposes:

1. To provide cooling rooms for experiments in butter and cheese.
2. To provide cold storage in connection with the horticultural department.
3. To provide cold storage for the experimental feeding department, so that individual animals may be slaughtered at the right time, and the carcases kept until the whole batch is ready for scoring.
4. To provide cold storage accommodation for the College store-room.
5. To afford an opportunity for experiment and instruction on this subject, in the department of Physics.

If all of these interests were considered in one undertaking, a much more efficient plant could be installed than if two or three small affairs were built in connection with the several departments. This matter of a refrigerating plant will, I think, deserve your early attention.

I have outlined elsewhere the amount of instruction given in the department of Physics. Altogether, in English and Physics, my work is as follows:

First Year.—Two lectures a week in Physics, in the winter term. Two lectures a week in English Literature, throughout the year. Correcting occasional compositions.

Second Year.—Two lectures a week in Physics, with demonstrations that involve previous preparation of apparatus, throughout the year. Practical instruction in Physics, in addition to lectures, two afternoons a week for the whole year. Two lectures a week in English Literature. Correcting weekly essays, from October to February. After that time the second year students employ the time allotted to essays in writing their theses.

Third Year.—Two lectures a week in Physics in the fall term. Two afternoons a week in practical instruction for the year. Three lectures a week in fall term, and two a week in winter term, in English Literature. Correcting of essays prescribed in the circular. Directing students in original work required for the preparation of theses. I have four of the present third year conducting their theses work under my direction—two in Agriculture and two in Dairying.

There is a growing demand on my department for the analysis of soils, a demand coming from farmers in the Province. This work I am entirely unable to do in the winter time, when most of the samples are sent in. To be satisfactory, this work should be attended to promptly. Four soils were sent in a few days ago for analysis, but I could do nothing with them except to give a very general report. Since a physical analysis of soils reveals so much that is decisive, showing the texture, the degree of fertility, and the availability of plant food in the humus form, it is imperative that this department should be provided with the means for attending promptly to soil analysis.

In addition, I have been trying to carry on original investigations in soil physics during the summer. Last summer and the summer before, with the valuable assistance of Mr. R. D. Craig, B.S.A., whom a provisional appropriation enabled me to employ, experiments on the cultivation of the soil in relation to moisture were conducted. The results of this work are outlined elsewhere. The results of the co-operative experiments were obtained with the same assistance.

If the departments under my charge are to do the work that will be demanded of them, in lectures, demonstration, correcting of essays, analysis of soils, and original investigation, permanent assistance must be provided. In each of my last two reports I made a recommendation that a Fellow or an assistant be appointed to this department. Unless really valuable work for the College and the Province is to be neglected, this assistance should be provided at once. I hope that it will be possible for you to enable me to begin the next year with the departments under my charge well equipped for broad and useful service.

Allow me to thank you for the generous and hearty encouragement accorded to me personally, and for the liberal appropriations toward the purchase of apparatus and supplies.

Yours respectfully,

J. B. REYNOLDS,
Professor of Physics.

ONTARIO AGRICULTURAL COLLEGE,
GUELPH, Dec. 30, 1899

PART IV.

PROFESSOR OF BIOLOGY AND GEOLOGY.

To the President of the Ontario Agricultural College:

SIR,—I beg to submit herewith my second report as head of the Biological Department.

The year 1899 was a busy one with this department. Regular and systematic instruction was given in four distinct branches, viz., Botany, Zoology, Entomology, and Geology; a large correspondence was conducted with persons asking help in the identification and treatment of insects and weeds; the fumigation method of treating nursery stock in the nurseries of the Province was inaugurated; consultations were frequently held with the scale inspectors regarding the identification of scales; a bulletin on the San José and other scale insects was prepared; experiments in the spraying of mustard, and the fumigation of granary insects were made; papers were read at the meeting of the Entomological Society of Ontario, held in London, October 11th and 12th; two short addresses were delivered to the students of the Toronto Normal School on "Nature Study;" and special studies were made on certain new insect and weed pests.

INSTRUCTION.

Laboratory work forms the basis of all instruction given in this department, and it should be borne in mind that such work done, even under most favorable conditions, throws a large amount of additional labor on the instructors.

The building at our disposal is wholly inadequate for the needs of the work. The lack of laboratory accommodation is perplexing and annoying, as the room is far too small, and is unsuitable for the purpose, hence the classes must be divided into sections and the work repeated. This repetition of work for different sections of the same class consumes the time and energy of the instructors, leaving no time for the preparation of next day's work, nor for correspondence, while research work and the reading of scientific magazines and bulletins are simply impossible. If two or more large and properly equipped laboratories were provided for this department, not only would the students get better instruction, but the instructors would also get the time which should be theirs, for reading and preparation.

The work of instruction is very onerous on account of the number of subjects to be taught. In the general courses two lectures are given every day to the First Year students; one lecture every day to the Second Year students; and one lecture every day to the Third Year students, throughout the year. In addition, courses of lectures are given in Cryptogamic Botany, Physiological Botany, Histology, Fungi and Fungous Diseases and Zoology to the specialists in Biology and Horticulture. Six lectures a day are delivered on the average throughout the year, while every afternoon and Saturday morning have their classes, which require constant supervision and preparation.

The First Year students get no practical laboratory instruction in Zoology or Geology; the Second Year and Third Year students do not have the amount of practical work in Entomology which is so desirable; yet it is difficult to see how the amount of practical work can be increased without additional room, time and assistance.

I may say, moreover, that a large portion of my assistant's time is devoted to the preparation of material in general Histology, and the Histology of Fungi and general Cryptogamic plants, which required the full time of an assistant when Prof. Harrison had the work in charge.

Correspondence.

This phase of our work has again assumed large proportions, and as a consequence much time and research are required. Over five hundred letters and two hundred circulars were sent out during the year 1899. This department is being freely consulted by the fruit growers, farmers and others in all matters pertaining to weeds, plant diseases, and insects, and frequently the nature of the inquiries necessitates considerable research and lengthy replies.

My assistant has had also considerable correspondence in connection with the distribution of sets of weed seeds, work which Prof. Harrison handed over prior to his leaving for Europe.

In consideration of the large correspondence, the demand for special articles on biological subjects by the agricultural press of the Province, and the various annual reports for the College, and the entomological and other societies, a typewriter would be of much service, and I would respectfully ask that one be secured for use in the Biological Department.

Fumigation of Nursery Stock.

On the passing of the Fumigation Act by the Legislature in April last, the Hon. the Minister of Agriculture asked me to take charge of the work of inaugurating the system of fumigation of nursery stock in specially constructed air-tight buildings. With the assistance of Professors Harrison, Reynolds and Shuttleworth, all the nurseries of Ontario were visited and the nurserymen instructed how to build suitable fumigating houses, and how to fumigate with hydrocyanic acid gas.

The chemicals used in fumigation were sent out from the College to the different nurseries in quantities suitable to the size of the various fumigating houses.

The work of inspection of the nurseries occupied nearly the whole month of April, and interfered to some extent with the closing weeks of the college term. The fumigation of nursery stock in the autumn also involved considerable time, and much correspondence was necessary to get information from many nurserymen as to the effects of fumigation on exposed stock.

Identification of Scale Insects.

During the progress of the inspection of the orchards of Ontario for the location of the San José Scale, many inspectors and orchardmen sent specimens of scale for identification. As official entomologist, I was obliged to be extremely careful in naming the scale sent, for sometimes much depended on my report. In every case the specimens of scale were subjected to treatment to render them transparent and suitable for examination with the high powers of the microscope.

The *Ostreæform Scale*, a recent importation from Europe, which had been previously reported from only a few places in North America, was found to be quite common in some sections infested with San José Scale. This work of identification of scales occupied most of my time during the months of August and September.

A Bulletin on the San José and other Scale Insects of Ontario.

The San José Scale Commissioners, who were appointed by the Government to inquire into the operation of the San José Scale Act in Ontario, made a recommendation in their report to the Government that a bulletin be prepared, which would give the main facts regarding the habits and life history of the San José Scale and other scales of our orchards. Accordingly the Minister of Agriculture asked me to prepare a bulletin along the lines suggested by the Commissioners for distribution to orchardists. This bulletin I have prepared, and have submitted to the Minister for approval. Illustrations of the common scales of the orchard have been made, so that the intelligent orchardist will be able, with the help of the descriptions in the text of the bulletin, to identify any scale which he may find in his orchard. This bulletin, I trust, will also be of use to the future inspectors of scale in our orchards, as I have inserted many items of information regarding scales, which will make them observe more intelligently and decide more confidently than they have hitherto been able to do. The work of identifi-

cation of scales in late summer and the observations made during my trip with the Scale Commissioners were of great service to me in the preparation of this bulletin.

Spraying to Kill Mustard, and Fumigation to Kill Granary Insects.

Several series of experiments were tried in England last year on the use of copper sulphate and iron sulphate solutions, applied in the form of a spray, for the eradication of wild mustard. Outlines of these experiments are to be found in the May 27th, June 24th, and August 5th issues of Field, the great English agricultural weekly. In the majority of these experiments, a weak solution of copper sulphate was found very efficacious.

During the past summer my assistant, M. W. Doherty, used a knapsack sprayer, and applied solutions of different strengths of copper sulphate and iron sulphate to mustard plants growing in a field of oats. Only one strength (1.25 per cent. solution) of iron sulphate was tried, with the result that the mustard was not entirely destroyed and no injury was done to the oat crop. A 4 per cent. solution of copper sulphate (4 lbs. of copper sulphate dissolved in 10 gallons of water) was found very effective in destroying the mustard, and caused very little, if any, injury to the grain crop; but a 2 per cent. solution of copper sulphate (2 pounds dissolved in 10 gallons of water) was found to be the best strength to use. The oats showed practically no injurious results from the application, even at the time of spraying, while the mustard was completely destroyed. Two weeks later the oats which had been browned slightly by the spraying were as bright and green as those of the unsprayed portions of the field; and when the sprayed oats were ripe the straw was over six inches longer than that which was unsprayed. It is probable that the best results can be secured when the mustard and oat plants are young.

During the coming summer the experiments will be repeated on a larger scale, and on several kinds of crops. A special spraying apparatus has been designed for the work, and it is probable that the machine will be placed on the market during the year 1900.

From the good results obtained by the use of hydrocyanic acid gas in the destruction of the San José Scale and other orchard insects, it was thought advisable to try the effects of the gas on grain-infesting weevils found in granaries. Two tall glass jars, with ground stoppers, and with a capacity of 625 cubic inches each, were used as air-tight compartments in which the insects were treated to the gas. In jar No. 1, which was kept beside a warm radiator in my office, was placed a package of corn badly infested with active grain weevil and cadelle. In the first experiment the insects were treated for three hours to the same strength of hydrocyanic acid gas as was used in nursery fumigation. In jar No. 2 a similar package of infested corn was placed and treated, but the insects had previously been rendered torpid by exposure to a cold of 40 degrees Fahr. for an hour. The gas treatment was continued for three hours at this temperature, and when the jars were opened and the insects taken out and brought into a warm room, fully 95% of those in jar No. 1 failed to show signs of life even after a period of 24 hours, while 95% of those in jar No. 2 revived and became active.

These experiments were repeated, using twice the usual strength of the gas. When the jars were opened at the end of 24 hours all of the insects in jar No. 1 were dead, while fully 10% of those in jar No. 2 showed signs of life, revived, and became active in again in 24 hours, although they had been exposed to a temperature of 14 degrees Fahr. for a whole day.

The results of these experiments show plainly that torpid grain insects are very difficult to kill with hydrocyanic acid gas, but that they can be killed readily in rooms warm enough to render them active. The use of this gas cannot, then, be recommended for winter treatment in either granaries or mills.

Papers Read Before the Entomological Society.

I attended the annual meeting of the Entomological Society of Ontario which was held in London Oct. 11th and 12th. The most prominent feature of the proceedings was a discussion of the San José Scale problem by Prof. Webster of Ohio, Dr. Fletcher of Ottawa, Mr. John Dearness, Deputy Minister James, Mr. G. E. Fisher and myself. At the conclusion a resolution was adopted expressing approval of the efforts made by the

Minister of Agriculture to rid the Province of the pest. I read two papers before the Society, entitled "Notes on Some Insects of our Coniferous Shade Trees" and "The Asparagus Beetles in Ontario." At a public meeting, held on the evening of Oct. 11th, I gave an address on "Insect Pests of the Garden, Orchard and Farm," which was illustrated by stereopticon views of the insects discussed. The Society honored me by electing me Vice-President and a member of the editing staff of the *Canadian Entomologist*.

Nature Study.

In my report of last year I stated as follows: "The present drawback to the introduction of nature study into the public schools lies in the fact that the majority of teachers in rural schools are not sufficiently equipped for the work of instruction. To overcome this difficulty, leaflets might be prepared by this department and issued to teachers to show how Nature-study may be presented to the pupils." These words still hold true in so far as the equipment of the teachers for the work is concerned; but there are indications that point to an improvement along those very lines in the near future. The teachers of the normal schools of the Province are interesting themselves in the work, so that ere long courses of nature-study for teachers will likely be given. One teachers' association has taken the work in hand, and is endeavoring to organize a summer course of study in elementary botany, entomology, geology and physics. Another teachers' association has provided its members with the best works on nature-study, and has had special lessons on nature topics taught from them. The agricultural papers of the Province are publishing articles on Agricultural Instruction, which will be widely read by the farmers.

In furtherance of the great scheme of nature study, I had the honor of giving two talks on insects to the students of the Toronto Normal School on the occasions of their visits to the college, one practical lesson on evergreens to the Guelph city teachers, and another practical lesson on the cabbage butterfly to the pupils of the Marden public school, Wellington county.

I have also prepared an illustrated nature-study leaflet on the cabbage butterfly, which will appear in the forthcoming annual report of the Entomological Society.

Prof. C. C. James has happily said: "Keeping close to nature as it is right at home, in the fields, along the roadsides, in the running brooks, looking for the simple workings of laws all about us, not trying to fathom the far-aff problems of some remote science; starting right at our feet with the simplest things of life about us, and getting down to the explanations of so-called common things, is the key to the situation." To do this there must be intelligent, enthusiastic teachers, who can make the common things of nature plain and intelligible to the pupils. It is the duty of this college to further this grand work of indirect agricultural education, not only by giving practical lessons to teachers and classes of pupils, but also by furnishing information about the common objects of nature in the form of leaflets.

New Insect Pests of the Year 1899.

Several insects made their appearance in Ontario in somewhat alarming numbers, and many inquiries were made as to the best methods of dealing with the new arrivals. I shall now treat very briefly of a few of the worst.

(1) The Asparagus Beetles (*Crioceris asparagi*) *and* (*C. duodecempunctata*). In 1898 the arrival of these beetles at the Niagara River was noted, and it was then predicted that they would soon be with us.

For over forty years these pests of asparagus have molested the market gardens of certain portions of New York State, especially Long Island. In 1862 the common asparagus beetle (*C. asparagi*) occasioned the loss of over one-third of the crop in Queens County, the loss being estimated at $50,000.

These two beetles arrived in Ontario at the same time, although they had different starting points and were introduced into the United States at different times. At present the common asparagas beetle is the more abundant and destructive.

Fig. 1, shows very clearly the form and markings of the beetle, egg, larva, and pupa, of the common asparagus beetle (*C. asparagi*). The beetle is blue-black in color, with red markings on the thorax and wing covers, and passes the winter under sticks and rubbish on the ground. About the first week of May it leaves its winter quarters and deposits eggs on the fresh, succulent shoots of asparagus. The eggs are placed in rows of

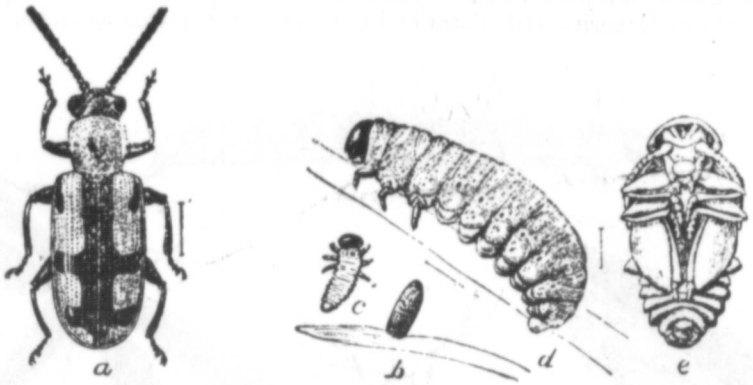


FIG. 1. Asparagus Beetle (*Crioceris asparagi*); *a*, adult beetle; *b*, egg; *c*, young larva; *d*, larva, full-grown; *e*, pupa. (Chittenden, Year-book of Dept. of Agriculture for 1896.)

four or five, are nearly one-sixteenth of an inch long, and are dark-brown in color. The eggs hatch in about a week; the bodies of the grubs are gray; the head and the three pairs of legs are black. In twelve days the grubs are full-grown, when they enter the ground, surround themselves with a cocoon and become pupæ. In another week the adult beetles emerge. It will be seen that about 30 days are required for this beetle to develop rom the egg to the adult stage.

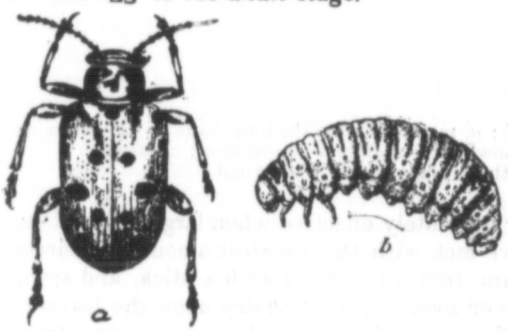


FIG. 2. Twelve Spotted Asparagus Beetle (*Crioceris 12-punctata*); *a*, adult beetle; *b*, full-grown larva.

Fig. 2 shows very clearly the form and markings of the twelve-spotted asparagus beetle (*C. 12-punctata*), and its larva. The beetle is orange-red in color, with black markings on the wing covers. The grub or larva when full-grown is about one-third of an inch long, and of an orange color. The life-history of this species is not yet thoroughly known, but it is generally supposed that the eggs are deposited on the stems of the asparagus. These beetles, like those of the other species, feed upon the stems and leaves.

Remedies.—(a) The Long Island practice is to "cut down all plants, including seedlings and volunteer growths, in early spring, so as to force the parent beetles to deposit their eggs upon new shoots, which are then cut every few days before the eggs have time to hatch from the first brood."

(b) Some permit shoots to grow as trap plants which are cut down every week so as to destroy the eggs deposited upon them.

(c) Insecticides are frequently employed when neither of the first two remedies is practicable. The best applications are lime, pyrethrum powder, and paris green. The lime should be fresh, and air-slaked; the paris green may be mixed with flour, and applied dry to those shoots which are left uncut. All shoots should be treated with paris green after the cutting season.

(2) THE DIAMOND-BACK MOTH (*Plutella cruciferarum*) was quite destructive to turnips in several localities. Although not a new arrival in Canada, this is the first time that its occurrence in Ontario has been noted in large numbers, and over a large area.

The caterpillars are green in color, and are beset with short jet-black hairs. When full grown they are nearly half an inch long. They eat holes in the leaves, which soon become very tattered and torn. A very characteristic feature of this insect is the thin gauzy cocoon, which the full-grown caterpillar spins on its changing into the chrysalis.

Dr. Fletcher reported an outbreak at Ottawa in 1889. From the observations made then he was led to believe that there are probably three broods each year, and the last brood passes the winter in the chrysalis state. Experience with this pest in England and the United States has proved that it may be very troublesome one year, and difficult to find the next. In Canada, it was very abundant at Victoria, B. C., and Winnipeg, in 1885, but has not been reported as serious since. It was quite serious at Regina in 1887, and at the Ottawa Experimental Farm in 1889, but not reported as serious from those districts since.

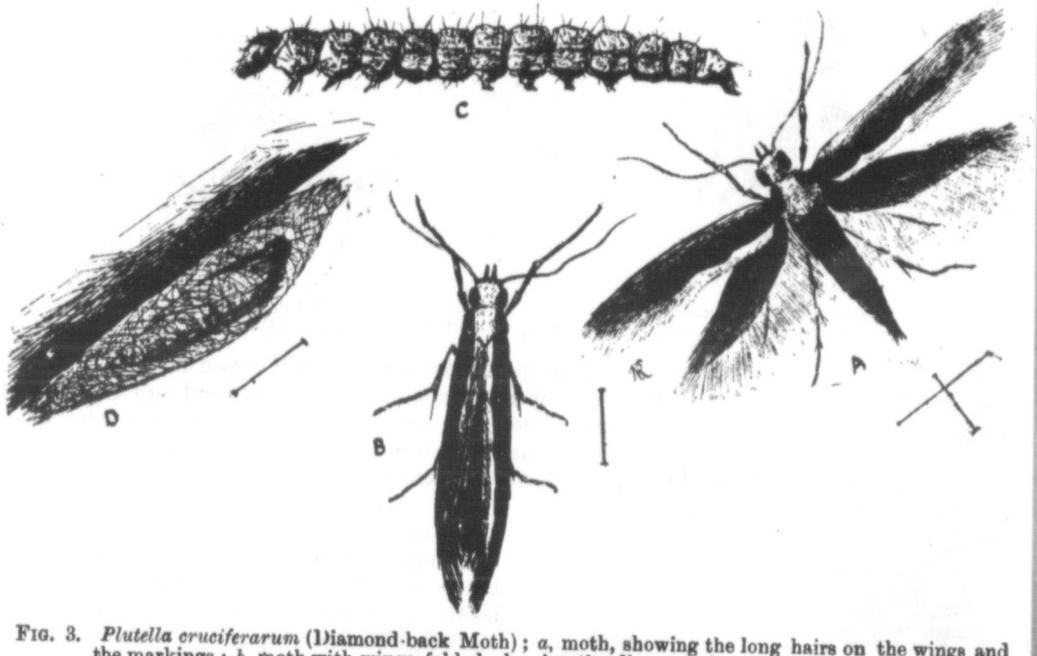


FIG. 3. *Plutella cruciferarum* (Diamond-back Moth); *a*, moth, showing the long hairs on the wings and the markings; *b*, moth with wings folded, showing the diamond-shaped area; *c*, larva or caterpillar; *d*, gauzy cocoon with chrysalis within. (Original.)

Remedies.—Remedial treatment is never absolutely effective when large fields of turnips are infested. The treatments which have met with the greatest amount of success in England are: (a) Swish off the caterpillars from the leaves with a stick, and spread broadcast by hand a liberal supply of gas-lime or soot. (b) Dust dry upon the leaves an application of paris green mixed with either flour or land plaster, whenever young turnips are effected by the first or second brood of caterpillars.

(3) THE PEA LOUSE.—There was an outbreak of this pest in York County in the last week in July. A correspondent wrote as follows:

"I have about eighteen acres of peas smitten with lice, and I do not think they will fill. The lice are much like the turnip lice, and occur in large spots where the stems are dying. I would like to know what is best to do with them." So far as I am aware this is the first recorded occurrence of a louse affecting peas in Ontario. As I did not see the infestation, I cannot tell which species was doing the damage. Prof. Johnson of Maryland reports a terrible outbreak in that state during the past summer, the loss being estimated at over $3,000,000.

"The standard remedy for plant-lice, and plant-bugs is kerosene emulsion; and as the pea and bean infesting species feed chiefly on the under sides of the leaves of these plants an underspraying is necessary."

(4) THE CORN APHIS OR LOUSE (*Aphismaidis*). Ordinarily this louse is not troublesome, but during the drouth of the months of August and September corn was seriously affected by it. Fig. 4 shows the appearance of this louse. When plants have become weakened by drouth or otherwise, they become very susceptible to attacks from plant-lice and other parasites.

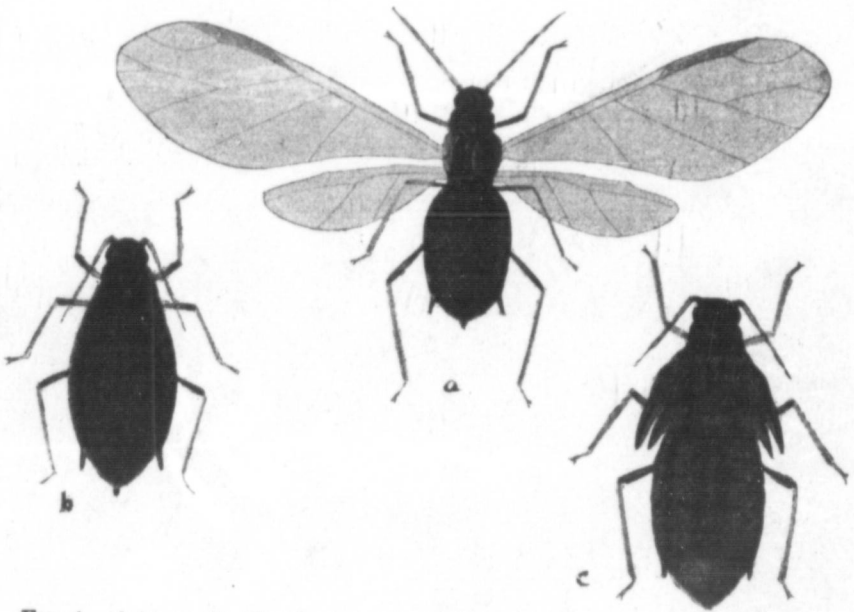


FIG. 4. *Aphis maidis* (Corn Louse); *a*, winged female; *b*, wingless female; *c*, pupa. (After Forbes of Illinois.)

Remedy.—No direct, practicable remedy has yet been found for the prevention of the ravages of the corn louse. Good farm practice, however, will do much towards lessening the extent of the depredations of plant-lice in general, for it is a well-known fact that healthy, vigorous plants are seldom injured by these insects. Whenever plants become weakened in vitality from lack of fertility, drouth, or neglect, plant-lice are very liable to appear in large numbers. "Therefore, if the farmer gives special attention to the fertility and drainage of his land, procures the best seed, and, by proper planting and cultivation, secures vigorous plants from the start, and by proper care endeavors to keep them in this condition until the product is matured, he will have accomplished more in preventing loss from insect depredations than he would accomplish by the best remedies known, applied to half-starved, neglected plants."

NEW WEED ARRIVALS.

(1) A very serious pest has made its appearance in the south-west counties of the Province within the last few years. I refer to the PRICKLY LETTUCE (*Lactuca scariola*).

This is an annual weed which has been introduced from Europe, and has spread to all parts of the United States. It is a winter annual; it springs from seed in the fall, and survives the winter. It is distributed by means of its seeds, which are readily blown long distances by the wind. The plant begins to bloom in July, and produces a few blossoms each morning thereafter until killed by frost. An average plant has been estimated to bear 8,000 seeds.

The best methods of destroying the weed are:

(*a*) To mow repeatedly as it comes into bloom, or earlier. This process will eventually subdue it.

(*b*) To cultivate thoroughly with a hoed crop; by this method the seeds in the soil will be induced to germinate. They should not be covered deeply in plowing, as this would simply bury the seeds and prevent their germinating. Mature plants should be cut down and burned, lest the seeds be blown about and scattered by the wind.

Farmers should be careful to buy only clean clover, millet, and grass seeds, and the weed-inspector should insist on the fulfillment of the law, and have all fence-corners, roadsides, and waste lands cleared of the pest.

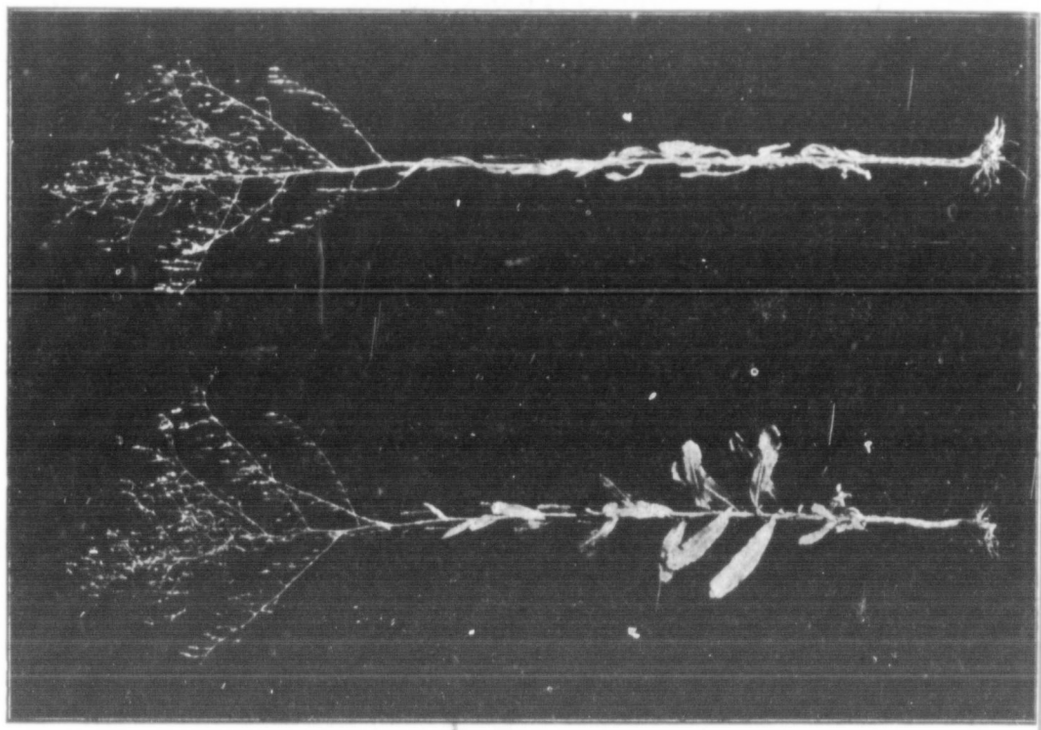


FIG. 5. Two views of *Lactuca Scariola* of the usual form, showing the compass-like habit of the leaves. To the left a view from the east (or west) side, as the plant grew, to the right a view from the north (or south) side of the same plant.

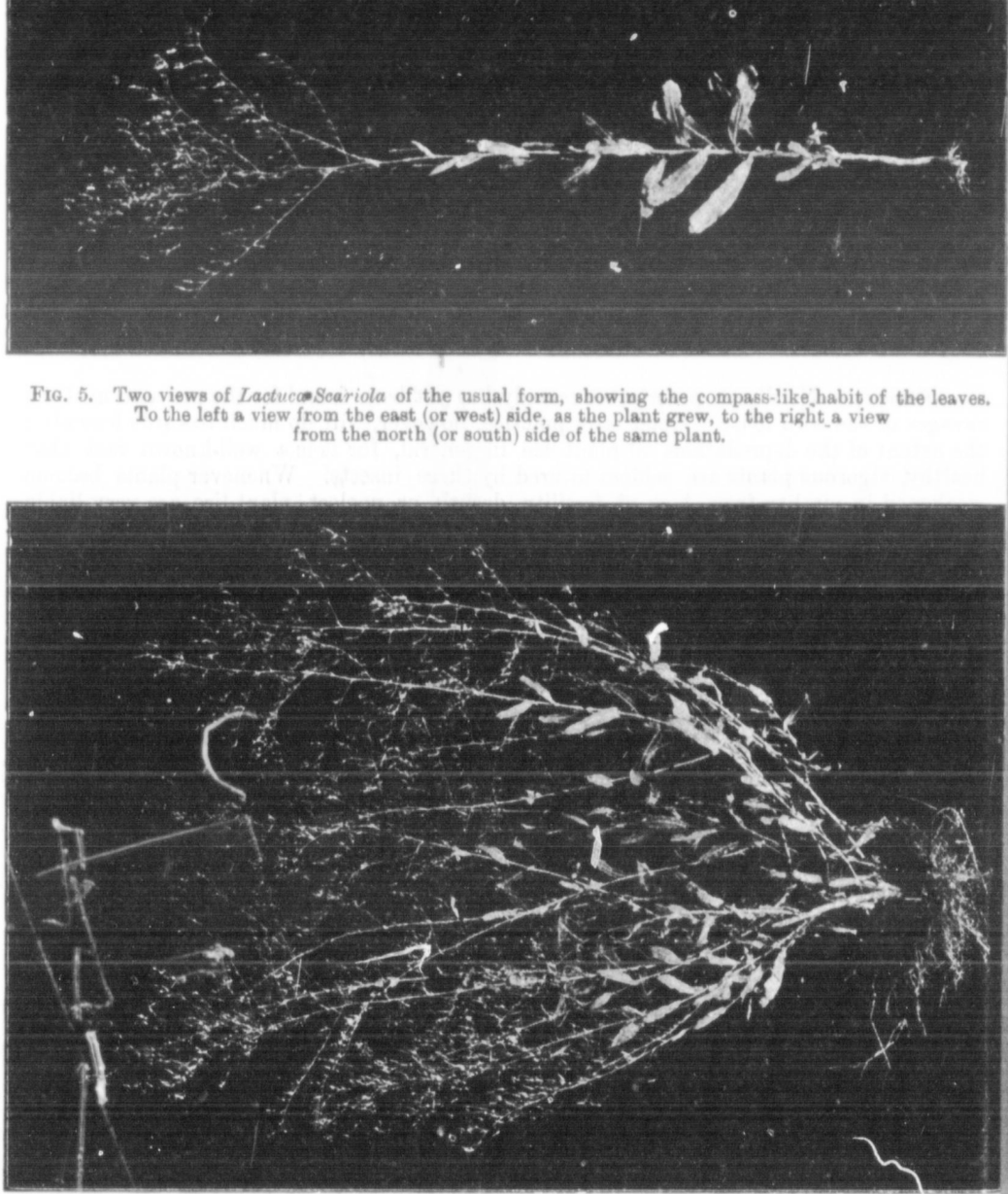


FIG. 6. A plant of *Lactuca Scariola*, which had been mowed off. [It is readily seen by comparing with Fig. 5 that the branches have started from the base of the stem as a result of the mowing.

The plant may be recognized from figures 5 and 6. The leaves are clasping; the heads are numerous in an open panicle; the rays of the flowers are yellow; and the pappus is white.

(2) The Broad Leaved Gum Plant (*Grindelia squarrosa*), Fig. 7, has appeared in one or two places in Ontario. It is a native of the western plains from Manitoba to Mexico. The plant resembles a wild sunflower, but it is very gummy and sticky. The heads are yellow and nearly an inch across. It is propagated by its roots and seeds; and as it is a perennial it must be dealt with accordingly. The plants should be prevented from seeding by mowing repeatedly. When the weed becomes a pest all lands not in grass should be gang-plowed quite shallow after harvest, and cultivated as often as necessary in the fall to keep the weeds down. A hoed crop the following season should destroy most of the gum-plants and any annuals that are near the surface.

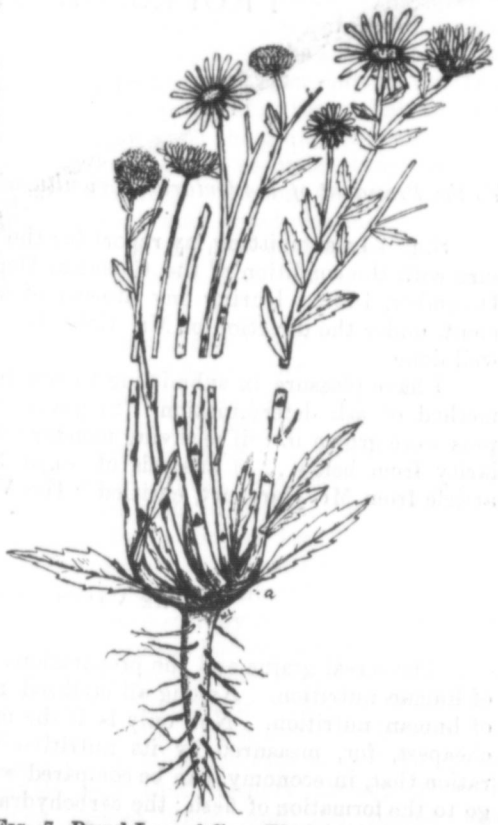


Fig. 7. Broad-Leaved Gum Plant (*Grindelia Squarrosa*), a plant which had been mowed off at *a*. The branches have started from the base as a result of mowing off. (Original).

The Needs of the Department.

This department is laboring under several serious disadvantages, some of which I outlined in a previous section of this report. Briefly, the needs of this department are:

1. A larger laboratory for the first and second year students.

2. More time for practical work in entomology, geology, and zoology. In the case of the first year, one afternoon every week during the winter term should be devoted to practical exercises in zoology and geology.

3. Better facilities for museum studies. The museum is too far removed from the class-room and laboratory to be of much practical value.

4. An insectary for the study of the life-histories of insects. Where the department is doing the work of an experiment station a good serviceable building of this kind becomes an absolute necessity.

5. A special laboratory for practical exercises and investigations in physiological botany.

6. A class-room for our own use. At present the lectures to the third year are given in the bacteriological lecture room, for the reason that the biological lecture-room is occupied by a class in horticulture.

In conclusion, I wish to place on record my appreciation of the valuable services not only of my assistant, Mr. M. W. Doherty, who has shown himself to be a willing worker, a good botanist, and a capable instructor, but also of Mr. D. H. Russell, a student of the first year, whose artistic abilities have enabled me to illustrate quite fully the San José Scale bulletin, and other articles in the annual reports; and of Mr. Norman Ross, B.S.A., whose skill as an illustrator is well and favorably known at the Ontario Agricultural College.

All of which is respectfully submitted.

WILLIAM LOCHHEAD,
Professor of Biology and Geology.

Ontario Agricultural College,
Guelph, December 30th, 1899.

PART V.

PROFESSOR OF CHEMISTRY.

To the President of the Ontario Agricultural College:

SIR,— In submitting my report for the year 1899, I beg to express to you my pleasure with the condition of the Chemical Department upon my return from Germany in December, 1898. During my absence of some twenty months the work of my department, under the direction of Mr. Robt. Harcourt, assistant chemist, appears to have been well done.

I have pleasure in submitting to you in this report (1) a brief statement of a new method of ash determination; (2) grain experiments, in which oats, barley, wheat and peas were grown in soil receiving moisture through surface application, and through capillarity from below; (3) analysis of sugar beets. My report also contains a valuable article from Mr. Harcourt, entitled "The Value of Gluten in Flour."

THE VALUE OF GLUTEN IN FLOUR.

The cereal grains and the preparations made therefrom form the most important part of human nutrition. Among all civilized nations, bread, in the broad sense, is the basis of human nutrition. Not only is it the most important, but at the same time it is the cheapest, for, measured by its nutritive value, there is no food so nearly a complete ration that, in economy, can be compared with bread. In it are found the proteids which go to the formation of flesh; the carbohydrates, of which starch is the most important; the fats and oils, which go to produce fat, heat and mechanical energy; and the phosphoric acid, lime, potash, and other mineral constituents which are necessary for the formation of bone. There is no tissue of the body which cannot be nourished by bread, especially if it be made from the whole wheat flour.

"There are many substances from which the material for bread-making may be obtained. Wheat, corn, rye, barley, oats, buckwheat and potatoes have all been used for making bread. In fact, nearly every plant furnishing a product rich in starch has been used for this purpose. The two constituents which are found in largest quantities in the cereals are the starches and proteids, the former averaging about 60 to 70 per cent. and the latter 9 to 12 per cent. So far as is known, the starches are chemically identical, and all may be detected by the same chemical action. The starch kernels, however, differ in size and shape and in their action towards ferments. The character, composition, and even the number of proteids contained in the different cereals is not thoroughly understood; but it is known that, owing to a peculiar property of the proteids of wheat flour, which it has in common with rye flour, it forms a dough when mixed with water, which, on leavening and baking, produces a light porous bread. This property of these flours is due to a difference in the composition of the proteids of the grains. They contain what is commonly known as gluten, a substance with which many of us are familiar in the form of a gum made by chewing wheat. The gluten from different varieties of wheat or from different parts of the same wheat may be very different in quality, some being firm and elastic, others soft and sticky. It is because of this gluten in wheat flour that when it is wet a dough is formed, and that when the dough is impregnated with a ferment or any gas-producing substance, the dough rises. The height to which the dough will rise depends largely on its ability to retain the escaping gases,

or upon the toughness and elasticity of the dough, which in turn depends upon the quantity and quality of the gluten. It will thus be seen that the gluten content of a flour has a great deal to do with the quality of the bread.

A commercial examination of a flour takes into account three things, namely, strength, yield and color. Flavor is so much affected by the modes of working the flour that it can hardly be considered in speaking of the commercial value. The *strength* largely depends upon the quantity and quality of the gluten, the *yield* of bread depends principally upon the amount of water the gluten will absorb, while the *color** of the flour is affected by the wheat from which it is made, by the amount of bran left in the flour, and by the amount of germ that escapes separation. It is evident, then, that the value of a flour, apart from the color, depends almost entirely upon the gluten it contains. In view of the immense amount of flour used, it is surprising that so little study has been given to the subject of flour in its relation to bread-making. During the past year we have done some work in determining the gluten content and bread-yielding power of a few of our Ontario varieties of fall wheat, and while no definite conclusions have been reached regarding comparative values, it is quite apparent that quality in gluten is almost, if not altogether, as important as quantity.

Climate and soil have a great influence on the character of wheat; apparently there is as great a difference in the strength of flour made from the same variety of wheat grown in favorable and unfavorable seasons as in the strength of samples from different varieties of wheat, while change of soil may almost entirely change the nature of the wheat. A fertile soil and a comparatively short season of growth are the most favorable to the production of a wheat with the highest and best quality of gluten. A long-growing season is favorable to the production of a large, plump grain, rich in starch. A short, quick-growing season forces the crop on the side of gluten formation, as less time is given to the filling out of the kernel with starch. It is, no doubt, true that the way the plants have wintered also affects the gluten content. When it is remembered that environment, as climate and soil, may force the wheat crop to produce starchy or glutinous seeds, that the stage of ripeness, the quality of gluten, and the ferment bodies, all give character to the grain; and, also, that when the wheat is milled a mechanical separation of the proteids takes place, it is evident that there are a great many factors which go to determine the character of the wheat and the quality of the flour. This is no doubt the cause of the differences of opinion among millers as to what wheats should be grown. Not long ago a prominent Ontario miller said that farmers should grow the varieties of wheat which would give the largest yield and the proper color, and pay no attention to the gluten content. At the same time, another equally prominent miller declared that unless farmers would grow wheats rich in gluten, irrespective of yield, the milling business in Ontario would be ruined. There is the same difference of opinion regarding the appearance of the best wheats for flour. Some millers prefer the gluey-looking, opaque kernels; others, the fine, white, transparent grains. Practically so little is known with any degree of certainity that there is here a wide field for the investigator.

Millers are complaining that Ontario wheat does not make so strong a flour as it formerly did. The same complaint is now being heard regarding the wheat from Manitoba and the North-West Territories. It is also not uncommon to hear farmers remark that their flour does not make so good bread as it did a number of years ago. At the same time, while certain varieties of wheat are spoken of as deteriorating, it is claimed that some of our soft winter varieties are improving in the quality of gluten. An effort is being made to study the change in the gluten content of wheats grown on newly broken ground and on ground that has been cropped for a number of years, to see whether the difference is one of quality, or quantity, or both; also to see if there is any possibility of of preventing the deterioration.

R. HARCOURT.

*The market at present demands a flour that will make a white, porous bread, irrespective of nutritive value or gluten content. This demand is so pronounced that a wheat which makes a dark flour, no matter how rich it may be in gluten, cannot be used for bread making. The Wild Goose wheat is a good example of such wheats.

A New Method of Ash Determination.

It is important to the science of agriculture to be able to make an accurate determination of the percentage of ash contained in plants, grasses, grain, and other agricultural products. The ash contains the lime, potash, phosphoric acid, etc., collected as plant food from the soil by the growing plant. How much ash each different kind of crop takes out of the soil, and what quantities of the various constituents are contained in this ash are questions closely related to soil fertility and soil exhaustion, which can be answered only by an accurate ash determination and analysis.

A quantitative determination of ash percentages is difficult to make, and errors which careful chemists find difficulty in avoiding, are easily introduced. The high percentage of carbon contained in the above products, the difficulty experienced in burning off all the carbon, the tendency of certain constituents to volatilize and of the ash to fuse, are the principal causes of this difficulty.

The usual method practised consists in incinerating an accurately weighed sample in an open platinum dish which has been previously weighed. The increase in the weight of the dish due to the ash which it contains, after the incineration of the substance, represents the crude ash. The percentage which this weight of ash forms of the weight of the weight of the original substance can be readily calculated. But ash thus prepared may not contain all the phosphoric acid and potash of the original substance from which the ash was obtained. It also contains more or less carbonic acid, unburned carbon and foreign matter (sand, &c.), none of which form part of the ash of the plant. Owing to the presence in the ash of one or more of the above-named substances, viz., carbonic acid, carbon and sand, it is called crude ash. Too frequently percentages of ash are reported as crude which may be more than the real ash of the substance incinerated. To these sources of error may be added the previously mentioned tendency of certain constituents to volatilize, the absorption of moisture from the air during weighing, and the formation in the ash, during incineration, of silicates, which substances seriously interfere with the analysis of the ash.

To obtain a method giving accurate ash percentages and analysis, I conducted an extensive series of analyses of natural products (straw, hay, grain, &c.) and artificial silicates. In these analyses attention was given first to the determination of the percentage of crude ash in a sample of oat straw by the ordinary method of incinerating the dried material in an open platinum dish. During the process, different degrees of heat were employed with different samples. Those samples receiving the highest heat yielded the lowest percentages of ash, and those gently heated yielded the highest. But the ash prepared by the high heat yielded high percentages of silica and low percentages of potash, while ash prepared by the low heat yielded high percentages of potash and low percentages of silica. An analysis of the silica separated from the highly heated ash showed that it (the silica) contained portions of the other ash constituents, viz., lime, magnesium, potash, &c. This circumstance led me to prepare mixtures of pure silica, potassium, carbonates, and calcium carbonates of known quantities, which, after moistening with nitric acid and drying, were subjected to different degrees of heat corresponding to the conditions in regular ash determinations by the ordinary method. An analysis of these mixtures, after heating, gave results quite similar to the results of the analyses of the above samples of ash prepared from oat straw, *i. e.*, the highly heated mixture yielded high percentages of silica, owing to the lime and potash of the mixture uniting with the silica and forming silicates, which are indecomposable in hydrochloric acid.

After trying numerous substances, I found that the addition of a solution of acetate of lime to the dry substance prevented the formation of indecomposable silicates during incineration at any temperature. The formation of indecomposable silicates being prevented by the use of the acetate, ash can be prepared which is quite decomposable in hydrochloric acid; and, consequently, accurate silica determinations can be made.

The loss of chlorides in incineration by the ordinary method has for many years been known, and numerous devices to prevent the loss have been proposed by chemists. While the quantity volatilized has been, by certain precautions, considerably lessened, its entire prevention has never been accomplished in the ordinary method of ash determination. A careful study of this source of error, viz, volatilization of chlorides, led me to design a special form of apparatus (see Fig. 1.) composed of platinum and provided with lids, cylinders and open-

ings in which the material moistened with acetate of lime solution and dried can be completely incinerated without the slightest loss of chlorides.

It is difficult to weigh fresh ash without alteration of its weight due to absorption of moisture from the air. This source of error in ash determination is entirely obviated by the freshly incinerated ash being weighed within my closed ash apparatus.

By removing certain parts of the apparatus, Fig. 1., it may be immediately connected after weighing with drying tubes and potash bulbs, as in Fig. 2., for the determination of carbonic acid in the ash, without the removal of the ash to a special carbonic acid apparatus.

Sample carefully and grind the steam-dried material to a uniform powder, which may be preserved in a tightly stopped bottle.

Two to three grains of this prepared and bottled sample are weighed for a moisture determination.

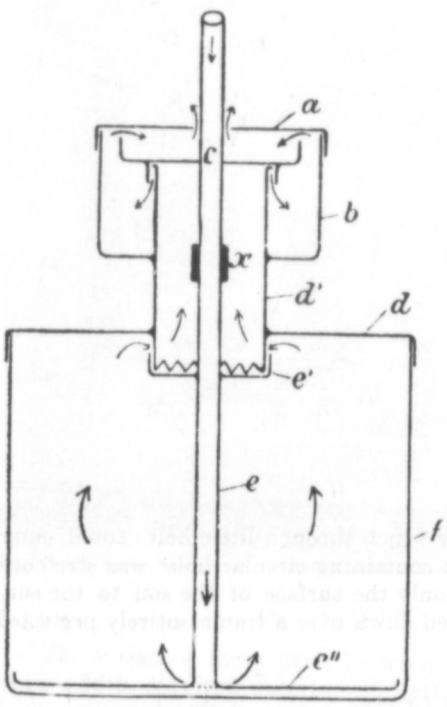


FIG. 1.

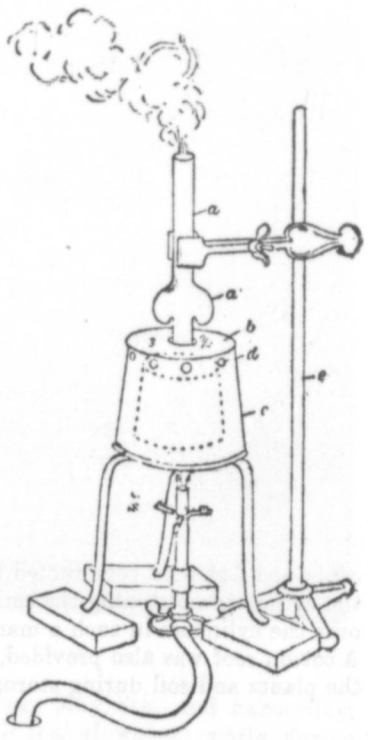


FIG. 2.

Ten to fifteen grains are next weighed into the previously weighed ash apparatus, Fig. 1, and moistened with twenty or more cubic centimeters of calcium acetate solution. The deep dish, or principal part of the apparatus which contains the weighed and moistened sample, is fitted into the charring oven, Fig. 2, where the sample is first dried and then charred to a gray ash at a very low heat. The drying and charring should not require more than three hours. The other parts of the ash apparatus are now carefully fitted together, enclosing the gray ash which, as in Fig. 3, is incinerated to a white or grayish white ash. The apparatus containing the ash after cooling is again weighed, to obtain by difference the weight of the enclosed crude ash. Leaving the ash in dish, certain parts of the apparatus are cleaned of adhering ash and laid aside while the dish containing the ash is connected, as in Fig. 4, with the drying tubes and potash bulbs for a carbonic acid determination. The dish containing the dissolved ash and separated silica is again placed in the charring oven, Fig. 2, where the ash in the presence of hydrochloric acid is evaporated to dryness. After taking up with concentrated hydrochloric acid, warming, and diluting, the silica is collected upon a Gooch crucible, dried and weighed. The filtrate containing the other constituents of the ash is analysed in the usual way. The crude ash minus the carbonic acid equals the carbon-free ash

GRAIN EXPERIMENT:—SURFACE AND SUBSOIL OR UNDERGROUND MOISTURE.

Early in May last, a cart load or two of surface soil from a farm field where roots were grown the previous year, was thoroughly mixed to be used in a grain experiment. Ten cylinders of galvanized iron, 12 inches in diameter and 3 feet long, were placed in two rows upon the ground, and filled with the soil mentioned above, each containing practically the same weight of exactly the same soil. These cylinders

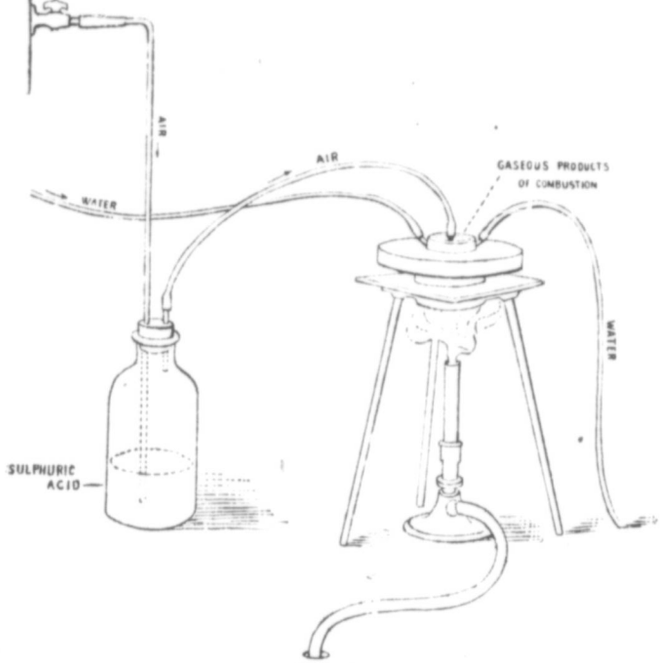


FIG. 3.

contained bottoms constructed for retaining water which through little holes could enter the cylinder, moistening the soil. A cotton sheet containing circular holes was stretched over the cylinders in such a manner as to expose only the surface of the soil to the sun. A cotton roof was also provided, which being pulled down over a frame entirely protected the plants and soil during storms.

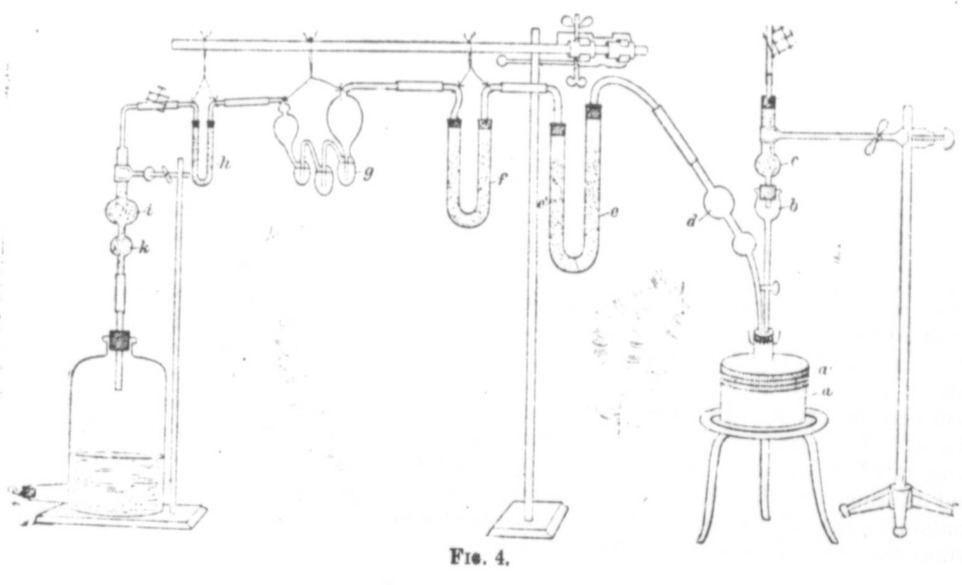


FIG. 4.

Fig. 5 illustrates the experiment on the 3rd of August, when the grain was beginning to ripen.

Cylinders marked 1, in Fig. 5, contain oats; those marked 2, barley; those marked 3, wheat; and those marked 4, peas. There are, therefore, two of each kind. In every instance, the cylinders to the left, facing the experiment at the end by 1, are supplied with water at the bottom, while those to the right are watered at the top. The surface, or top-watering, represented rain and was repeated whenever the soil appeared dry, while the bottom-watering represented an abundant supply of ground-water. No manures were used. All grains were sown on May the 8th, when the soil was nicely settled and moist. The young plants began to appear above ground in four to five days, that of the surface-watered soil appearing from twenty to thirty hours before that of the bottom-watered soil.

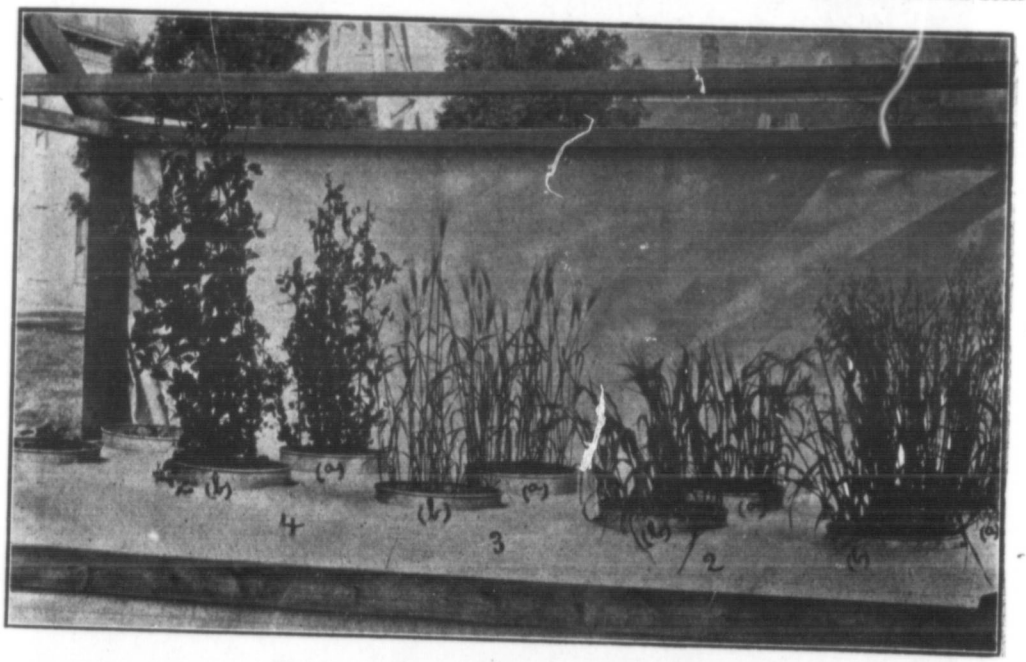


FIG. 5. (1) Oats, (2) Barley, (3) Wheat, (4) Peas.

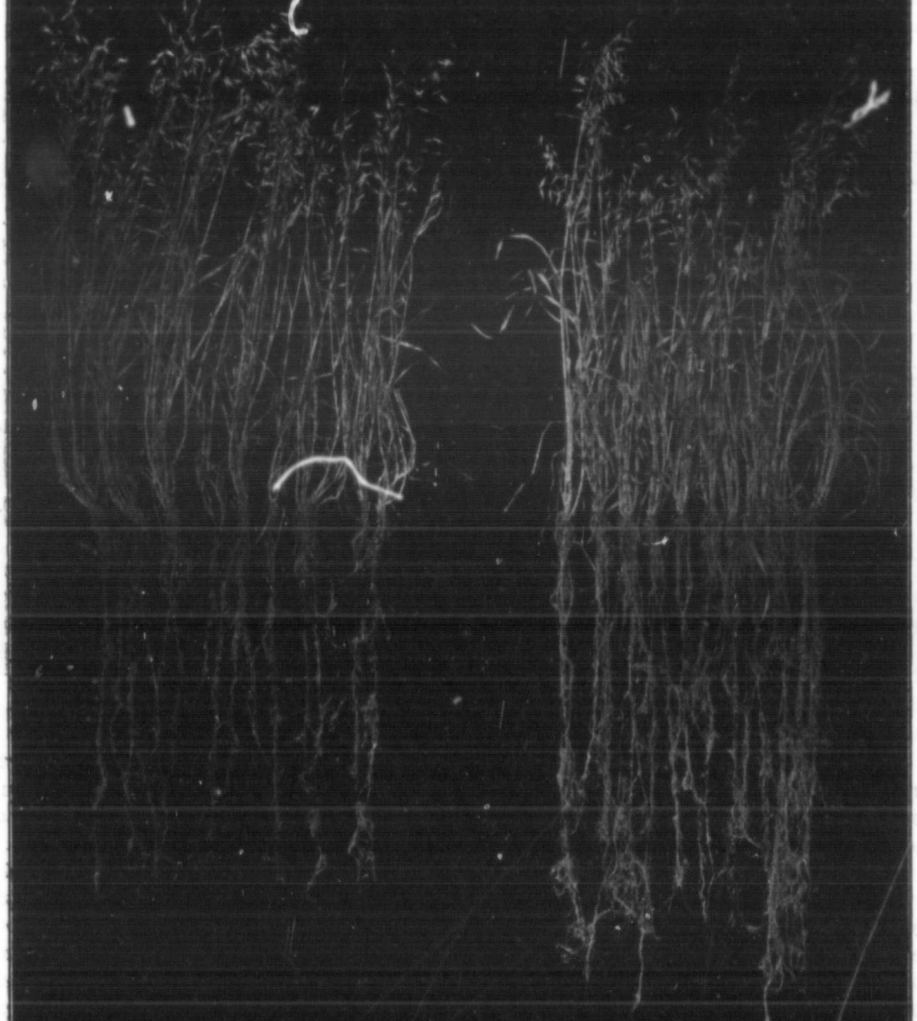
The surface-watered oats, between the date of sowing, May 8th, and harvesting, August 26th, required watering 46 times, taking in all 43 lbs. of water; while, during the same period, 65¼ lbs. of water entered the soil in the other cylinder growing oats. The surface-watered barley, wheat, and peas required respectively 38½ lbs., 29¾ lbs., and 28 lbs.,—while the bottom-watered required, respectively, 25½ lbs, 34¼ lbs., and 104 lbs. of water. It was only in the case of the barley that the amount of water applied upon the surface exceeded the amount taken up at the bottom. In these latter kinds, as with the oats, surface watering had to be frequent, to prevent parching. Barley, having a comparatively shallow growing root, cannot draw upon the deeper soil moisture so well as oats, wheat, or peas; and this no doubt, accounts for barley suffering quickly in dry spells.

SURFACE AND GROUND MOISTURE IN THE GROWTH OF OATS.

On August the 20th, the oats in cylinder 1 (a) were ripe, while those in 1 (b) were four days later in ripening. Fig. 6 shows that (a), the surface-watered oats, has produced less growth of straw than (b), the bottom-watered; but (b) shows a lighter root-growth than (a), which is in reality not the case. In removing the soil from the roots without breaking the rootlets, greater difficulty was experienced in these soils which had been watered from below. The total growth, in the case of (a), amounted to 67.66 grams, composed of roots, 10.63 grams; straw, 45.13 grams; and grain, 11.9 grams; while (b) amounted to 82.39 grams, composed of roots, 7.96 grams; straw, 56.93 grams; and grain, 17.5 grams.

Surface and Ground Moisture in the Growth of Barley.

There was little difference in the growth, maturity, and yield between the surface and ground-watered barley. (a), surface, and (b), ground-watered barley are shown before harvesting in Fig. 5, and after harvesting in Fig. 7. The roots of barley (a) in Fig. 7, owing to an attempt to wash them free from earth, appear much less than they

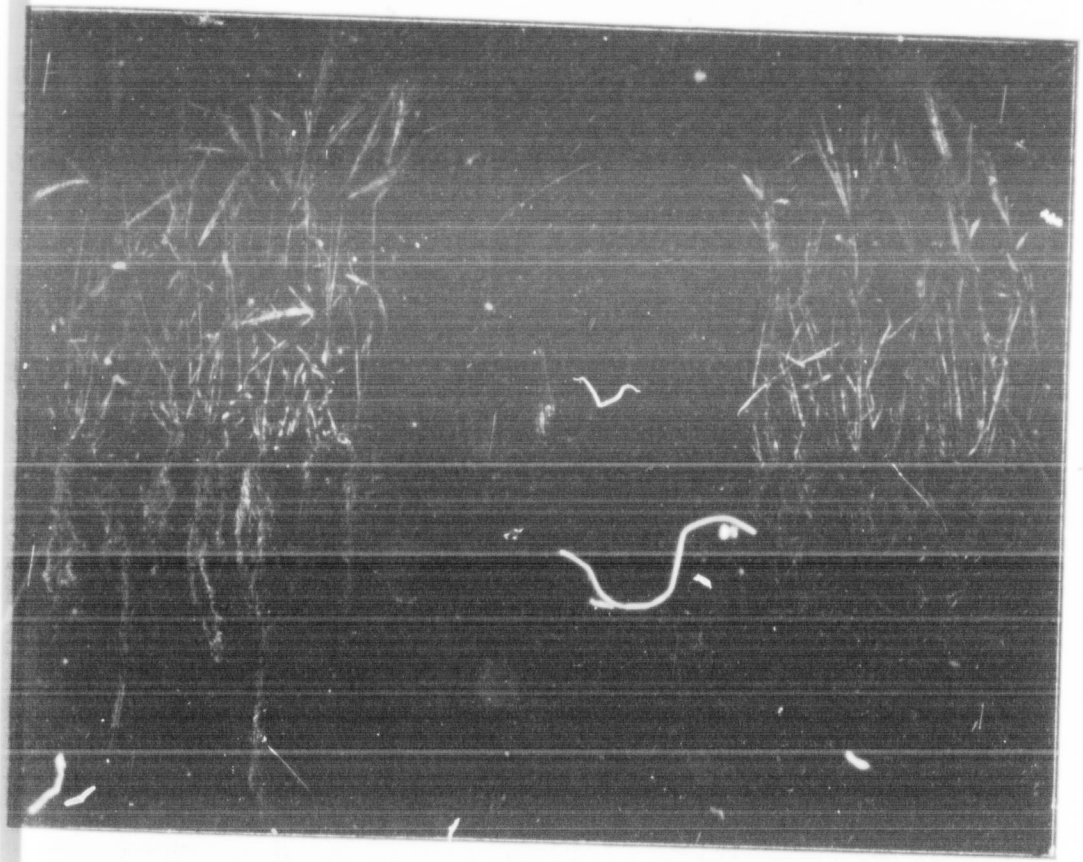


(b) Fig. 6. (a)

are. The total yield of roots, straw, and grain, amounts in (a), surface-watered, to 45.39 grams; and in (b), ground-watered, to 45.34 grams. This experiment with barley shows the importance of the preparation of a seed-bed for barley, which supplies moisture in the surface soil, where the roots develop. Hence a spring-plowed soil cannot be expected to produce the best results in barley growing.

Surface and Ground Moisture in the Growth of Wheat.

It will be seen by reference to (b) and (a) of 3 in Fig. 5, and to (b) and (a) in Fig. 8, that the surface watered soil has grown a somewhat shorter but better headed crop than the other soil. The total weight of growth (roots, straw, and grain) is 29.95 grams on the former, and 26.62 grams on the latter soil. But while the sum of the straw and grain in (a), the surface watered crop, is 27.4 grams, and that in (b) is 23.5 grams, the roots of (b) are slightly heavier and better developed than (a). It is quite probable that the yield of crop on the ground-moistened soil, with a somewhat greater root growth, would have been greater than that on the surface-watered soil had not the blight injured the former, which matured more slowly, considerably more than the latter.



(b) Fig. 7. (a)

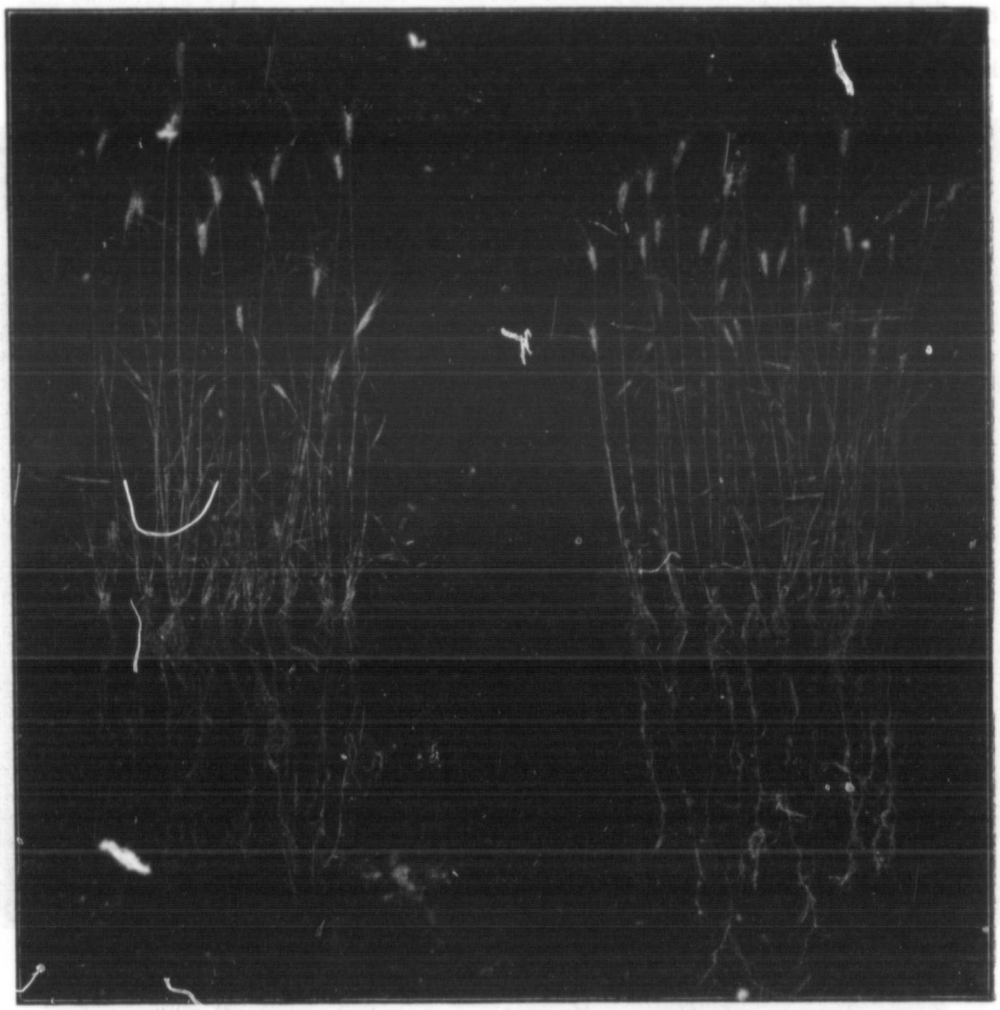
Surface and Ground Moisture in the Growth of Peas.

It is quite evident that the pea crop marked (b) in Fig. 9 and 4 (b), Fig. 5, is decidedly stronger and heavier than the other pea crop in the same Figs., which grew in the surface-moistened soil. The latter crop matured on the 15th of August and the former on the 22nd of the same month. The surface-watered soil yielded a total crop of 63.32 grams, consisting of straw, 39.05 grams; grain, 21.30 grams; and roots, 2.97 grams, while the soil moistened from below yielded a total crop of 116.6 grams, consisting of straw, 73.0 grams; grain, 38.5 grams; and roots, 5.1 grams.

It may be remarked that owing to the very little rain which fell during the period of this experiment the atmosphere for days in succession was dry and parching; and had it not been for frequent watering of the surface soil the crops supplied with moisture in this way would have suffered badly—the natural watering by rain would not have sustained anything like a satisfactory growth. If the soil can supply sufficient moisture for

the crop's requirement its growth becomes, to a great extent, independent of summer rains. Humus in soil greatly increases its power to retain moisture, and cultivation of the right kind and at the right time contributes greatly towards the retention of moisture and aids in its movement through soil for the use of the crop.

The analysis of the grain and straw grown in this experiment is under way for the purpose of ascertaining the total quantity of the several ash constituents and nitrogen in each kind of grain, with their distribution between the straw and the grain.



(*b*) FIG. 8. (*a*)

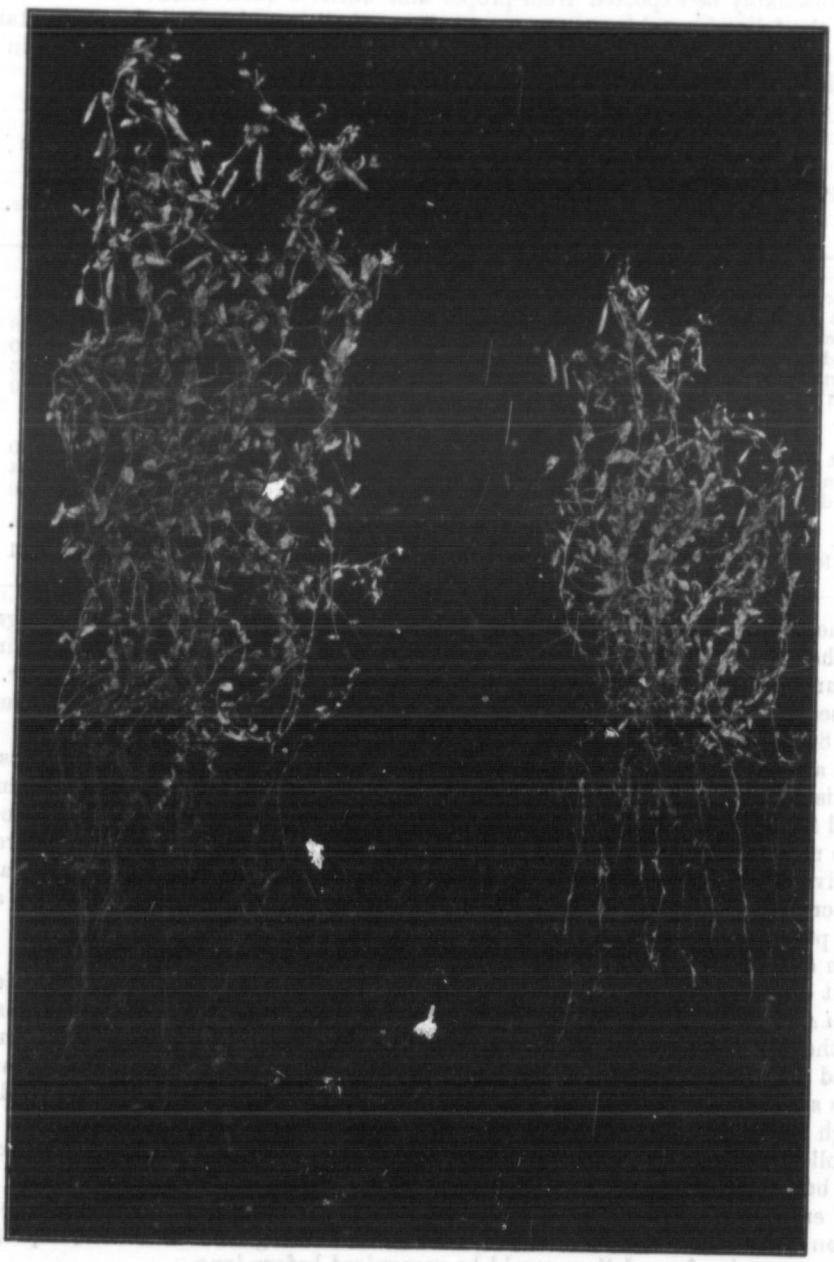
SUGAR BEET ANALYSIS.

Mr. Robert H. Lawder (now deceased) in a letter dated January 11th, 1899, wrote me to the effect that Mr. William James Stewart, Glasgow, Scotland, who represents a Scottish sugar syndicate, spent the winter of 1887-8 in the United States and Canada enquiring into the prospects for the profitable investment of capital in beet sugar factories. Further, that the above gentleman, having returned to Scotland, was at that time in correspondence with him (Mr. Lawder) in reference to Ontario as a suitable place for sugar factories.

Nothing more regarding this matter was heard until October last, when a communication from the Department of Agriculture, Toronto, requested me to make an analysis of beets which were then being forwarded from Aylmer, Ont.

A few days later, the above gentleman, Mr. William James Stewart, arrived at the Ontario Agricultural College to enquire into the results of the analysis of Aylmer sugar beets, and to arrange with us to have analyses made of other samples of sugar beets that would soon be forwarded from Aylmer, Dunnville and Wiarton.

In consultation with you, it was decided to comply with Mr. Stewart's request to analyse the beets, provided express charges were prepaid. In all, ninety-two samples of



(*b*) FIG. 9. (*a*)

sugar beets were received and analysed in our laboratory between October 25th and November 14th. Fifty-seven samples were received from Dunnville, twenty-two from Aylmer, and the remaining samples chiefly from Wiarton.

To obtain beets that yield profitable quantities of sugar, the roots must mature or ripen sufficiently before they are pulled. To grow such roots special attention must be

given to manuring, cultivation, thinning, etc. As a rule, the Canadian farmer manures, cultivates, etc., to obtain a big yield of roots, regardless of the proper degree of maturity for a high yield of sugar. It can be well understood that, owing to the influence of maturity upon sugar content, where little or no attention is given to the maturity of the beet, there would be grown good, bad and medium beets from a sugar standpoint. Such samples were received in our laboratory; consequently the averages cannot be so high as might reasonably be expected from proper and uniform cultivation.

In the following table averages are given of all samples pulled upon certain dates. These averages show better results, as a rule, in the samples of the later than in those of the earlier dates.

Place and lot.	Date of pulling.	Number of samples.	Average weight of roots.	Analysis of juice.		
				Solids.	Sugar.	Purity.
			lbs.			
Dunnville.						
First	Oct. 25th	1	1.35	16.34	12 8	79.2
Second	Nov. 1st	29	1.75	15.71	12.08	75.0
Third	Nov. 18th	8	1.71	18.25	14.50	78.4
Fourth	Nov. 22nd	10	1.35	18.60	15.03	80.8
Fifth	Nov. 27th	9	1.73	17.17	14.20	82.5
Aylmer.						
First	Oct. 24th	6	....	16.06	11.90	74 1
Second	Oct. 26th	5	1.80	16.54	12.44	74.8
Third	Nov. 14th	11	1.08	18.20	15.00	82.1
Wiarton.						
One lot	Oct. 30th	10	....	16.78	13.31	80.1

The above averages show that the November beets are better from a sugar standpoint than the October-pulled roots. Wiarton roots of October 30th are fairly good. The fourth lot of Dunnville beets were somewhat wilted when received. Mr. Stewart expressed himself quite satisfied with beets yielding 14 per cent. sugar in juice with purity 80.

It appears to me quite clear that there can be grown in Ontario sugar beets containing satisfactory quantities of sugar, and that several sections have soil, climate, and natural facilities suitable for sugar beet cultivation for factory purposes. However, it will be necessary, for the best results, to furnish growers with clear and full directions as to cultivation. It is my intention to publish such directions should there be a prospect of one or more beet sugar factories being established. This, however, does not appear to be the proper place and time for such a publication.

In concluding my report I would respectfully remind you of the vastly increased amount of work in my department occasioned by the method of teaching by laboratory work, *i.e.*, by the students of all the years performing experiments and doing laboratory work themselves as a basis of instruction. The value of this method is recognized and adopted by the best institutions. I have not found in any of the European institutions for the study of natural science that the staff of professors are so hampered and harassed through lack of demonstrators to assist in this practical method of teaching as we are in this College. In my last report, I asked for the appointment of a fellow in my department, but received none. At the opening of this present College year, seeing my situation, I engaged assistance, with your permission, upon my own responsibility rather than abandon what is known to be the best method of teaching natural science, hoping that the pressing necessity for a fellow would be recognized before long.

Work at Present Under Way.

It has always been difficult in this department, where results cannot be obtained rapidly, to complete investigations at a fixed or set time. There must necessarily be work under way, which, not being completed, cannot appear in the report.

We have at this date several important investigations that cannot be finished for this report. Of these, the most important are: (*a*) digestion work, to ascertain the relative composition and digestibility of nearly matured and freshly cut fodder corn, cut at the same time and cured, in the silo, in the barn, and in the field; (*b*) an investigation into the quantity and quality of gluten in different varieties of wheat, together with their bread-producing capabilities to see what extent the quantity and the quality of the gluten are related to the deteriorating strength noticeable in flour; and (*c*) the total ash constituents that the various staple crops remove from soil and the distribution of these several constituents in the grain and straw.

It will not be forgotten that each department in an institution of this kind has, at all times, a fairly heavy correspondence and numerous requests by farmers and others to analyize, examine, and identify samples and specimens of various kinds. This is a sort of work which, we know, must not be neglected nor delayed. My assistant, Mr. Harcourt, has this entire time more than occupied in the station laboratory with the analysis of miscellaneous substances received from farmers and others, and with a large part of the analyses belonging to the investigation work; while I find it quite impossible to handle alone, with any degree of justice to our students, our large classes, two of which, upon two days in the week, are present at the same time.

Finally permit me to express my appreciation of the valuable services rendered to this department by my assistant, Mr. Robert Harcourt, and to acknowledge the services of Mr. Wm. P. Gamble, who has cheerfully and gratuitously aided in what would otherwise have been an impossible task.

Respectfully submittted,

A. E. SHUTTLEWORTH,
Professor of Chemistry.

ONTARIO AGR'CULTURAL COLLEGE,
GUELPH, December 30th, 1899.

PART VI.

PROFESSOR OF VETERINARY SCIENCE.

To the President of the Ontario Agricultural College:

SIR,—I beg herewith to submit my report for 1899.

CLASS-ROOM.

First Year—To the first year students I delivered a course of lectures on comparative anatomy, paying particular attention to the anatomy of the horse, and where important differences exist between the horse and the ox, drawing the attention of the class thereto. In this course, I aim at giving the students an intelligent idea of the general anatomy of domesticated animals, as regards bones, joints, ligaments, muscles, tendons, the digestive, respiratory, urinary, and genital systems; also the circulatory and absorbent systems, the skin, foot, and organs of special sense. I endeavor to make the points as simple and plain as possible, and use for illustration the skeleton of a horse, a living horse, specimens, and charts. I also gave a course of lectures called "Practical Stable", in which we discussed the proper kind of stables to build, in respect to site, size, material, ventilation, drainage, kinds and sizes of stalls, mangers, &c; the general care of horses, as regards food, water, work, grooming, care of feet, shoeing, &c., care of harness, saddles, &c., &c. Also a course of lectures on judging horses, in which I selected two or more individuals of the class of horses under discussion, mentioned the points as regards conformation, action and manners of a typical animal of the class, and then compared the animals present with the ideal. I impressed upon the class the general principles upon which a man acting as judge of horses should proceed in order to do justice to himself, the institution from which he graduated, the exhibitors, and the society for which he is acting.

To this class also I gave a course of lectures on veterinary *materia medica*, in which I spoke of the general actions of medicines, the properties, actions, uses and doses of the different drugs and remedies used for the prevention and cure of the ordinary diseases of farm stock.

Second Year.—To this class I delivered a course of lectures upon Veterinary diseases and treatment, mentioning the causes, symptoms and treatment of the ordinary diseases to which farm stock is subject, paying special attention to preventive measures. During the spring term I gave a course of lectures upon Veterinary Obstetrics, speaking of the general hygienic treatment of breeding animals, both before, during and after pregnancy; the means and precautions to be observed to prevent disease or accident and the symptoms and treatment of such as are liable to occur; the care of the young animal before and after weaning, &c., &c. I also gave a course of lectures and illustrations upon a subject we call "Practical Horse", in which I explained the desirable points of the different classes of horses, the means of detecting disease and blemishes in horses; the modes of securing horses for the performance of simple operations, such as dressing and stitching wounds, opening abscesses, dressing teeth, and bandaging; the different modes of administering medicines, with the precautions to be observed; dressing the feet, &c. In all my lectures to both classes my aim is to make everything as simple and practical as possible, avoiding technicality.

To the special dairy class I gave a short course of lectures upon the causes, prevention, symptoms and treatment of the ordinary diseases to which dairy stock is subject.

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

Horses.—We had a few cases of acute indigestion, colic, influenza, lymphangitis, sprains, &c., all of which yielded to treatment. We had one case of leuchorræ in a mare, which also yielded to treatment; and one of the experimental horses developed a ring-bone, which caused lameness. I fired with a hot iron and blistered, and the lameness disappeared.

Cattle.—We had three cases of parturient apoplexy (milk fever) in cows, all of which made perfect recoveries. We had one fatal case of pneumonia in a farm cow. The farm herd became affected with infectious ophthalmia, that serious and common disease of the eyes to which cattle have been subject for five or six years. We used the following mode of treatment with perfect success :—We isolated the affected animals as far as possible, protected them from the sun and wind, and excluded all draughts ; we also gave each animal a slight purgative, consisting of a pound of Epsom salts dissolved in warm water, and put a few drops of the following lotion into the eyes twice daily : Sulphate of zinc, 10 grs ; fluid extract of belladonna, 15 drops, and water, 2 oz. In a few cases an ulcer formed and burst, in which cases I touched the parts carefully, once daily for a few days, with a pencil of nitrate of silver. In every case a thorough recovery resulted. We had several cases of inflammation of the udder, sore teats, impaction of the rumen, retention of the placenta, fardel-bound, a few cases of lameness, &c., all of which recovered. I dehorned several feeding steers, and both Mr. Rennie and Prof. Day have arrived at the conclusion that they are more gentle and feed better after the operation.

PRACTICAL HORSE—VETERINARY DEP'T.

Sheep.—We had three fatal cases of grub in the head. One ewe died during parturition. A ram got his leg fractured and as he was in good flesh we decided that it would be more profitable to butcher than to treat him. We lost two or three lambs from wool ball in the fourth stomach. The lambs became affected with tape-worm, as usual, and we treated them as follows : We made a mixture of one part oil of turpentine and sixteen parts sweet milk, starved the lambs for 10 or twelve hours and administered to each from 2 to 4 oz. of the mixture, according to age and size, and after ten days we repeated dose. We had no actual losses, but the lambs did not do so well as they otherwise would have done. A few of the ewes were worried by dogs, and as a result one of them died,

Swine.—We had very little trouble with the swine and no fatalities, except in newly born pigs.

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

J. H. REED.
Professor of Veterinary Science.

ONTARIO AGRICULTURAL COLLEGE,
GUELPH, Dec., 19th, 1899.

PART VII.

PROFESSOR OF DAIRY HUSBANDRY.

To the President of the Ontario Agricultural College:

DEAR SIR,—I beg leave to submit my ninth annual report of the Dairy department. I wish to acknowledge assistance given by the Farm, Chemical and Bacteriological departments during the year. Mr. Rogers, instructor and experimenter in the butter section of the department, resigned on May 1st. Miss Bella Miller and Miss Alice Squirrell, graduates of the Dairy School, were placed in charge during the summer, and did the work in a very satisfactory manner. Mr. Stratton has done excellent work in the cheese section. He has also acted as butter instructor for the regular college students and for the special creamery course in the month of December.

Mr. Jas. A. McFeeters, graduate of the dairy class of 1897, has been appointed to succeed Mr. Rogers as experimenter and instructor in the butter section.

THE DAIRY SCHOOL.

The past year has been a very successful one for the Dairy School. In addition to the regular course during the months of Jannary, February and March, we have had a special creamery course in December of this year. The attendance at the regular course exceeded that of 1898, during which year there were 110 registered. In 1899, the number of students registered during the three months was 115, of whom 17 were ladies. During the creamery course in December the attendance was nineteen, including four ladies; also about 40 second year students in the regular course took this course.

Of those who attended in the early part of the year 53 registered for the full course, including cheese-making, separators, milk-testing and butter-making; 17 took special work in butter-making and milk-testing; 2 took butter-making alone; 7, cheese-making and milk-testing; 1, cheese-making; 4, milk-testing; 3, special work on general lines; and 27 took the home dairy course. It will thus be seen that our students choose quite a variety of dairy work. This, to a certain extent, hinders the work of our regular classes; hence, one reason for a special course in butter-making during December. It may also be necessary to have special classes for cheese-makers and home dairy men and women in December, to lessen the number who at times crowd the work in practical cheese and butter making during the regular term. We would prefer having for the three months' term only those who purpose taking up the full course, and would also prefer that these should all have more or less experience before coming. Inexperienced students, those staying for a short time only, and those who wish to take up work in only one department, can be best managed in small classes during a special term.

Of those registered for butter-making only, their experience ranged from 0 to 21 years. The cheese men's experience was 0 to 16 years. It is difficult to map out work suitable for such, at one and the same time.

We had considerable difficulty in securing a supply of milk suitable for our work. As Guelph and the vicinity is not a dairy section, we shall, I presume, always meet this difficulty.

On the final examinations at the close of the term 44 wrote for certificates, of whom 5 were specialists in butter-making, 2 in cheese-making, and 2 in home dairy work. All passed, but certificates were with held from a number owing to lack of experience.

It is gratifying to know that a number each year send in the monthly reports for professional diplomas. Those applying this year are: J. W. Newman, Roebuck, Ont. (cheese); John McCready, West Lima, Wis. (cheese); T. B. Code, North Rideau, Ont (cheese); Harvey Mitchell, Sussex, N. B. (butter); S. J. Taylor, Regina, N. W. T (butter).

Most of our students came from the Province of Ontario. There was one student each from the following Provinces, States, and countries: Quebec, Manitoba, British

Columbia, Pennsylvania, U.S.A., Scotland and England. We had demand for more students as makers and helpers last spring than we could supply. So far as we know, all who were capable of working in creameries or cheese factories secured places at the close of the term or shortly after.

To the Instructors in the Dairy School and the Lecturers from the College, I am indebted for their efficient work during the term.

Care of Milk for Cheese-making.

There is a diversity of *opinion* as to the best methods of caring for milk to be manufactured into cheese, and but few *accurate experiments* have been made to discover what is really the best plan. During July, August and September, some 40 experiments were made by treating the milk from our own herd in different ways in order to gain some definite knowledge on the subject. Most cheese makers advocate aeration of the milk, and say that if the milk is properly aired, it will not require cooling. Others recommend airing and cooling, while the average patron thinks that nothing is necessary. We have found it a very complicated problem and one which will require several year's investigation in order to ascertain the effects which the cows themselves have on the milk, the effect of pasture, the effects of weather, methods of handling, etc. At present, I am inclined to think that the peculiar condition of the atmosphere at times is largely responsible for "gassy" and other flavors, assuming that cleanliness is observed. Under certain conditions the milk from our own cows is "gassy," no matter how it is handled; and this is probably true of many, if not all herds of milk cows. At certain times the growth of bad-flavored organisms is very rapid and it is difficult, with our present knowledge, to prevent them growing. Here is a field for the Dairy Bacteriologist to work in, and find out how the bad crop of germs may be best controlled.

Our experiments during the past season may be classified as follows: 1. Effect of aeration of milk at the stable, in the cow yard, and in the pasture field; 2. Effect of aeration combined with cooling by means of ice; 3. Effect of cooling without aerating; 4. Effect of milking in the stable, yard, and the pasture field; 5. Effect of rejecting the first few streams of milk from each teat; 6. Effect of aerating milk one day and not aerating the next; 7. Care of Saturday night's milk.

We shall treat them under two general headings: Effect on sweetness of milk, and on quality of curd and cheese.

At the time of the experiments, we were milking about 25 cows. Some were fresh and others were in various stages of lactation. Our herd consists of a mixed lot—some pure-bred Holsteins, Jerseys, and Ayrshires, and the remainder, grades of various breeding.

The Champion aerator was used in most of the work. A few trials were made of the Cornett aerator and agitator. The aerated lots were usually run over the aerator twice. The temperature of the air at night varied from 59° to 86°. The temperature of the air in the morning varied from 42° to 70°. The temperature of the milk at night was 90° to 96° before aerating, and 84° to 94° after aerating. The night's milk which had been aerated was 54° to 73° the following morning. The unaerated night's milk was 55° to 74° the following morning. The rennet test of the aerated milk was 21 to 29 seconds, and that of the unaerated 12 to 26 seconds the following morning. The quality of milk in each lot varied from 109 to 120 lbs. in one can. When the temperature of the air at night was 80° or above, the milk which was aerated twice over the Champion without any cooling other than that done by the atmosphere, was very ripe, or sour, the following morning. The same was true of the Cornett aerator.

When the temperature of the night air was under 80° and that of the morning air under 70°, the milk was in good condition the following morning, by aerating only. When 4 to 6 lbs. of ice were placed in a shot-gun can and the can set in the milk after aeration, or in the unaerated milk in hot weather, the milk was sweet the following morning. On Aug. 28, when the temperature of the evening air in the milk stand was 84°, and the temperature of the morning air 60°, and that of the milk 95° in the evening and 68° in the morning, a can of milk containing 152 lbs. was set in a tub of cold water and the Cornett agitator set going. The following morning the rennet test of the milk 8 seconds, or, in other words, it was nearly sour. Ten pounds of ice were put in the

water the following evening, and the rennet test was 20 seconds, which means that it was sweet.

To sum up the whole question of aerating and cooling in their effects on the ripeness of milk, these experiments indicate that aeration alone is not sufficient to keep milk sweet over night and in good condition for cheesemaking the following morning during hot weather, or when the air is above 80° at night, or not below 70° in the morning; but a very small amount of ice placed in a can and the can set into the milk will keep it all right. This is necessary only on hot nights.

For keeping the milk sweet, 4 to 6 lbs. of ice in a can, set in the milk, was more effective than aeration.

Flavor and Gas in Curd as Affected by Place of Milking and Place of Aeration.

On July 19th, the cows were milked in the yard, stable, and pasture field, and half the milk was also aerated in the yard, stable, etc., and the other half not aerated at all. Possibly the best plan to show the effects will be to give the treatment of the milk each day and the comments of our cheesemaker, Mr. Stratton.

July 19th. Cows milked in yard. High wind blowing the dust about very badly. Milk in A vat was aerated in yard; in B vat, not aerated. Both curds had an equal amount of gas. B curd had also a weedy flavor. A cheese scored 90 points, B 93, on Aug, 30th.

July 20th. Cows milked in yard. Wind did not blow. A vat aerated in yard; B not aerated. Acid slow in A. B vat very gassy. A cheese scored 88, and B 87, on Aug. 30th.

July 21st. Cows milked in yard. A vat of milk aerated in yard; B not aerated. Curds in both seemed good until heated; then they developed a very bad flavor. Cheese scored 91 and 92 on Aug. 30th. Both scored 84 points on Sept. 19th.

July 22nd. Cows all milked in pasture field, half mile from dairy buildings. Milk in A vat aerated in pasture field; B vat not aerated. A was a nice curd; B had very little gas, but a very bad flavor. B vat, washed twice at dipping time. Score of cheese on Aug. 30th—A, 93; B, 88 points. Flavor, 37 and 36 out of 40.

July 25th. Cows milked in stable. Milk all run over Champion aerator once in stable and once at dairy. Milk not divided. Curd very gassy. Cheese scored 85 points on Aug. 30th.

July 26th. Cows milked in stable, but milk carried outside and aerated once in yard. Aerated again at dairy. Rained previous day. No dust blowing. Gassy at milking time, but nice when salted. Cheese scored 93 points.

July 27th. Cows milked in stable. First six streams from each teat put into separate pails. Weight of rejected milk in evening, 12½ lbs., testing 1.5 per cent. fat. Morning milk rejected, tested 1.3 per cent. fat, and weighed 15 lbs. Milk very ripe. Curd washed with cold water after being heated to 108° before dipping. Score of cheese, 65 points.

July 28th. A vat from dairy herd. Cows milked in yard and milk aerated in yard and once at dairy. B vat of milk from patrons' regular delivery and not aerated. Both curds gassy. No starter used. Cheese scored 90 and 91 points. Both scored 36 in flavor.

July 29th. Cows milked and milk aerated in pasture field. Milk over-ripe. Curd washed with cold water after heating to 106°. After milling, curd had a "slimy" feeling and flavor not good.

Aug. 1st. Cows milked in stable and milk aerated at stable and once at the dairy. Starter used in milk. Curd slightly gassy, but after milling the gas and gassy flavor disappeared. Score of cheese, 89, on Sept. 19th.

Aug. 2nd. Cows milked in stable, but milk was aerated in yard once as milked and once at dairy after milking. Starter used. Curd gassy. Score, 89.

Aug. 3rd. Cows milked in stable, but first few streams from each teat put in a separate pail. The night's and morning's rejected milk weighed 30 lbs. and tested 1.5 and 1.3 per cent. fat. One-half a per cent. of starter used. Curd very gassy. Score of

cheese on Sept. 19th was 90 points. Messrs. Bell, Brill and Steinhoff each scored this cheese on Nov. 17th, and gave it respectively 89, 92 and 94 points.

Aug. 4th. Cows milked in yard. Milk aerated once in yard and once at the dairy. One-half a per cent, of starter used. Curd worked nicely. Best flavor and least gas of any day during the week. Score, 91 points.

Aug. 5th. Cows milked in pasture field and milk aerated in pasture field. Starter used. Curd gassy. Flavor fair. Score, 88, on Sept. 19th.

Aug, 8th. Cows milked in stable. Milk not aerated. Flavor of curd very bad. No starter. Little gas. Curd weak in body. Score, 91, on Sept. 19th.

Aug. 9th. Milk run over Champion aerator twice. No starter. Milk sweet and ripened slowly. Bad flavor at dipping time, which disappeared at salting. Curd gassy. Score of cheese, 87.

Aug. 11th. Milk aerated twice. No starter. Curd worked nicely. Some bad flavor at dipping time. Good curd at salting. Score, 90, on Sept. 19th, and it was given 83, 87 and 35 by the judges on Nov. 17th.

Aug. 12th. Milk not aerated. Milk over-ripe. Washed curd after dipping. Flavor fair. Score, 78.

These experiments were continued up to Sept. 29th. Sometimes half the milk from the dairy herd was aerated and the other half was not aerated in any way. At other times all the milk from the herd was aerated one day and left unaerated the next. There was very little difference in the curds or in the quality of the cheese, as shown by the average score of the cheese in the table. Where the milk was mixed together before aerating, and while the milk was warm, the cheese have an average total score of exactly the same, though the cheese made from the aerated milk was slightly better in flavor. Where the milk was not mixed together, but all the milk aerated one day and left unaerated the next, the average score of flavor is slightly better in the unaerated cheese, and the total score is also higher.

Average score of cheese from aerated and unaerated milk.

—	—	Average lbs. milk used.	Average per cent. fat in milk.	Average lbs. cheese per 1,000 lbs. milk.	Average flavor. (Max. 40.)	Average closeness. (Max. 15.)	Average texture. (Max. 20.)	Average total. (Max. 100.)
Milk mixed together before aerating half of it...	Aerated...	290	3.55	94.04	36.04	13.09	17.14	90.04
	Unaerated	287	3.55	93.19	35.45	13.36	17.23	90.04
Milk not mixed together..	Aerated...	.....	.....	.....	34.18	13.07	16.78	88.11
	Unaerated	.....	.....	.....	36.13	13.33	17.13	90.93

Conclusions.

1. Milking and aerating in the pasture field gave two very good curds and one bad curd, chiefly due to milk being over-ripe.

2. On certain days the curds were gassy, no matter where the cows were milked or how the milk was treated. A good flavored starter in the milk seems to be the best remedy for gassy and other bad flavors.

3. Rejecting the first few streams of milk from the teats of each cow did not prevent gas forming in the curd.

4. In these experiments aeration of the milk did not prove so beneficial as we expected. When the cows are healthy and are fed on clean food and are milked in a cleanly manner, in a clean place, aeration is probably of no particular advantage to milk for cheesemaking. Aeration to some extent cools milk and is thus advantageous in keeping it sweet.

5. Further experiments are needed before coming to definite conclusions.

Saturday Night's Milk.

In many cheese sections it is customary to make the milk of Saturday evening into butter or cheese during Saturday night and Sunday forenoon. This makes a slave of the cheesemaker who has practically no rest during the week.

During July and August some experiments were made to find to what temperature it was necessary to cool the milk on Saturday evening in order to have it in good condition on Monday morning.

The milk from the dairy herd was divided into two lots, and put into cans which were placed in cold water. The temperature to which the milk was cooled ranged from 46° to 64°. It will be noticed in the table that when the air in the milk-stand was 72° to 82° and the milk cooled to 62° to 64° the milk was nearly sour on Monday morning, and would in all probability be rejected at a cheese factory. A can of similar milk kept in the same place but cooled to 52° to 54° was in good condition on Monday. When the temperature of the air in the milk-house is between 70° and 85° it is necessary to cool to between 50° and 55° for good results. When the temperature of the air is between 65° and 75°, cooling the milk to 56° to 58° gave good results. During the summer it is seldom safe to hold milk until Monday at a temperature above 58° to 60°, and in hot weather it should be cooled to 50° to 55°. In these trials the milk was not aerated any more than the necessary aerating which it received by stirring it with a dipper while cooling.

On August 12th one lot of 95 lbs. was put into a can and a lot of similar milk was divided among four shot-gun cans to see the effect of keeping milk in a smaller bulk. There was no difference in the sweetness or general condition of the two lots of milk.

Saturday night's milk set in tank of ice water and stirred with dipper.

Date.	Pounds milk in each can.	Temp. of air. Min. and max.	Temp. of milk. (Range.)	Rennet test on Monday morning. Seconds.	Remarks.
July 15.....	110	72° to 82°	62° to 64°	9	Milk would be rejected at a factory.
			52° to 54°	25	Good condition.
" 22.....	95	67° to 73°	56° to 58°	25	" "
			46° to 48°	35	" "
" 29.....	98	52° to 70°	56° to 58°	26	" "
			46° to 48°	37	" "
Aug. 5.....	96	56° to 73°	58° to 60°	24	" "
			50° to 52°	30	" "
" 12.....	95	52° to 70°	54° to 56°	31	One lot was divided into 3 shot-gun cans. No difference in rennet test.
			54° to 56°	31	

Careful *vs.* Rough Handling of the Curd.

On July 7th and 8th 1200 pounds of milk were thoroughly mixed in a vat each day. Six hundred pounds were then weighed into another vat and both treated exactly alike except that one vat of curd was handled very roughly at cutting, and during the heating process the other vat was handled as carefully as possible to see the effects upon yields of cheese and texture of the cheese. The 600 pounds of milk handled carefully yielded about one pound of cheese extra, as compared with 600 pounds of similar milk handled carelessly. There was not much difference in the quality of the cheese. The texture was practically the same in both lots.

On July 10th 1200 pounds of milk as delivered by the patrons were placed into one

vat, and 1200 pounds put into another vat. The treatment was the same as on the 7th and 8th, except that the milk was not previously mixed together. Again there was an increased yield of cheese from that which was carefully handled, but the difference in quality was very little.

The lesson to be learned is that cheesemakers should handle the curd very carefully at the cutting and also during the heating of the curd, or there will be a loss of cheese. On a vat containing 6,000 pounds of milk the loss may be as much as 10 pounds of cheese. This loss will nearly equal the extra wages of a first-class maker over what is paid to an inferior man that is careless in his work.

Curing Cheese at Different Temperatures.

These experiments were conducted on much the same lines as those of last year. The College curing-room is divided into three compartments which were kept on an average temperature of about 60°, 65° and 70° respectively.

The cheese made in the College dairy each day from May to October were always from the same vat of milk and when taken from the press were carefully weighed and marked A. B. and C. They were then placed in the different rooms at the temperatures given. These cheese were weighed at the end of a month and the per cent. of shrinkage noted. The cheese were scored at different times by experts. Two lots were sent to Stratford for scoring by Thos. Ballantyne & Sons, and by Mr. I. W. Steinhoff. Messrs. A. T. Bell, I. W. Steinhoff and G. J. Brill scored the September and October cheese on Nov. 17th. each scoring separately, and where there was much difference in the scores, the three judges together scored them a fourth time.

Green cheese were also obtained from the Freelton factory during the five months from June to October, and from the Rockwood factory during four months, June to September. One lot of three cheese were got from each factory every month. These were carefully weighed, marked and placed in the curing-rooms along with the College cheese.

The main points of the experiments are summarized in the tables.

Four experiments, factory at Rockwood.			A.	B.	C.
Size of room, cubic feet			863.	1,344.	863.
Method of controlling the temperature			Ice.	Sub-earth duct.	No control.
Method of controlling moisture			"	"	"
Highest temperature in room			67.°	72.°	80.°
Lowest "			52.°	58.°	56.°
Average "			59.4°	64.8°	68.3°
Highest per cent. moisture in room			90.	90.	90.
Lowest "			67.	53.	50.
Average "			80.0	79.0	72.6
Average per cent. shrinkage in cheese in one month			2.71	2.78	3.26
Quality of cheese	Average flavor	Max. 40	32.11	30.0	29.22
	" closeness	" 15	13.88	13.66	13.67
	" color	" 15	14.11	13.78	14.00
	" texture	" 20	17.78	16.89	16.55
	" total score	" 100	87.88	84.33	83.44
Five experiments, factory at Freelton.					
Average per cent. shrinkage in cheese in one month			2.10	2.23	2.78
Quality of cheese	Average flavor	Max. 40	35.58	33.25	33.83
	" closeness	" 15	14.46	14.00	13.75
	" color	" 15	13.83	13.75	13.50
	" texture	" 20	17.17	16.58	15.50
	" total score	" 100	91.04	87.58	86.58

Summary of cheese-curing experiments, six months, May to October. Cheese made

in College dairy. The highest outside temperature was 98 degrees, the lowest 18 degrees, and the average 59 degrees.

Total number of experiments, 54.		A.	B.	C.
Size of room, cubic feet		863.	1,844.	863.
Method of controlling temperature		Ice.	Sub-earth duct.	No control.
Method of controlling moisture		"	"	"
Highest temperature in room		67.°	72.°	80.°
Lowest "		52.8	58.°	56.°
Average "		59.4°	64.8°	68.3°
Highest per cent. moisture in room		90.	90.	90.
Lowest "		67.	53.	50.
Average "		80.0	79.0	72.6
Average per cent. shrinkage in cheese in one month		4.40	4.54	4.89
Quality of cheese	Average flavor ..... Max. 40	36.01	35.46	35.51
	" closeness ..... " 15	13.62	13.27	13.15
	" color ..... " 15	14.23	14.21	14.12
	" texture ..... " 20	18.15	17.69	17.53
	" total score..... " 100	92.01	90.63	90.31

Conclusions.

1. The shrinkage, or loss in weight, during the curing for one month was about one half of one per cent. greater curing at 70° as compared with curing at 60°. A factory making half a ton of cheese per day would lose five pounds more per day in the curing at 70°, as compared with curing at 60°. Five pounds of cheese would mean a loss of about 50 cents per day during the past season. For 200 days the difference in loss would be about $100 on shrinkage alone.

2. The cheese cured at a temperature of about 60° were also better in quality, though there is not the same marked difference as there was last year. This is accounted for by the fact that the nights were much cooler this past season, and the strong demand for cheese inclined the judges to look with more favor on the cheese which were cured most at the time of scoring. This was especially noticeable in the lots sent to Stratford.

There was the same difference in quality of the cheese made in the two factories where the weights of the cheese were 75 to 80 lbs. as there was in the College cheese weighing about 30 lbs., or even more so, especially in flavor. It was more pronounced in the Rockwood cheese, which apparently had more moisture. It will be noticed in the table that the difference in flavor of the College cheese was only about half a point as the average of the season, while the difference in flavor of the Rockwood cheese was about three points, and in Freelton cheese two points. The difference in texture also is not so marked as it was last year, there being but half a point in the College cheese, one point in the Rockwood, and one and a half points in the Freelton cheese by curing at 60° and 70° respectively.

Curing Cheese at High Temperature for a Week, then Placing in Medium and in Cool Rooms.

From May 15th to July 15th five cheese were made from one vat of milk on eleven different dates. These cheese weighed about 30 lbs. each. Three of them were placed in the room averaging about 70° as soon as taken from the hoops. At the end of a week one of these three was placed in the cool room, averaging about 60°, and another was placed in the medium room, averaging about 65°, while the third was allowed to remain in the warm temperature. One each of the remaining five cheese were placed in the cool and medium temperatures at once after taking them from the hoops. The object of these experiments was to note the effects on shrinkage and quality of cheese from placing the green cheese for a while in a warm room to start the curing or ripening and then finish the process in a cool and medium temperature.

The average shrinkage of the cheese placed in the cool room and allowed to ripen there was 4.31. Those placed in a medium temperature lost 4.73 per cent., and those cured at 70° lost an average of 5.05 per cent. The cheese placed in the warm room and then moved to a cool room lost 4.25 per cent. in weight during the four weeks, and the lot moved from the warm room to a medium temperature lot 4.62 per cent. in four weeks, one week of which was in the warm room.

The conclusion may be drawn that the loss of weight during the curing is almost directly affected by the temperature of the curing-room. The higher the temperature the greater the loss of weight while ripening. Other factors no doubt affect this loss, but temperature seems to be a very important one.

QUALITY OF THE CHEESE CURED AT FIVE TEMPERATURES.

Av. Temperature for Curing.	Av. Flavor. Max. 40.	Av. Closeness. Max. 15.	Av. Color. Max. 15.	Av. Texture. Max. 20.	Av. Total. Max. 100.
60°	36.71	13.75	14.06	18.33	92.85
65°	36.29	13.47	14.12	17.97	91.85
69°	35.87	13.27	14.12	17.69	90.97
69° one week then 60°	36.24	13.52	14.13	18.02	91.92
69° one week then 65°	36.35	13.61	14.06	18.15	92.17
Average of all.	36.29	13.52	14.09	18.03	91.95

CONCLUSIONS.—It will be seen by the foregoing table that there was little difference in the quality of the cheese cured at these different temperatures. What difference there is in quality is in favor of curing at about 60°. Curing at 69° for a week and then curing at 60° for the remainder of the time gave practically the same results as curing at 65° for the whole period, and slightly better results than curing at 69° for the full term. Curing at 69° for a week, then finishing at 65°, gave the next best results to curing at 60°. Taking the results as a whole there was not the difference in quality we might expect, judging from the results of experiments in 1898; but there is apparently no advantage in curing at a high temperature for a week, as advocated by some authorities. However, another year's experiments may give different results.

A BAD FLAVOR IN CHEESE.

In the Middlesex and Elgin districts this past season the makers were greatly troubled with a bad flavor in the curd and cheese. In these sections it is locally termed "the Billy Goat flavor." It was also troublesome more or less in other western sections, where it is sometimes called a "Goose flavor." Mr. Stratton found that it is also giving some difficulty in the eastern factories. One of the worst cases was at Avon, in Elgin county. A peculiarity of the flavor is that it can seldom be detected in the milk, although Mr. Scott, of Harrietsville, says he detected it one morning in the milk, and the flavor was present on the curd and in the cheese. The milk appears to work normal, or at times a little "fast," and the flavor does not appear to develop until the acid shows on the curd, as tested by the hot iron. I brought a sample of two cheese from the Avon factory and submitted them to the College bacteriologist. He made cultures from them, and we made cheese from some of the cultures, but there was no "Billy Goat flavor" about the cultures or the cheese.

Later the maker sent down some curd that had the "flavor," and a culture from this gave the undesirable aroma in the curd and in the cheese. This curd was from the only batch in the Avon factory having this flavor from August 1st to August 10th. Another peculiarity about the flavor is that it does not appear every day but may skip several days, and when the maker thinks that his troubles are past it reappears in one or more vats. Sometimes it may be in one vat only, sometimes in two, or in several.

The cheese made from a culture of this bad-flavored curd had all the characteristics of the "B. G." flavor for two or three weeks. It gradually disappeared, however, until, when scored on Nov. 17th, it could not be detected, and the cheese was very fair in quality.

Mr. Archie Smith, one of the instructors for the Western Cheese and Butter Association, gives the following as his method of treating the curd to overcome the difficulty: "Heat the milk to 84° in the vat and set, using not less than 3½ ounces of rennet per 1,000 lbs. milk. If the milk is working fast enough to allow the curd to dip in 2¾ to 3 hours I would heat up to 88° or 99° at once; but if the milk is working slowly, I should heat to but 94° to 96° and stir it continually until the acid begins to show on the hot iron. Then heat quickly to 99° or 100° and run the whey to the surface of the curd. Stir the curd well until it shows nearly an eighth of an inch of acid; then dip. The curd will be quite soft and I do not attempt to firm it at this stage, but merely turn it over three or four times quickly, so as not to allow it to mat together, being careful to bruise it as little as possible. Leave it spread over the curd sink three or four inches deep, then cut it in small narrow strips and do not pile it. By this method the curd will drain well, and there will be no loss of butter or white whey. The acid will develop very quickly, and when it shows 1 to 1¼ inches on the hot iron I would mill immediately. After milling wash it thoroughly with clean water at a temperature of 94° to 96°. This will wash out the sour whey, firm the curd and help the flavor. Keep the curd well spread over the sink, stir frequently, and do not allow it to mat. Air it as much as possible and keep up the temperature until just before salting. Cool to 80°, if you can do so, before putting to press. Use one-quarter of a pound more salt per 1,000 milk than with an ordinary curd."

Methods of Controlling Temperature in Cheese-curing Rooms During Hot Weather.

A great deal of interest has been aroused among cheese-makers and factory owners in the question of curing cheese at a moderate temperature in hot weather. Owing to the cool nights of the past season, and the great demand for cheese, the full benefits of the various systems advocated and used were not ascertained. It is in a hot season, with hot nights and a slow demand for cheese, that the value of sub-earth ducts, ice-boxes, air compressors, pans, etc., are demonstrated.

In connection with this question I visited the following factories in Western Ontario in April and May and gave help in the construction of ducts: Woodburn, Canboro' and Lyons. I also visited Nilestown, Dorchester, Harrietsville, Mapleton, and Glanworth factories about the same time. In July and August I visited Norwich Junction, Dunboyne, Malahide, Northwood, Lyons (2nd visit), Springfield, Brownsville, Culloden, Avon, Harrietsville (2nd visit), Strathallan, Tavistock, Woodburn, (2nd visit) Caistorville, (2nd visit), Canboro and Caledonia.

There are ducts in the following: Woodburn, Canboro', Caistorville, Caledonia, Lyons, and Dunboyne. At Springfield, Harrietsville, Strathallan, and Tavistock there were ice-boxes in the curing-rooms, but at Strathallan only did I find any ice in the boxes, though the rooms ranged from 70° to 73°. The temperature in the curing-room at Strathallan was 70° at about 5 feet from the floor, but the air at the bottom of the box was 60°, while in the shade outside it was 78° at the time of my visit on August 2nd. So far as I could gather from those who had the ice-boxes, they could prevent the temperature from going above 70° by a liberal use of ice, but the labor of getting in the ice is quite a serious drawback in factories where the help is limited.

At Nilestown there is a single row of iron pipe about the curing-room into which spring water may be turned when needed for cooling. This is a cheap and effective method where cold water is convenient.

Construction and Cost of Sub-earth Ducts.

Last year I described in detail the construction of the duct to the College curing-room. The following are some of the main points in the ducts which have been put in during the past season:

The first factory that I visited to give help in placing a sub-earth duct was that of Mr. J. N. Paget, Canboro', in Haldimand County. I assisted with the laying of the tile in April and again visited the factory in August. The soil is a heavy clay and gave considerable trouble by caving into the trench. This duct averages seven feet in depth and has four rows of 5-inch drain tile in the bottom of the trench, with one row of 5-inch and

two rows of 4-inch lying directly on top. A circular brick curb at the farther end of the duct forms the inlet for the air to the tile. It was Mr. Paget's belief that a tall pipe would not be necessary on top of the brick curb, but he found that the draft was not good, so he had a conical-shaped, wooden inlet made, with a cowl on top, made of galvanized iron. The wooden part is three feet square at the base and 20 inches at the top, made of 2x4 scantling and covered outside with half-inch lumber. The height is 31 feet, but the factory is located on the high bank of a creek, with no high buildings near to hinder the draft. The drain for water that might accumulate in the duct was placed at the factory end, because most convenient, though I would prefer it at the other end. The whole length of the duct is 150 feet, and cost $80.

I took the following observations on August 11th: Velocity of the wind outside, 250 to 500 ft. per minute. Velocity of air entering the curing room through the duct, 80 to 110 ft. per minute. Temperature outside in shade at 3 p.m., 78°; in the sun at side of curing-room 92°. Temperature in the duct 62°; in the room 72°. This curing-room is not well insulated, and it very seldom went above 72° during the summer. Mr. Paget is well pleased with the duct, and proposes to insulate the room thoroughly for the coming season, when the results will be better. (Since this was written have heard that factory was burned to the ground).

The second factory visited was Woodburn, in Wentworth County, owned by Mr. A. J. Edwards. I assisted in the laying of the tile in April and again called at the factory on August 10th. This duct is 152 feet long and averages seven feet deep. There are three rows of 6-inch drain tile in the bottom of the trench, and three other rows placed directly on top, though the joints were broken. The drain for carrying off water is about the centre of the duct. The inlet pipe was built 38 feet high at first, but the draft was very poor, owing to the fact that there are a number of tall elm trees near the factory and buildings on the side of the prevailing winds. He was compelled to add several feet to the intake pipe, and it is now 62 feet high with cowl on top, the whole made of galvanized iron, 15 inches in diameter. Before the intake pipe was heightened, Mr. Edwards tried lengthening the outlet pipe from the curing-room, but this was not satisfactory. The curing-room is well lined and has double windows and doors. On August 10th the velocity of the wind outside was 115 to 150 ft. per minute at 8 a.m. Inside, the air was entering at the rate of 50 to 75 feet per minute, though at times the draft was not sufficient to move the anemometer. The total cost of the duct was $65, exclusive of Mr. Edwards' own labor. He did most of the excavating and the carpenter work. He was pleased with the results after getting the inlet pipe of sufficient height.

The proprietor of the Caistorville factory is Mr. A. W. Edwards, a brother of Mr. A. J. Edwards He was at Woodburn at the time of my first call. He put a duct into his factory without any further assistance. The factory is on the bank of the Chippewa Creek, and Mr. Morrison, instructor for the Cheese and Butter Association, reported this duct during the summer as giving excellent satisfaction. The duct is 115 feet long and 8 feet deep. The tile consists of 3 rows of 5-inch, 2 rows of 6-inch and one row of 8-inch. The intake pipe is made of galvanized iron and is 30 feet high. The inlet to room is simply a hole cut in the floor, and the outlet is into a room above with no direct connection outside. The factory and curing-room are poorly constructed and the loss of "grease" was very great in former years.

In the forenoon of August 10th there was little or no draft into the room, though there was a very faint breeze outside. After dinner the wind outside was moving 115 to 270 feet per minute, and inside it was 70 to 155 feet per minute. The temperature outside in the shade was 78°, inside 68°, and in the duct 64°. In the early part of the season a stream of water flowed under the tile in the duct, and this, no doubt, helped considerably to cool the air, On August 10th the stream had practically dried up. The total cost of this duct was $65, exclusive of Mr. Edwards' own labor.

If the curing room were properly insulated this duct would give excellent service, although, as it is, the proprietor is well satisfied with his expenditure.

In the same district is the Caledonia factory, Haldimand County. The owner, Mr. J. M. Clysdale, built a duct 153 feet long and 6 feet deep. He used 7 rows of 5-inch tile, 4 in the bottom and 3 rows directly on top. This duct did not work so well as the others, owing to the fact that the inlet pipe is but 30 feet high and is located in a hollow, surrounded by trees. The pipe was made of boards put together lengthwise. He pur-

poses adding 15 or 20 feet to the pipe next season. The duct cost about $100. On Aug. 11th the temperature in the room at 8 a.m. was 70°, though it was but 68° in the shade outside. The air was very still, not enough to move the anemometer at times, though occasionally it reached 110 ft. per minute. There was no perceptible draft into the room. The curing room is a very large one, and the owner proposes to put a partition through it before another year.

The owner of the Lyons factory in Elgin Co. is Mr. J. H. Williams, an ex-student of the Dairy School. His duct is 168 feet long, and 6 to 8 feet deep. He used two rows of 10-inch tile. The intake pipe is made of inch boards put together lengthwise, with white lead and twine along the edges to make a tight joint. The pipe is 50 feet high with a galvanized iron cowl on top, the mouth of which is about 3½ feet in diameter. The pipe sits over a well, but is not connected with it any more than the opening on top. The tile of the duct also opens into this well. For leading the air from the duct into the curing-room Mr. Williams used tile with elbows to connect the main drain with the rooms, thus doing away with the need of curbs. This is the only place I have seen drain tile with the elbow for making a turn.

The velocity of the air outside on August 14th at 9 a.m. was 200 to 300 feet per minute. Coming into the room the air travelled 70 to 100 feet per minute. Temperature outside in shade was 70°, in the curing room 64°, in the duct 60°. The curing-room is divided and the rooms had not gone over 70°. The owner was very well pleased with the working of the duct. Mr. Williams wrote on Nov. 18th, "My duct cost me $60, but I would not be without it for a good deal more than this sum. In the hottest weather my curing-room never rose more than three degrees."

The Dunboyne Cheese Co., in Elgin Co., put in a duct about 80 feet long—60 outside the factory and 20 under the factory. The depth is 6 ft. at the inlet end and only about 3 ft. deep under the factory. It has 3 rows of 6-inch drain tile—2 in the bottom and one on top. The intake pipe is 25 feet high, made of galvanized iron, 10 inches in diameter with cowl on top. The air enters the curing-room through a house register set in the floor about the middle of the room. There are two outlets for the warm air from the room. At two o'clock in the afternoon of July 31st the temperature in the shade outside was 73°, in the curing-room it was 69°. Velocity of wind outside 200 to 300 ft. per minute; inside, 50 to 80 ft. per minute. I was unable to get the cost of the duct as none of the officers of the cheese company were present. The maker informed me that the results had not been so good as they anticipated, due, no doubt to the shortness and shallowness of the duct, especially as it ran through a sandy knoll which would warm quickly during hot weather.

Points in building sub-earth ducts:

1. Have the duct at least 100 ft. long, 150 to 200 ft. is better.
2. Have it at least 6 feet deep, 8 or 10 feet is better.
3. Use from 5 to 6 rows of 6-inch tile, or about 2 rows of 10-inch.
4. Have the intake pipe from 30 to 60 feet high—above all surrounding trees or buildings. It may be made of wood or galvanized iron.
5. Have the mouth of the cowl from 3 to 4 feet in diameter, and the vane so constructed that it responds readily to changes in the direction of the wind.
6. Make the connection between the intake pipe and the tile in the ground, as well as the connection between the tile and the curing-room, by means of a wooden or brick curb, or by the use of tile having an elbow for the turn.
7. Regulate the inlet of air to the curing-room by means of a register, or by a small door on hinges.
8. Regulate the outlet of warm air from the room by means of an ordinary ventilator. The height or size of this ventilator does not appear to be a very important point.
9. Have the cool air enter at one side of the room and the warm air leave at the opposite side, or have the cool air enter at two to four different points near the walls, and the warm air to leave near the centre of the room.

A duct for an ordinary factory need not cost over $60 to $100.

Methods Other Than the Sub-earth Duct.

Water.—As previously noted, the Nilestown factory has a single row of water pipe around the room and this is filled with cold spring water for cooling the room. In factories

that are so situated where they have an abundance of cold water, the curing-room may be cooled by means of water. The pipes used for cooling may also be used for heating from the boiler in cold weather, by having suitable valves and connections for heating, allow one linear foot of inch pipe for each 20 cubic feet of space to be warmed. These pipes may be conveniently arranged along two or three sides of the curing-room or between the shelves and may be used for both heating and cooling. Drip pans under the pipes would be necessary for the summer, to catch the condensed moisture of the room.

Fans.—The cheesemaker at the York factory, Mr. Bond, purposes using a "blower" or fan, similar to that used in the saw-mill at York, for cooling his curing-room. Mr. Morrison, inspected the "blower" at the saw-mill in October at my request, and sends the following notes: "I examined the saw-dust blower, of which Mr. Bond spoke when in Brantford and found it to be a wooden cylinder, two feet in diameter, having four fans 6 in. x 6 in. The cylinder makes 2,200 revolutions per minute, and the dust is forced through a 7 inch stove pipe, 35 feet long. The temperature of the air at the entrance of the blower was 63°, and at the outlet of the pipe the air came out at 53°. The proprietor claims that no matter if the air is 70° or 80° at the entrance, it will come out at 52° after it has been running for some time."

This is a method of cooling curing-rooms that is worth looking carefully into.

Compressed Air for Cooling Curing-Rooms.

In the latter part of August, Mr. Stratton, our cheesemaker, visited the following factories in eastern Ontario, to note methods adopted there for controlling temperature in cheese curing-rooms: Kingston Dairy School, Cataraqui, Collins' Bay, Bayside, Gilead, Algonquin, Domville, Glenmore, North Augusta, Roebuck, South Branch, Willow, Bishop's Mills, Farmers' Union, Farmers' Own, Old Fairfield, Rideau Valley, Roseville, Barlow, Glen Buell, Maple Grange, Orchard Valley, Newbliss, New Klondike, Addison, and Frankville.

At the Kingston Dairy School he found the rooms fitted similarly to our own at Guelph, with a sub-earth duct and ice for cooling. The most interesting factory, and about the only one visited which had done anything special to control the temperature, was Mr. J. W. Newman's, at Roebuck, in Grenville Co. Mr. Newman is a graduate of our 1899 dairy class. On his return to practical work in the spring of this year he began investigating the question of temperature in the curing-rooms, and, as a result, concluded that compressed air would best serve his purpose in maintaing a moderately uniform temperature of 60° to 65°. Mr. Newman very kindly furnished the following details of the system used in his factory:

1. The contents of our reservoir is about 140 cubic feet.
2. The contents of our curing-room is about 4,700 cubic feet or about 34 times that of reservoir.
3. Our compressor (a Westinghouse 8 in. x 8 in.) should deposit 20-43 of one cubic foot of air at each full stroke.
4. Our compressor makes about 3,300 full strokes to fill reservoir to 90 lbs. pressure in 45 minutes.
5. At 90 lbs. pressure, air is compressed about seven times.
6. At 90 lbs. pressure our reservoir contains about 1,000 cubic feet of air at natural density.
7. Emptying our reservoir from 90 lbs pressure to 0 actually cools our room from 10 to 12 degrees F., though the room is not well insulated.
8. The air to be compressed should be taken from near the ceiling of the curing-room.
9. The compressed air should be passed through brine to cool it and also to purify it. It may also be stored in brine tanks for future use.
10. It requires an average of four horse-power for 45 minutes to fill the reservoir to 90 lbs. pressure, though at 90 lbs. pressure 6 horse-power is required.

Mr. Newman adds: "I believe this system could be simplified and cheapened so as to displace all other systems for cooling to moderate temperatures."

Effect on Fat in Milk when Cows are First Put on Pasture in the Spring.

For seventeen days before the cows in the dairy herd were turned on pasture—from

May 15th to May 31st—the milk from the whole herd was sampled carefully and weighed. The per cent. of fat was determined with the Babcock tester. The average per cent. of fat in the morning's milk was 3.69. In the evening it averaged 3.8 for the seventeen days. The lowest test was on the morning of May 20th, when the fat was 3.3 per cent. The highest was 4.7 on the evening of May 16th.

On June 1st the cows were turned out to pasture and the average percentage of fat in the morning's milk was 4.36 for the next seventeen days. The evening's milk averaged 4.47. The milk tested 3.5 on the morning of June 1st. The evening milk of the 1st of June tested 3.6. The morning's milk of the 2nd tested 3.9 and the evening's milk tested 3.4—the lowest test during the seventeen days after being turned out to pasture. The highest test was 5.3 per cent. of fat on the evening of June 16th. The average of both the morning and evening tests was higher during the first seventeen days on pasture than it was when the cows were in the stable and yard. This agrees with experiments made in previous years, which showed that the cows of our herd gave richer milk when first turned out to pasture than they did in the stable. This is contrary to the views of most dairymen, who are of the opinion that "grass makes thinner milk."

The cows also gave more milk on the pasture. Whether this difference in the quantity and quality of the milk was altogether due to the feed or not is an open question. The probabilities are that the difference was due more to the congenial surroundings of the cows than directly to the feed.

Changes in Colostrum Milk During 21 Milkings.

During the season tests were made with the lactometer and Babcock tests of five cows in the herd for the first 21 milkings after freshening, or dropping the calf. The cows comprised one Holstein and one Holstein grade, an Ayrshire and two Ayrshire grades. The calves were removed shortly after being dropped and the cows were milked by hand. In four cases the Quevenne lactometer would not test the specific gravity of the first milking, and in the case of two cows it would not register the gravity of the second milking.

The first and second milkings gave a decided purple tinge to the precipitate when sulphuric acid was used. This purple tinge was not apparent after the third or fourth milking. The purple tinge is probably caused by an excess of albuminoids in the milk, and points to a method whereby colostrum milk may be detected. With most of the cows the milk appeared normal after the eighth or ninth milking. In some the seventh milking appeared normal.

There was quite a marked difference in the per cent. of fat contained in the first milking of the five cows. One cow tested 8.4; the others tested 3.5, 4.1, 2.2 and 3 per cent. fat. The fat varied a great deal with the different cows and with the same cow.

Table showing lactometer readings and percentage of fat in freshly calved cows' milk, grouped in three periods:

Cows.	First 8 Milkings		Second 8 Milkings.		Third 5 Milkings.		Date of Calving.
	Average Lact. reading.	Average per cent Fat.	Average Lact. reading.	Average per cent. Fat.	Average Lact. reading.	Average per cent. Fat.	
Jean	35.2	4.2	34.2	3.25	32.36	3.14	April 10, 1899.
Patience	36.7	3.77	33.62	3.59	34.10	3.44	April 24, 1899.
Meg	33.14	3.72	32.60	3.94	32.70	3.60	April 25, 1899.
Ethel	34.95	2.95	33.24	3.59	32.00	3.90	Aug. 28, 1899.
Elsie	25.48	3.13	33.94	3.24	33.86	3 00	Aug. 28, 1899.
Average	35.09	3.55	33.52	3.52	33.00	3.41	

1. There was a gradual decrease in the per cent. of fat and the per cent of solids not fat with three cows, and a decrease of the solids not fat in the milk of all five cows from the 1st to the 21st milking. In the case of one cow, Ethel, an Ayrshire grade, the per cent. of fat increased from the 1st to the 21st milking, while another grade Ayrshire was lower in fat for the first eight milkings, then increased, and afterwards decreased.

2. Milk is not normal until the 8th or 9th milking after calving, and in some cases the 12th or 14th milking contains an abnormal proportion of solids not fat.

Pasteurized vs. Raw Skim-milk for Calves.

This is an experiment similar to one reported last year. The conditions were much the same as those of last year. Four calves were selected for the experiment, two of which belonged to the dairy breeds and two to the beef breeds. One of each was placed together for feeding, and the surprising thing was that the two calves belonging to the dairy breeds made greater gains than the other two—118 lbs. as against 97 lbs. The gains were not so good as last year in either lot. In addition to the milk and meal, given as reported in the table, each calf was given silage, hay, grass, and green peas and oats according to their appetites.

Name.	Breed.	Dropped.	Lbs. milk consumed in four weeks.	Kind of milk.	Lbs. meal—corn meal and bran in equal parts.	Lbs. grain during four weeks.	Period.
1. Whitehead	Grade Hereford steer.	Dec. 22, 1898	616	Pasteurized.	14	23	May 9 to June 6.
			560	Raw	28	16	June 13 to July 11.
2. Lily	Jersey	Nov. 10, 1898	616	Pasteurized.	14	14	May 9 to June 6.
			560	Raw	28	27	June 13 to July 11.
3. Dora	Grade Shorthorn	Jan. 28, 1899	616	Raw	14	28	May 9 to June 6.
			560	Pasteurized.	28	30	June 13 to July 11.
4. Topsy ...	Grade Holstein	Dec. 31, 1898	616	Raw	14	34	May 9 to June 6.
			560	Pasteurized.	28	43	June 13 to July 11.

1. The total gain of the four calves when fed on pasteurized skim-milk was 110 lbs. The total gain on raw milk was 105 lbs. In 1898, the gain on pasteurized skim-milk was 20 lbs. more than the gain on raw skim-milk. There is thus an agreement in the two years' experiments in favor of the pasteurized, or scalded skim-milk for calves.

2. We would recommend creameries to scald the skim-milk before returning it to patrons. Pasteurized (heated to 160°) skim-milk, along with meal, makes excellent food for young stock.

Dilution Creamers, or "Separators," so-called.

In the spring of the present year we received a number of letters in reference to the value of dilution "separators." Among those we were asked to pass an opinion upon were the "Hydro-lactic," made by J. F. Gill & Co., Niagara Falls, Ont.; the "Wheeler," made in Syracuse, N.Y.; and the "Aquatic," made in Watertown, N.Y.

Method of creaming.	Lbs. milk set.	Average per cent. fat in whole milk.	Average time set. Hours.	Per cent. milk taken as cream.	Per cent. fat in skim-milk.	Quality of Butter.			
						Flavor, 45.	Grain, 25.	Color, 15.	Total, 0.
April Experiments.									
Hydro-lactic	480	3.9	14.5	17	0.60	37	24	14	90
Diluted in Cooley cans	330	3.9	15.5	18	0.62	36	24	14	89
Brampton (no water added to milk)	345	3.9	20.6	16	0.68*	38	24	15	92
November Experiments.									
Hydro-lactic	300	4.0	24	....	0.53	.....	.....	.....	.....
Wheeler	300	4.0	24	.....	0.50	.....	.....	.....	.....
Cooley (undiluted)	300	4.0	24	...	0.50	.....	.....	.....	.....

* On April 15th and 16th the per cent. fat in Brampton skim-milk was 1.2 and 1.0, which caused the high average for this creamer.

The manufacturers kindly furnished us with one each of the "Hydro-lactic" and "Wheeler." During April, 13 experiments were made comparing the "Hydro-lactic" with the Brampton creamer, and also with milk set in Cooley cans, diluted with one-half

water. The cans of diluted milk were set on the floor of the basement and not in water. Ice water surrounded the cans set in the Brampton creamer. In the "Hydro-lactic," an equal quantity of milk and cold water were placed in the "separator," or creamer—a more correct name. The milk set in the three creamers was first thoroughly mixed together and then divided into three parts, and about the same quantity was set in each. The table shows the main points of experiments made when the cows were in the stable during the months of April and November.

1. There was little or no advantage gained by using the dilution creamers as compared with the ordinary creamers, in which the milk was set in ice water without dilution. In neither cases were the results satisfactory. The loss of fat in the skim-milk was too great. The centrifugal cream separator would remove practically all of the fat.

2. The results were more unsatisfactory by allowing the milk to sit but three to four hours after diluting, as recommended by the manufacturers.

3. As good results were obtained by diluting in an ordinary shot-gun, or Cooley can, as by the use of the "separator," though the cans are not so convenient.

4. The quality of the butter and skim-milk was not so good from the dilution methods.

5. If a dairyman had not ice, cold water, or a centrifugal separator, and did not value the skim-milk, or was in the habit of diluting the skim-milk "to make it go round," he might use the dilution system to advantage. It would then become a question whether he should pay the price asked for these "separators" or use an ordinary shot-gun can, which would give him just as good results, though not quite so convenient. Adding water to the milk in order to help the cream to rise might also be an advantage with "stripper" or "farrow" cows' milk, as it reduces the viscosity and enables the cream to rise more readily.

Ripening Cream with Different Percentages of Starter.

These experiments are a continuation of those made in 1897 and 1898. Twelve experiments were made in August and September by using no starter in some cases, 5 per cent. in others, and 15 and 20 per cent. in others. The cream was first thoroughly mixed and then evenly divided into two lots by carefully weighing the cream. The starter was added at once after dividing the cream, and the two lots kept at the same temperature until thickening, when it was cooled to churning temperature. Where no starter—or not more than 5 per cent.—was used, it was not cooled until the following morning. When 15 to 20 per cent. starter was used, the cream was cooled to churning temperature the same evening that the starter was added, and allowed to stand at the lower temperature during the night

Altogether there were used in these experiments 15,831 lbs. of milk, containing an average of 3.4 per cent. fat. The average per cent. fat in the skim-milk was 0.125. The average per cent. fat in the buttermilk was nearly one-tenth, being slightly less where 5 per cent. starter was used. The acidity of the cream at churning was .49 with no starter, .59 with 5 per cent. starter and .61 and .55 with 15 and 20 per cent. starter. The yield of butter was slightly greater in those churnings where 20 per cent. of starter was used in ripening the cream. The score of the butter was :—

Per cent. starter in cream.	Flavor. (45)	Grain. (25)	Color. (15)	Salting. (10)	Package. (5)	Total. (100)
	Av.	Av.	Av.	Av.	Av.	Av.
No starter	41.7	23	13.3	10	5	93
5 per cent. starter	41.0	24	13.0	10	5	93
15 " "	41.8	23.3	13.2	10	5	93.3
20 " "	41.0	24.2	13.2	10	5	93 4

The starter caused the cream to ripen more quickly, but there was little or no difference in the quality of the butter. This agrees with the results obtained for the past two years.

Ripening Cream at Different Temperatures.

During July and August 21 experiments were made similar to those of last year to note the effects of ripening cream at a moderately high temperature (70° to 75°) and ripening a portion of the same cream at a temperature of 55° to 60°. Altogether there were used in the experiments 26,986 lbs. milk, containing an average of 3.44 per cent. fat. After separating, the cream was thoroughly mixed and then equally divided in two cream vats.

	Cream ripened at 70° to 75°.	Cream ripened at 55° to 60°.
Average per cent. acid in cream at churning time	.571	.508
" " fat in buttermilk	.072	.074
" time for churning	30 mins.	34 mins.
Total lbs. butter made	495.5	497.5
Pounds butter made per 1,000 lbs. milk	36.7	36.8
Average per cent. of overrun	6.7	7.2
" score of flavor (Max. 45)	41.1	42.4
" " grain (" 25)	23	23.8
" " color (" 15)	13.3	14
" total score (" 100)	92.2	95.2

The yield of butter was slightly greater from ripening at the lower temperature, and the quality of the butter was also somewhat better—three points as the average of 21 lots. This agrees with previous results. We have had best results in summer from ripening at a temperature not over 65°, though the difference in quality of butter is not very great, as shown by the average of three years' experiments.

Pasteurizing Milk and Cream for Buttermaking.

During April and May two series of experiments were conducted to see the effect of pasteurization on milk for buttermaking. A "Reid pasteurizer" was used for the work. The milk was first thoroughly mixed in a 3,000 lb. vat; then one-half was carefully weighed and run through the pasteurizer. The other half was separated at 95° to 100° and heated in an ordinary channel heater. The next day the milk for separating at ordinary temperature was weighed out first, and the remainder pasteurized in order to check any differences there might be as a result of the weighing and handling. The temperature for pasteurizing ranged from 155° to 162°. The total quantity of milk used in these experiments was 52,968 lbs. Average per cent. fat in whole milk, 3.5. The average per cent. fat in pasteurized skim-milk was .042; unpasteurized, .1. There were 3,119 lbs. cream from the pasteurized milk and 3,496 lbs. from the unpasteurized. The average per cent. fat in the cream from pasteurized milk was 27.3; from raw or unpasteurized, 25.6. The average per cent. acid at churning in the cream from pasteurized milk was .515; from raw or unpasteurized, .498. Time of churning, 29.9 minutes and 33 minutes, respectively. The average lbs. of butter per 1,000 lbs. pasteurized milk was 39.7; unpasteurized, 40.2. The per cent. of overrun was 13.5 and 14.9 respectively from pasteurized and raw milk.

In the first series, from April 4th to 25th, the butter was packed in 56-lb. boxes. Six boxes of butter from pasteurized milk and six from raw milk were sent to Thos. Ballantyne & Sons, Stratford, for scoring. An equal number of every other day's make was sent to D. Derbyshire & Co., Brockville, for scoring. We requested from each that an odd and even numbered box should be retained for scoring at the end of one month and again at the end of three months. These firms were not aware as to how the butter had been made or what the numbers referred to. Messrs. Derbyshire & Co. spoke of the shipment in the highest terms of praise. Messrs. Ballantyne & Sons say they find that the reports of their scorers usually compare very closely with reports of scores received from Manchester. We are indebted to these firms for their kindness in scoring and storing the boxes sent to them.

TABLE SHOWING SCORES OF PASTEURIZED AND UNPASTEURIZED BUTTER.

Butter.	Scorer.	Date of Scoring.	Flavor. (45)	Grain. (25)	Total. (100)
(1st series.)			(Average.)	(Average.)	(Average.)
Unpasteurized	Thos. Ballantyne & Sons	May 8th	41.3	23.3	94.5
Pasteurized	" "	" 8th	41 6	23 1	94.8
Unpasteurized	D. Derbyshire & Co.	" 17th	42.5	24.5	97.0
Pasteurized	" "	" 17th	43.6	24.6	98.3
(2nd series.)					
Unpasteurized	Thos. Ballantyne & Sons	June 12th	43.2	22.2	95.5
Pasteurized	" "	" 12th	42.5	23.0	95.5
(1st series.) One of each box scored three times.					
Unpasteurized	Thos. Ballantyne & Sons	May 8th	43	24	97
Same box unpasteurized	" "	June 12th	35	23	88
" "	" "	Aug. 17th	31	24	80
Pasteurized	" "	May 8th	42	23	95
Same box pasteurized	" "	June 12th	40	23	93
" "	" "	Aug. 17th	38	24	87
Unpasteurized	D. Derbyshire & Co.	May 17th	44	25	99
Same box unpasteurized	" "	June 21st	42	25	95
" "	" "	Aug. 11th	40	25	95
Pasteurized	" "	May 17th	42	25	97
Same box pasteurized	" "	June 21st	40	25	95
" "	" "	Aug. 11th	39	25	94
(2nd series.)					
Unpasteurized	Thos. Ballantyne & Sons	June 12th	44	23	97
"	" "	Aug. 17th	39	24	92
Pasteurized	" "	June 12th	42	23	95
"	" "	Aug. 17th	38	24	91

From May 22nd to May 29th a second series was completed. Five boxes of each (pasteurized and raw milk butter) were sent to Thos. Ballantyne & Sons for scoring. There was also in this lot a box each made from pasteurized and raw cream. The butter was scored on June 12th. Two boxes—one of each kind, made on the same day and from the same milk—were scored again on Aug. 17th, having been kept in the firm's cold storage in the meantime. The table shows the average scorings in flavor, grain and totals as given by each firm; also detailed scoring of flavor, grain and totals for the boxes kept, to test keeping quality of the butter from pasteurized and raw milk.

CONCLUSIONS:

1. There was less loss of fat in the skim-milk from pasteurizing the whole milk before separating.

2. There was less volume of cream from pasteurized milk, but the cream was richer.

3. By using a starter, after cooling, there was no do difficulty in ripening the cream from pasteurized milk.

4. The pasteurized cream churned in less time than the raw cream.

5. The yield of butter, per 1,000 lbs. of milk, was .89 lbs. greater from the unpasteurized milk. (This may have been due to a dryer butter having been made from the pasteurized milk, and more moisture left in the raw milk butter.)

6. There was not much difference in the quality of the butter when first made. The average of the first scorings from both firms was 42.6 for flavor and 23.6 for grain in the pasteurized. The unpasteurized averaged 42.2 and 23.3 for flavor and grain.

The three boxes of pasteurized butter which were scored several times, averaged 42 in flavor, and 23.6 in grain on the first scoring. The unpasteurized averaged 43.6 and 24 for flavor and grain. The second scorings were 39.3 and 24 for flavor and grain of the pasteurized, and 38.6 and 24 for the unpasteurized. The third scorings were 38.5 and 24.5 for the pasteurized and 35.5 and 24.5 for the unpasteurized in flavor and grain.

One box of pasteurized butter scored 100 points by Derbyshire & Co. Thirteen boxes of unpasteurized butter scored 95 points and over, and sixteen boxes from the pasteurized milk scored 95 points or over.

In the first series, the box of pasteurized butter sent Ballantyne & Sons, scored 42 for flavor on May 8th; 40, on June 12th; and 38, on August 17th The unpasteurized box made on the same day and from the same vat of milk scored 43, 35, and 31 on the same dates. The box of pasteurized butter held its flavor much better than the butter made from unpasteurized, or raw, milk

The box of unpasteurized butter kept by D. Derbyshire & Co., in cold storage, scored higher at all three scorings, though the pasteurized butter lost but three points in flavor during the three months, while the box of unpasteurized lost four points in the same length of time and under the same conditions.

In the second series, the box of unpasteurized sent to Ballantyne & Sons scored higher than the pasteurized (44) when first examined, and was still higher (39) when scored two months later, but it lost *five* points in flavor in the two months, while the box of pasteurized butter made on the same day and out of the same milk, lost but *four* points in flavor, scoring 42 and 38 in the two tests.

All the trials indicate that the pasteurized milk butter had better keeping quality, though when first made there was little or no difference in the quality. The chief advantage in pasteurization is in making butter for the export trade or for storing; and also in winter, when feed and other bad flavors give the butter-maker trouble.

7. By pasteurizing we found that the skim-milk kept sweet from 24 to 48 hours longer than the skim-milk from the separator where the whole milk was not heated to 160°. The same results may be obtained by heating the skim-milk *after* separating.

Mangels vs. Turnips Fed to Cows for Buttermaking.

Early in April we commenced an experiment to ascertain the difference in the quality of butter from cows fed on turnips and mangels. The cows on one side of the stable were given all the mangels they would eat, along with other food; and those on the other side were given all the turnips they would eat, along with other food. Owing to the scarcity of roots, the experiment was not continued for a sufficient length of time to come to any definite conclusions as to the relative merits of these two roots for the production of butter. The average score of the turnip butter was 37 for flavor, while the mangels produced butter which scored an average of 39.3, out of 45, indicating that the mangels were slightly superior for producing good flavor, although there was not the difference in flavor which we expected.

The Dairy Herd.

We maintain a herd of about 30 milking cows and heifers in the Dairy department, of which about 25 are in milk all the time. On December 31st, 1899, we have the following pure-breds:—5 Holstein cows and heifers and 3 calves, 4 Jerseys and 3 calves, 1 Ayrshire cow and 1 heifer calf, 21 grade cows and heifers and 3 grade heifer calves.

The milk from the herd is weighed at the dairy and a sample taken the same as if the milk came from a patron. At the prices paid patons for milk this past season, our cows furnished by months the following values:—January, $135.57; February, $135.14; March, $128.00; April, $163.32; May, $128.99; June, $132.41; July, $112.22; August, $103.69; September, $113.56; October, $96.41; November, $105.90; December, $90.56, making a total for the year of $1,445.77. In addition, a considerable quantity of milk is used for rearing young calves, and about five dollars per month is received for milk sold by the quart to customers who come to the dairy stable for it. Outside of the milk used

for rearing stock, the milk supplied by the dairy herd was worth during the past year over fifteen hundred dollars at the prices we are compelled to pay in the vicinity of Guelph for milk to be used in the Dairy School and for experimental purposes.

The record of all cows which have been in the herd for the full time of the year ending November 30th, 1899, is as follows :

Name of cows.	Weight.	Calved.	Breed.	No. days milking.	Total lbs. milk.	Per cent. fat.			Total lbs. fat.	Total lbs. butter, adding 15 % to butter fat.	Remarks.
						Highest weekly.	Lowest weekly.	Yearly average.			
Annie	1,195	Nov. 12, '98.	Jers. Grade.	304	7,400	4.6	3.3	4.04	299.46	344.38	
Belle Temple.	980	Jan. 2	Jersey	315	5,576	6.1	4.0	4.87	271.68	312.43	
Bella	1,195	July 17	AyrshireG'd	355	6,107	4.5	2.8	3.8	232.62	267.51	3 yrs. old, 2d calf.
Birdie	1,165	Dec. 22, '98.	Grade	335	7,185	4.3	3.5	3.9	280.34	322.39	
Dolly	1,210	Oct. 31	Hol. Grade.	286	6,000	3.6	3.0	3.4	205.10	235.86	3 yrs. old, 1st calf.
Elsie	1,093	Aug. 27	Ayr. "	227	4,721	3.8	2.9	3.28	155.35	178.65	
Ethel	820	" 28	" "	223	4,952	4.2	3.4	3.8	192.74	221.65	
Grey	1,150	Feb. 26	S.-H. "	281	9,052	5.1	3.0	3.44	311.74	358.50	
Jean	925	Ap'l 10.	Hol. "	223	6,382	4.5	3.3	3.5	223.52	257.05	
Jennie	1,055	Mar. 1	Ayr. "	275	5,730	3.8	3.0	3.24	186.04	213.94	(9 mo's.)
Lilly	943	Nov. 16	Jersey	299	5,455	6.2	3.4	5.5	302.46	347.83	
Lucy	1,045	Dec. 18, '98.	H. Grade	335	7,012	3.8	2.9	3.48	244.31	280.95	2 yrs. old, 1st calf.
Margaret	1,576	Aug. 19	Holstein	270	9,128	4.2	2.8	3.45	315.66	363.00	
M. Cornelius.		May 7	"	214	4,860	3.2	2.1	2.6	125.26	144.04	2 yrs. old, 1st calf (7 mo's).
Molly	1,195	Nov. 20, '98.	H. Grade	350	8,345	4.6	3.0	3.6	302.34	347.69	3 yrs. old, 1st calf.
Moss	1,041	May 26	J. "	308	6,208	6.4	3.7	4.65	289.15	332.52	
Megg	1,365	Ap'l 25	Holstein	214	7,145	4.6	2.8	3.3	236.98	272.52	
Nellie	972	Nov. 4	Grade	282	5,334	4.4	3.1	3.9	209.07	240.43	
Ont. Belle	986	Aug. 11	Jersey	320	4,490	6.8	4.0	5.7	255.77	294.13	
Patience	1,190	Ap'l 24	Ayrshire	266	7,273	5.2	3.0	3.68	268.26	308.49	
Polly	1,235	Dec. 31, '98.	Hol. Grade.	305	6,815	3.9	3.0	3.35	227.59	261.72	3 yrs. old, 1st calf.
R. Burnette	912	Feb. 26	Jersey	280	7,892	6.4	3.0	4.16	338.08	388 79	
Wedo	1,202	Oct. 4	Holstein	291	8,707	3.6	2.0	3.1	273.94	315.03	

1. The largest producer of milk was a Holstein cow, which gave 9,128 lbs. during the year. The second largest producer was a Shorthorn grade, and the third was a Holstein, and the fourth a Holstein grade heifer, 3 years old, after first calf.

2. The largest butter-producer was a Jersey cow with a record of 398 lbs. of butter, which is 48 lbs. below her record for last year. The second was a Holstein, the third a Short-horn grade, the fourth a Jersey, and the fifth a Jersey grade. (Butter was calculated by adding 15 per cent. to milk fat.)

3. The percentage of fat from individual cow's milk varied from 2 to 6.8 in the weekly or monthly composite samples. The yearly average percentage of fat varied from 2.6 to 5.7.

4. The lowest production of butter by one cow for a full year was 178.65 lbs. Her record last year was 222 lbs. We shall dispense with her services at an early date, though she was bought for a "record-breaker."

5. The lowest yield of milk by one cow was 4,490 pounds, but this cow's milk averaged 5.7 per cent. fat, consequently her butter record is very fair.

6. The number of days during which the cows were milking varied from 214 to 355, Bella, an Ayrshire grade heifer having milked practically the whole year, though she is not doing so well at present as she would have done had she been dry six weeks to two months.

7. The live weight of the cows varied from 820 lbs. (an Ayrshire heifer registered in Appendix) to 1,576 lbs., the weight of a pure-bred Holstein, the cow which gave the largest quantity of milk. The live weight of the largest butter-producer is 912 lbs.

Milk Tests at the Fall Fairs.

I took charge of the milk tests at Toronto and Brantford Fairs. Mr. Stratton took charge at Straffordville and Aylmer Fairs. At Toronto, the awards were made to the cows producing the greatest weight of milk solids in 48 hours. At Brantford, Straffordville and Aylmer the prizes were awarded according to the Provincial Dairy Show scale of points (old scale). At Brantford the test was for 24 hours; and at the other two fairs, the time was but six hours, which is far too short to be satisfactory.

Toronto, Sept. 4 and 5, 1899. Test, 48 Hours.

Rank.	Name of Cow.	Breed.	Owner.	Lbs. milk in 48 hours.	Lbs. fat in 48 hours.	Lbs. solids in 48 hours.
1	Daisy Banks	Holstein	Rettie Bros., Norwich	126.5	3.064	13.994
2	Inka Sylvia	"	C. J. Gilroy, Glen Buell	128.5	3.373	13.507
3	Highland Cornelia	"	Retty Bros	129.5	2.746	13.398
4	Queen de Kol 2nd	"	G. W. Clemons, St. George	120.25	2.939	12.632
5	Princess Lida 4th	"	C. M. Keeler, Greenbush	116.00	2.821	12.530
6	Juanita	"	C. J. Gilroy	111.50	2.750	12.226
7	Nellie Gray	Ayrshire	N. Dyment, Clappison	111.25	2.960	12.219

Brantford, Sept. 20th, 1899. Test, 24 Hours.

Rank.	Cows.	Owner.	Lbs. milk.	Lbs. fat.	Lbs. solids not fat.	Points scored.
1	Highland Cornelia	Rettie Bros	70.75	1.981	6.230	74.94
2	Daisy Banks	"	61	1.464	5.185	59.42
3	Jane	Jas. Britton	31	0.992	2.790	58.70
4	Nellie Gray	N. Dyment	53	1.431	4.369	58.02

Straffordville, Sept. 20th, 1899. Test, 6 Hours, 3 Cows.

1	Three cows	A. Jackson	24	0.978	2.207	160.48
	"	T. H. Mason	21	0.870	1.849	122.09
3	"	E. A. Garnham	11.25	0.370	1.028	104.75

Straffordville, Sept. 20th, 1899. Test, 6 Hours, 1 Cow.

1	One cow	E. Jackson	10.25	0.358	0.902	57.21
2	"	S. Murphy	4.25	0.233	0.399	40.70
3	"	B. Snell	4.50	0.198	0.401	40.36
4	"	D. Spiece	6.25	0.193	0.560	35.45
5	"	E. A. Garnham	2.75	0.060	0.253	29.96

Aylmer, Sept. 22nd, 1899. Test, 6 Hours, 3 Cows.

1	Three cows	Wm Pound	32.37	1.152	2.895	98.30
2	"	C. M. Clark	25.25	0.998	2.193	89.32
3	"	P. Abbott	24.25	0.907	2.198	88.63
4	"	C. M. Clark	18.37	0.768	1.597	83.14

Aylmer, Sept. 22nd, 1899. Test, 6 Hours, 1 Cow..

1	One cow	R. Bingman	8.12	0.324	0.748	30.17
2	"	P. Abbott	9.25	0.397	0.848	29.6
3	"	C. M. Clark	11.25	0.438	0.947	29.
4	"	D. McLennan	14.25	0.370	1.249	20.3

Testing Apparatus, Rennets, Cheese and Butter Colors, etc.

As usual, we have had numerous requests for tests of dairy apparatus and dairy supplies. We aim to comply with these so far as possible. We have tested the following with more or less satisfactory results: The Cumming's Churn, Cornett's Milk Agitator, Hydro-lactic Creamer, Wheeler Gravity Creamer, Swedish Cheese and Butter Colors, Swedish Rennet, Boyer's Rennet Powder, and Alderney Butter Color. As there has been considerable agitation during the past season in reference to "dilution creamers", we report the results of tests made with the Hydro-lactic and Wheeler in detail elsewhere. The Cornett Milk Agitator is a very ingenious device for stirring milk and preventing the cream from rising during the night.

We have also been using "Formalin" on our cheese for preventing mould and have found it quite satisfactory this season, although there has not been so much mould this year, as in other years, a fact due, no doubt, to the very dry season and cool nights. An ex-student of the College reports that he has used a strong brine on his cheese with satisfactory results in preventing mould.

Improvements of the Year.

Early in the season we thoroughly disinfected the cheese curing-rooms and had the inside painted. This was necessary as we found a few of our Dairy School cheese mottled; and the mottling was no doubt caused by having had mottled cheese for experimenting purposes in the rooms. We should have a special curing room for cheese of this class.

In the month of June, a receiving room for milk delivered to our home dairy was built at the north side of the home dairy building. It serves the purpose of a room for aerating experiments and for holding the home dairy milk at nights.

In September, we enlarged the home dairy department by taking in the adjacent lecture room, as our quarters were too small, especially for our regular college classes The instructions given to our college students has not been satisfactory until the present year. We can now accomodate a class of 40 to 50 in the home dairy department alone. We have six makes of hand separators, hand and turbine Babcock testers, and four or five hand churns, together with butter workers, etc., so that we are able to give a very thorough course in practical farm dairy work, which supplements and illustrates the lectures to first year students. Second year students will take some home dairy work and will also take the special creamery course in December.

Our home dairy will also be the college creamery for the summer months, and is nearly as complete as we could wish.

Needs of the Dairy department.

1. An up to date refrigerator plant.
2. Dairy stables put in good repair.
3. Excellent specimens of the leading dairy breeds. We ought to have some of the best females that can be purchased.
4 Dairy buildings repainted outside.

All of which is respectfully submitted,

H. H. DEAN,

Professor of Dairy Husbandry.

Ontario Agricultural College,
Guelph, Dec. 30, 1899.

PART VIII.

PROFESSOR OF AGRICULTURE.

To the President of the Ontario Agricultural College:

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

As a detailed statement of my work would not be of general interest, I shall restrict my report to summarizing some of our results in live stock experiments, with some additional observations under the heading of *Farm Superintendence.*

HEAVY, MEDIUM AND LIGHT MEAL RATIONS FOR FATTENING STEERS.

This experiment is the third of a series of experiments with different quantities of meal for fattening steers. Nine steers were divided into three groups, making three steers in each group. With the heavy ration group an effort was made to feed one pound of meal per day per hundred pounds live weight of the animals. They would not all eat this quantity, so they were kept as near the limit as was deemed safe. With the medium ration group, the aim was to feed about to two-thirds of a pound of meal per day per hundred pounds live weight of the animals. The steers in the light ration group were started on about one-third of a pound of meal per day per hundred pounds live weight, and this quantity was increased as deemed advisable. The method of feeding may be made clearer by means of a table, and the table given below shows approximately how the meal rations were increased.

Period.	Heavy ration. Meal per steer per day.	Medium ration. Meal per steer per day.	Light ration. Meal per steer per day.
	lb.	lb.	lb.
Dec. 6th to Jan. 3rd	10	8	4
Jan. 3rd " Feb. 1st	11	8	5
Feb. 1st " Mar. 1st	12	9	6
Mar. 1st " April 1st	12.5	9	8
Apr. 1st " May 23rd	12.5	9	9

The meal rations given in the table are merely approximations. The meal actually consumed by the heavy ration group amounted to nearly nine-tenths of a pound of meal per day for every hundred pounds of the average live weight of the animals throughout the feeding period. The medium ration group averaged two-thirds, and the light ration group slightly over one-half of a pound of meal per day for every hundred pounds of the average live weight of the animals throughout the feeding period.

The meal ration consisted of equal parts by weight of corn and oats.

The remainder of the ration consisted of mixed clover and timothy hay of poor quality and roots. The hay was cut and mixed with pulped roots a day in advance of feedings, in the proportion of twenty pounds of roots to fifteen pounds hay. All food was carefully weighed. The experiment lasted 168 days.

The foods were valued as follows: meal, $13; hay, $6; and roots $2 per ton. These valuations are purely arbitrary, but they serve as a basis of comparison, which is all that is required. Below is given a statement of the gains made by the steers and the cost of a pound of gain:

In 1899.

Heavy Ration	:	Average	daily	gain,	1.77	lbs.	Cost	of 1	lb.	gain, 7.68c.
Medium "	:	"	"	"	1.74	"	"	"	"	7.22c.
Light "	:	"	"	"	1.62	"	"	"	"	7.21c.

For the sake of comparison, the average results of three experiments in three successive years, are given below:

In 1897, 1898, and 1899.

Heavy Ration	:	Average daily gain,	1.75	lbs.	Cost of 1 lb. gain,		7.25c.
Medium "	:	" " "	1.70	"	" " "		6.69c.
Light "	:	" " "	1.61	"	" " "		6.53c.

Summary and Suggestions.

1. In each of three trials, covering a period of 216, 179, and 168 days respectively, a comparatively heavy ration gave larger but more expensive gains than those obtained with lighter rations.

2. In the average of three trials, the most economical gains were obtained by commencing with about one-third of a pound of meal per day per hundred pounds live weight of the animals, and gradually increasing as circumstances demanded.

3. In two of the trials the groups that made the most economical gains received, on an average, very little more than half a pound of meal per day per hundred pounds of their average live weight during the feeding period.

4. Other experimenters have shown that the cost of producing a pound of gain increases as the animals become fatter; therefore a finished steer is fed at a loss. From this it would seem that, to feed economically, an effort must be made not to have the steers finished for any considerable time before they can be disposed of. No doubt the light ration obtained some of its advantage through more nearly meeting the conditions favoring economical feeding, as given above.

5. No fixed rules can be given regarding the rate of increase in the meal ration. Each feeder must be guided by his judgment, and what has been said regarding the methods employed in these experiments can be taken only as a general guide.

6. The more attention paid to making the coarse fodders palatable, the better the results obtained from a given quantity of meal.

7. The experiments described deal only with somewhat protracted feeding periods. Shorter feeding periods would no doubt call for a considerable modification of methods, and a more rapid increase in the meal ration.

Mangels vs. Sugar Beets for Milk Production.

In order to test the comparative value of mangels and sugar beets for milk production, two experiments, each with different cows, have been completed, the first of which was reported in last year's annual report.

In each trial four cows were used. After a week's preparatory feeding the rations were changed. Two of the cows were fed sixty pounds of sugar beets per cow per day for two weeks; then they were fed sixty pounds of mangels per cow per day for two weeks. The other two cows were fed sixty pounds of mangels per cow per day during the first two weeks, and then changed to sixty pounds of sugar beets per cow per day during the next two weeks. Thus each cow was fed two weeks on sugar beets and two weeks on mangels. In addition to the roots the cows received a meal ration and what clover hay they would eat, each cow receiving like quantities of hay and meal.

In the first trial the four cows produced 1268 lbs. of milk on sugar beets, and 1275.5 lbs. of milk on mangels.

In the second trial the four cows produced 1230.25 lbs. of milk on sugar beets, and 1238.5 lbs. of milk on mangels.

1. In each experiment there is a slight difference in the total milk yield in favor of the mangels, amounting to 7.5 lbs. in one case, and 8.25 lbs. in the others, in the milk produced by four cows in two weeks.

2. In the first trial, cow No. 1 decreased in milk flow, and cow No. 2 increased in milk flow after being changed from sugar beets to mangels; and both cows 3 and 4 decreased in milk flow after being changed from mangels to sugar beets. In the second trial, all the cows gave more milk during the second two weeks than during the first two, but the cows that were changed from sugar beets to mangels made a greater increase, on the whole, than those that were changed from mangels to sugar beets.

3. Everything considered, these experiments indicate that there is very little, if any, difference between mangels and sugar beets as foods for stimulating the flow of milk. It must be remembered, however, that these experiments have no bearing upon the relative value of these foods for maintaining life or producing fat.

Experiments with Pure Bred Swine.

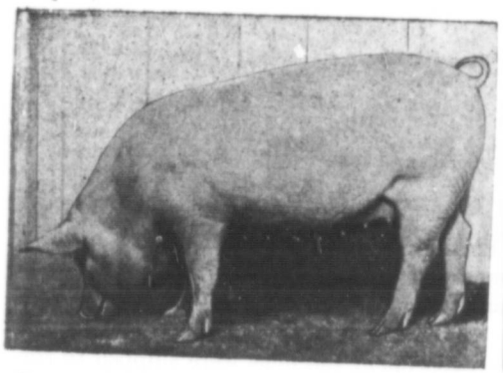


Fig. 1. This hog gave a first-class side of bacon.

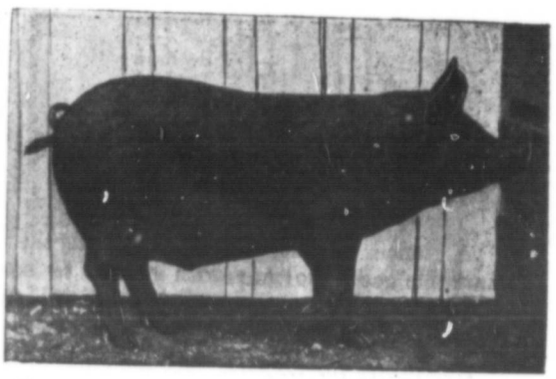


Fig. 2. A good bacon hog, but standing badly. Note, however, the high neck and jowl.

This experiment constitutes the fourth experiment in which representatives of six different breeds of swine were fed side by side. Six animals of each of the following breeds were used: Yorkshire, Tamworth, Berkshire, Chester White, Duroc Jersey, and Poland China. Each breed was divided into two lots of three hogs each. The experiment commenced June 13th, the hogs being at that time from 9 to 13 weeks old. Three hogs of each breed, 18 hogs in all, were fed equal parts by weight of corn and wheat middlings with skim milk. The remaining 18 hogs were fed equal parts by weight of barley and wheat middlings with skim milk. On August 10th, the meal mixture was changed to three parts grain to one part middlings by weight, corn still being used for one group and barley for the other. On September 1st, the skim milk was discontinued; and on September 15th, the middlings were dropped from the ration, the one group being fed pure corn and the other pure barley. The experiment was closed October 10th. On an average, about two pounds of skim milk to one pound of meal were fed during the time milk was used. The objects of these experiments were:

1. To compare the six breeds of swine:
   (*a*) With regard to economy of production.
   (*b*) With regard to suitability for the export bacon trade.
2. To compare corn with barley:
   (*a*) With regard to amount required for a pound of gain.
   (*b*) With regard to the quality of bacon produced.

Comparison of Breeds. In feeding the hogs, the animals were given a somewhat restricted amount of food, the aim being to keep them in good growing condition without developing an excessive amount of fat, though with some of the breeds it was a difficult matter to secure growth without too much fat. As stated before, considerable skim milk was fed, and in order to simplify comparison, the amount of dry matter in the foods has been estimated; so that instead of giving the pounds of meal and milk required for a hundred pounds of gain, we give the pounds of dry matter which the meal and milk represent.

Food Required for 100 lb. Gain, Live Weight. In this year's experiment the amount of dry matter required to produce one hundred pounds of gain, live weight, for the different breeds were as follows: Berkshire, 318.28 lbs; Tamworth, 331.16 lbs.; Yorkshire, 334.85 lbs.; Chester White, 336.68 lbs.; Duroc Jersey, 337.1 lbs.; Poland China, 349.99 lbs.

In this connection it will be of interest to note the standing of the different breeds with regard to economy of gain, in each of the four experiments which have been completed. The following table illustrates this point :

1896.	1897.	1898.	1899.
1. Berkshire.	1. Berkshire.	1. Yorkshire.	1. Berkshire.
2. Tamworth.	2. Tamworth.	2. Berkshire.	2. Tamworth.
3. Poland China.	3. Poland China.	3. Duroc Jersey.	3. Yorkshire.
4. Duroc Jersey.	4. Chester White.	4. { Tamworth. { Chester White.	4. Chester White.
5. Chester White.	5. Yorkshire.	6. Poland China.	5. Duroc Jersey.
6. Yorkshire.	6. Duroc Jersey.		6. Poland China.

A glance at this table shows that the Berkshires and Tamworths have made a remarkable good showing with regard to economy of production ; but on the whole it would appear that economy of production is more influenced by the individuality of the animals than by the breed.

Suitability for Export. At the close of the experiment the hogs were shipped to the Wm. Davis Company, Limited, of Toronto, where they were slaughtered and the carcases examined. The results of the slaughter test were practically the same as those of previous years. The Yorkshires were the most uniform lot, possessing greater length between shoulder and ham, and carrying a more uniform depth of fat along the back than other breeds. The Tamworths stood second, being more irregular in size, length of side, and depth of fat along the back than the Yorkshires. The remaining breeds were generally unsatisfactory, being characterized by heavy jowls and shoulders, short sides, an extreme thickness of fat over the shoulder tops, and, in most cases, an excessive development of fat throughout. Probably the Berkshires might be placed next to the Tamworths, as they were a rather more uniform lot than the Chester Whites, Duroc Jerseys or Poland Chinas. The Poland Chinas were all extremely fat.

We give photographs of some of the hogs used in the breed experiment. The object in inserting these photographs is to illustrate types rather than breeds.

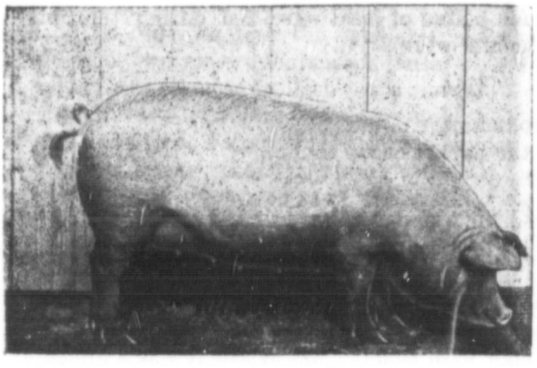


FIG. 3. A very good hog, but a little too fat.

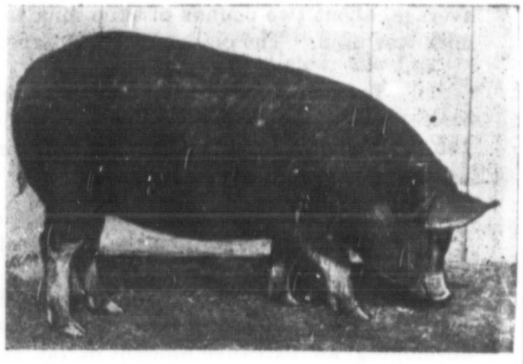


FIG. 4. Too short and chubby. Note the short arched neck and heavy jowl.

Comparison of Corn and Barley. As before stated, half the pure-bred hogs were fed corn and the other half barley. In addition, some skim-milk and middlings were fed with the corn and barley, except during about a month, at the close of the experiment, when one group was fed corn alone and the other barley alone. Owing to the unfortunate occurrence described below, this part of the experiment was very unsatisfactory and requires repetition. It may be stated, however, that, during the time milk and middlings were fed, the hogs receiving corn made the most economical gains ; but after the milk and middlings were discontinued, the hogs receiving barley surpassed those on corn in rapidity and economy of gains.

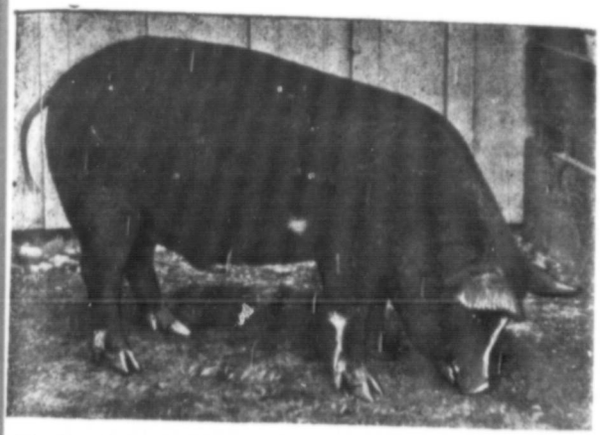


FIG. 5. A very fair hog, but the shoulder proved somewhat heavy when the animal was slaughtered.

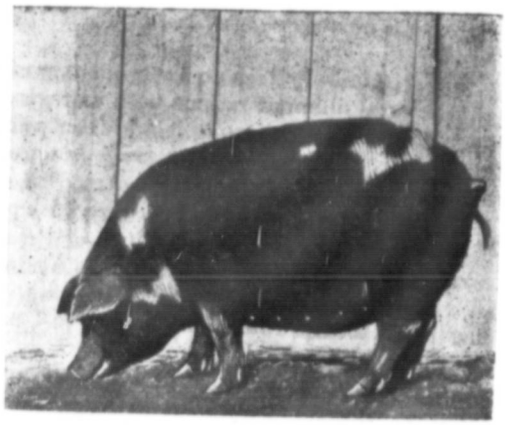


FIG. 6. Very short and fat. Too much belly. Compare with Fig. 1 in this respect.

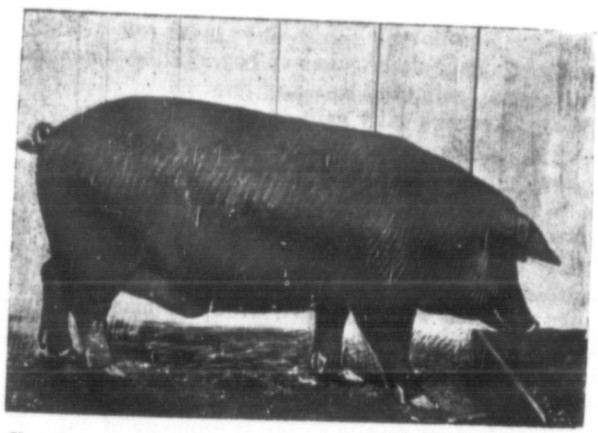


FIG. 7. A hog of fair length but entirely too fat. Compare the sagging, heavy belly with the trim belly shown in Fig. 1.

Quality of Bacon Produced. After the hogs were killed, the sides were all labelled, with the intention of having them salted separately, and examined for firmness when they came out of the salt. Owing to some misunderstanding or oversight on the part of the people connected with the factory, the sides were marketed without critical comparison after they came out of the salt. Thus the most valuable point in connection with the experiment was lost, and no part of it will be reported fully until further tests have been made. The sorter stated that some of the sides were firmer than the others, but none were rejected on account of softness. We have no record, however, as to which were the firmer. In the case of the Yorkshires and Tamworths, those fed corn were noticeably fatter than those fed barley. In the other breeds no marked difference could be detected.

Summary.

1. In each of four experiments the Yorkshires and Tamworths were pronounced by the packers more suitable for the export bacon trade than the representatives of other breeds.

2. Generally speaking, the results of four experiments indicate that economy of production is more dependent upon the individuality of animals than upon their breed.

3. The experiments indicate that it does not necessarily cost more to produce a pound of gain upon a hog of suitable bacon type than upon a hog of undesirable bacon type.

Experiments with Grade Swine.

On July 28th an experiment was commenced with grade swine, to test the value of several different rations both as regards economy of gain and the firmness of the bacon produced. Following is a a description of the plan of the experiment:

Group I., 11 hogs, average live weight at commencement, 63 lbs.

Ration: July 28th to Aug. 9th, equal parts by weight corn and middlings. Aug. 10th to Sep. 15th, 3 parts corn to 1 part middlings by weight. Sept. 16th to Oct. 10th, corn alone.

Group II., 11 hogs, average live weight at commencement, 62 lbs.

Ration: July 28th to Aug. 9th, equal parts by weight peas and middlings. Aug. 10th to Sep. 15th, 3 parts peas to 1 part middlings by weight. Sep. 16th to Oct. 10th, peas alone.

Group III., 13 hogs, average live weight at commencement, 63 lbs.

Ration: July 28th to Aug. 9th, equal parts by weight barley and middlings. Aug. 10th to Sep. 15th, 3 parts barley to 1 part middlings by weight. Sep. 16th to Oct. 10th, barley only.

Group IV., 14 hogs, average live weight at commencement, 61 lbs.

Ration: Same meal ration as Group III., except that hogs were fed only about two-thirds of the quantity given group III. In addition to the meal they were fed all the rape they would eat.

Results. Up to this period of the experiment the rate of gain and food consumed per 100 lbs. of gain were as follows:

Group I. (*Corn*): Average daily gain per hog, .79 lbs; meal consumed per 100 lbs. gain, 480 lbs.

Group II. (*Peas*): Average daily gain per hog, .61 lbs; meal consumed per 100 lbs. gain, 573 lbs.

Group III. (*Barley*): Average daily gain per hog, .80 lbs; meal consumed per 100 lbs. gain, 490 lbs.

Group IV. (*Barley and Rape*): Average daily gain per hog, .84 lb.

Food consumed per 100 lbs gain, { Meal, 324 lbs. / Rape, 750 lbs.

While middlings were fed with the peas, Group II made very satisfactory gains; but when the middlings were discontinued and clear pea meal fed, the pigs in this group did very badly. The method would not have been adopted only it was desired to test the effect of exclusive pea feeding upon the quality of bacon.

Rape gave very satisfactory results so far as economy of gain was concerned.

At the conclusion of this part of the experiment, the largest hogs in each group, about half the total number, were sent to the factory, along with the pure bred hogs, to be compared as to firmness of bacon. In this connection, however, they shared the same fate as the pure-breds, the bacon being marketed without critical examination when it came out of the salt, as was previously explained. While this was a very serious loss, it was not quite so disastrous as in the case of the pure-breds, because half the grade hogs had been retained for further feeding to make them heavy enough for export.

Second Part of Experiment.

The remaining hogs were kept in the same groups as before, and fed the same rations, with two slight modifications: the ration of Group II was changed back to 3 parts pea meal to 1 part middlings, and on Dec. 3rd rape feeding was discontinued for Group IV, the group being fed exclusively on barley from that date until the close of the experiment, a period 23 days. The rations for the different groups, therefore, were as follows:

Group I: Corn.

Group II: Three parts pea meal and 1 part middlings, by weight.

Group III: Barley.

Group IV: Barley and rape until Dec. 3rd, then barley alone.

This part of the experiment lasted from Oct. 11th to Dec. 26th, or a period of 77 days.

Results. The average gain per hog, and the amount of food consumed per 100 lbs. of gain were as follows :

Group I (*Corn*) : Average daily gain per hog, .7 lb. Meal consumed per 100 lbs. gain, 547 lbs.

Group II (*Peas and Middlings*) : Average daily gain per hog, 1.12 lbs. Meal consumed per 100 lbs. gain, 455 lbs.

Group III (*Barley*) : Average daily gain per hog, 1.17 lbs. Meal consumed per hundred pounds gain, 456 lbs.

Group IV (*Barley and Rape*) : Average daily gain per hog, .94 lb.

Food consumed per 100 lbs. gain { Meal, 440 lbs. / Rape, 764 "

The results just given do not correspond with those obtained during the first part of the experiment, and the fact that they do not is suggestive of several things. In the first part of the experiment, the corn group made the most satisfactory gains, but during this time the hogs in this group were fed pure corn for a comparatively short time. Those hogs of the corn group which were retained were fed pure corn during the whole of the second part of the experiment, and during this time they made the poorest gains of the four groups. This indicates that exclusive corn feeding for an extended period is poor economy.

Then, it has already been noted that the hogs in Group II did very badly when fed exclusively on pea meal. But during the second part of the experiment, when middlings had been added to the ration, they made the most economical gains of the four groups. This emphasizes the already pretty well known fact that to obtain the best results from peas, they must be mixed with other foods.

On the other hand, the hogs receiving barley did better during the second part of the experiment than during the first, indicating that barley is a very safe food for hogs.

Rape did not maintain its reputation during the second part of the experiment, but a good deal of the rape fed during this time was not of good quality,

At the close of the experiment the hogs were sent to the Wm. Davies Co. of Toronto, and below is given the report of Mr. J. W. Flavelle upon the bacon of the different groups, as it came out of the salt.

Mr. Flavelle's Report.

We have to-day examined the sides made from the hogs shipped to us by you, and upon which we understand you desire us to report.

Lot I (*Corn*) : Very soft, fat, pasty and greasy, in every way undesirable. The hogs in this lot seem to have thriven well on the feed as the sides are well finished, indeed quite fat.

Lot II (*Peas and Middlings*) : Excellent quality, firm.

Lot III. (*Barley*) : Very firm, probably the most distinctly hard and firm of any of the lots.

Lot IV. (*Barley and Rape*) : Good quality, firm with a slight tendency, but very slight, towards tenderness.

Summary.

1. Exclusive corn feeding during a somewhat extended period gave very unsatisfactory results in point of gain, and produced bacon of extremely soft, undesirable character,

2. The exclusive feeding of pea meal resulted in unthrifty animals and poor gains ; but a mixture of three parts pea meal and one part middlings by weight, gave good gains and produced bacon of excellent quality.

3. An exclusive ration of barley gave satisfactory gains, and produced exceptionally firm bacon.

4. A two-thirds ration of barley with all the rape the hogs would eat, followed by about three weeks' exclusive barley feeding at the close, gave economical gains on the whole, and produced bacon of good quality, though scarcely so firm as that produced by barley or by peas and middlings.

5. Barley appears to be an exceptionally safe and valuable food for swine, whether fed alone or in combination with other foods.

6. Peas should always be fed in combination with other foods, in which case they give good results.

7. Exclusive corn feeding is no doubt risky under any conditions, but the practice cannot be too strongly condemned when followed for any considerable length of time.

Experiments in Sheep Feeding.

Alfalfa and Red Clover Hay for Lambs.

Two short experiments have been made with these foods for lambs, the first of which is described in last year's report. In the first experiment, three groups of lambs were fed red clover, first cutting of alfalfa, and third cutting of alfalfa, respectively, together with a grain ration. In the second experiment, three groups of lambs were fed red clover, first cutting of alfalfa, and second cutting of alfalfa, respectively, without grain or any other food. The first experiment continued for 74 days, and the second for 42 days.

Summary.

1. In each experiment the alfalfa hay gave slightly better results than the red clover hay.

2. In the first experiment, the third cutting of alfalfa gave somewhat better results than the first cutting, but in the second experiment, the first and second cuttings of alfalfa were practically equal.

3. In the second experiment, one lamb in the red clover group made an extremely low gain, while the other lambs in the same group made an average gain equal to that of the alfalfa groups. This would indicate that the lower average gain on red clover was due to the individuality of this one lamb rather than to the food.

4. Everything considered, it cannot be said that either of the fodders showed marked superiority over the other. The experiments indicate that the feeding values of red clover and alfalfa hay are very similar.

5. All animals continued in perfect health from the beginning to the end of each experiment, indicating that alfalfa hay is a safe fodder for sheep, if it is cut and cured at the right stage of growth, say in early bloom.

Corn vs. Peas for Fattening Lambs.

During the winter of 1897-98, two groups of lambs were fed upon equal parts by weight of ground corn and oats, and equal parts by weight of ground peas and oats, respectively, together with clover hay. The results of this experiment are given in last year's report.

During the past winter, one group of lambs was fed ground corn, another fed ground peas, and a third group was fed equal parts by weight of ground corn and peas. All groups were fed like quantities of clover hay. The lambs were started on one pound of meal per lamb per day, which quantity was increased until it reached one and one-half pounds of meal per lamb per day. The experiment lasted 104 days.

Results. Briefly stated, the gains and meal consumed per pound of gain were as follows:

Corn Group: Average weekly gain per lamb, 2.52 lbs. Meal consumed per lb. of gain, 3.80 lb.

Peas Group: Average weekly gain per lamb, 2.91 lbs. Meal consumed per lb. of gain, 3.30 lbs.

Corn and Peas Group: Average weekly gain per lamb, 2.60 lbs. Meal consumed per lb. of gain, 3.68 lbs.

Summary.

1. In the first trial, corn and oats gave a larger gain than peas and oats.
2. In the second trial, peas alone gave the largest gain, followed by corn and peas.
3. The second trial is more satisfactory than the first because it covered a longer

period of time, and because, from the method of feeding, a more direct comparison of peas and corn was obtained. It is a suggestive fact that the gain made by the group on corn and peas is intermediate between the gains made by the other two groups.

4. During the second trial, ground corn could be bought for $17 per ton, while peas cost from 60c. to 66c. per bushel. As a result, though the peas gave the largest gain, the corn gave the cheapest gain.

5. According to the results of the second trial, if pea meal is valued at $20 per ton, ground corn would be worth $17.35 per ton.

Further tests will be made.

Farm Superintendence.

Upon the resignation of the former Farm Superintendent, Mr. Wm. Rennie, on October 1st I assumed control of this important department, in addition to my other duties, having for assistants Mr M. D. Geddes, as farm foreman, and Mr. W. J. Price, B.S.A., as Fellow in Agriculture. I am pleased to say that both these young men are doing excellent work.

Hauling in Hay on the College Farm.

Owing to the fact that I have had charge of the Farm department during only the last three months of the year, I cannot give anything like a full report of the year's work. The following is a brief statement of some points which may be of general interest:

The system of cultivation was the same as that followed during preceding years, which will be found described in previous reports of the Farm Superintendent.

The summer of 1899 was exceedingly dry, the total rainfall during the months of June, July, and August being less than two and three-quarter inches. As a result the crops were not so abundant as usual, and it is doubtful whether we shall have enough of all kinds of fodder for our rather heavy stock. The dry weather was particularly trying upon newly-seeded meadows, and it is quite probable that next year we shall have some very poor meadows as a result.

Live Stock.

Cattle.—Among the beef breeds we have representatives of the Shorthorn, Hereford, Aberdeen-Angus, Galloway, and Devon breeds. We are particularly in need of fresh Shorthorn blood. Among the milch cows kept in the department there are three Holsteins, one Ayrshire, and one Jersey, the remainder being grades.

During the winter of 1898-99, twenty-four steers were fed. In the fall of the present year, sixteen steers were purchased, and they are now in the farm stables.

Sheep.—Owing to the fact that the sheep have not done particularly well upon the College farm, the flock has been considerably reduced, representatives of only four breeds being retained, namely, Cotswolds, Leicesters, Oxfords and Shropshires. Should these prove successful, it is intended to increase the flock gradually. During the past summer, Lord Polworth kindly presented the College with three Border Leicester yearling ewes and a ram lamb. The ram, however, was unfortunately killed in an accident.

Swine.—Our swine represent three breeds, Yorkshire, Tamworth and Berkshire. Representatives of other breeds are fed in the experimental department. We have been somewhat overstocked with hogs this fall on account of the changed arrangements regarding the annual sale, as is subsequently explained. Private sales have not been very satisfactory, a fact due, no doubt, to the general depression in the price of hogs.

Methods of Feeding.

While there is, perhaps, no best ration for a given class of stock, an account of our methods of feeding may not be without interest. The following descriptions will give a fair idea of the methods we are practising at present, though they are subject to modification according to circumstances.

Beef Breeds of Cows.—The bulky part of the ration consists of cut hay, chaff, silage, and pulped roots. These foods are mixed a day in advance of feeding, in about the following proportions: Four bushels mixed cut hay and chaff, 5 bushels silage, and 3 bushels pulped roots. Of this mixture they receive what they will eat up clean three times a day. Cows suckling calves receive, in addition, a light meal ration, from 3 to 5 pounds, according as we deem advisable, though the quantities named do not necessarily represent cast-iron limits. Dry cows receive no meal. The meal mixture consists of 2 parts chopped oats to 1 part bran, by measure.

Milch Cows.—These receive the same bulky food and the same meal mixture at present as the beef cows. Cows giving in the neighborhood of 30 lbs. and upwards of milk per day are fed 10 lbs. per day of the meal mixture. Cows further advanced in lactation receive from 5 to 6 lbs. of meal per day.

Fattening Steers.—The steers are fed all they will eat, morning and night, of hay, silage, and root mixture. At noon they are given a light feed (about 6 lbs.) of long hay, by way of variety. Their meal consists of chopped corn and oats in the proportion of 5 parts corn to 4 parts oats, by weight. It is intended to increase considerably the proportion of corn in the mixture as the steers become used to it. In November the steers received about 4 lbs. of meal each per day, and in December 6 lbs. each per day. The quantity of meal will be increased as circumstances seem to demand, the aim being to have the quantity of meal average between one-half and two-thirds of a pound of meal per day for every hundred pounds of the average live weight of the animals. This method has given the most economical gains in our experiments with steers, a report which appears in Bulletin 110, published recently. The meal is fed by measure, but all grain is weighed in bulk before feeding, so that we shall know exactly how much meal the steer consumes during the fattening period. The same is true of the other classes of stock also.

Bulls.—Our stock bulls are fed hay, turnips, and a light meal ration. On an average they receive about half a bushel of turnips and 3 lbs. of meal each per day, the quantity of meal varying with the condition of the animals or the amount of service they have to perform. We find that a light meal ration and a somewhat limited bulky ration tends to keep the animals active. The meal consists of 4 parts chopped oats to 1 part bran, by measure.

Sheep.—The sheep are fed a mixture of cut hay and pulped turnips twice a day, with a feed of pea straw outside at noon. On an average they receive about 5 lbs. of turnips each per day, but this quantity will be reduced as lambing time approaches. In addition they receive a light meal ration, the quantity varying with the condition of the ewes. At present they average nearly 1 lb. per head per day of a mixture of 2 parts chopped oats to 1 part bran, by measure.

Swine.—In our piggery we have to feed a considerable amount of refuse from the College kitchen, a substance of varying composition and somewhat doubtful value. Our practice has been to cook this refuse, and to a barrel of it add about 70 lbs. of a meal mixture, composed of equal parts, by measure, of chopped barley, bran, and middlings. This mixture is fed to dry sows and hogs that have reached the age of about four months or over. The quantity varies with the condition of the animals, well grown animals usually receiving only two feeds per day, with roots at noon. Sows that are near farrowing or that are suckling pigs are not fed the refuse from the College, their ration consisting of chopped oats, bran and middlings, the oats constituting half the bulk of the ration. A few roots are fed by way of variety. To pigs just weaned we feed skim-milk, when ob-

tainable, with about two parts middlings to one of bran. A few roots are fed every day to accustom the pigs to eating them.

We are contemplating feeding more dry food during the winter months, and will report results at a later date.

Financial Matters.

As the necessary data are not at my disposal, I shall not attempt to give a statement of the financial standing of the farm department this year. The general financial statement of the institution, however, does not represent the farm in its true light, since no account is taken of the produce and labor supplied to other departments. For example, we may mention the hay, silage, roots, pasture, and bull service for the large herd of cows kept in the dairy department; the hay and roots supplied the experimental department; the keep of horses for the garden and College departments; the potatoes and milk supplied to the College; the purchase and keep of extra animals for educational purposes; and a long list of services in the way of labor of men and teams for various departments, for all of which the Farm department does not receive a dollar of credit in the Public Accounts. In addition to the above, there are a few other points to which I desire to call attention.

In the first place, at a meeting of the Advisory Board, held late in September, it was decided not to have an auction sale but to dispose of the surplus stock by ordinary sale, as the amount available was hardly sufficient to warrant the extra expense necessary for an auction sale. This left us over-stocked with hogs which were disposed of as best we could in order to reduce our herd to the capacity of our winter quarters. A considerable amount of stock remains unsold at the time of writing this report. This statement of facts accounts for the very considerable shortage in the estimated revenue from the farm.

In the second place, I beg to state most emphatically that under existing conditions, it is impossible to make the farm show a satisfactory profit. It is true that by requiring all departments to pay the Farm department for everything received therefrom, the same as if purchased or hired from an outsider, the annual deficit shown in the public accounts could be greatly reduced. In order to make the farm show a profit, it would be necessary to set a portion of it apart, equip it with separate buildings, stock and implements, allow no other department to interfere with it, and have its accounts kept entirely separate from all others. But if this were done in accordance with the demands of some critics, and a profit shown from the land thus set apart, of what value would this be to the farmers of the Province? It would merely be demonstrating what is already being demonstrated on many well managed farms in this Province, that it is possible to make a profit from farming by pursuing a certain course. We find men making money out of dairying, out of fattening animals for market, out of breeding pure-bred stock of various kinds, and other lines of farming, as well as from all sorts of combinations of the lines mentioned. Now, who is to decide, or how is it to be decided what particular line or combination of lines of farming is to be adopted for this proposed model farm? Since it is a provincial institution, it is evident that any system which might be adopted must be applicable to the Province as a whole. There could be no excuse for following methods which, from their nature, would be incapable of general adoption. Is dairying to be followed? Then what about those whose taste, location, or investment of capital renders dairying out of the question? And would it be an unmixed good if all the farmers in the Province engaged in dairying? Are cattle to be purchased for feeding, and possibly grain purchased to feed them? Then who is to raise these cattle and grow the grain? Let everyone who has a plan to propose, apply it to the touchstone of general applicability, and see whether at best it would not only be a scheme to benefit a few at the expense of many.

There is still another side to this question. Select any successful farmer, and then visit his less successful neighbors and ask them why they do not adopt his methods, and you will probably receive such answers as these: "I have not the capital;" "I have not the business ability;" "I have no taste for that kind of farming, and would not engage in it;" "I have not the same natural advantages;" "I have not the reputation," etc. Now, if our model farm were in operation, we should hear another reason: "I have not

the Government at my back." Those who advocate a model farm to demonstrate how to make money, are exceedingly vague regarding the details of the scheme; and unless the scheme can be shown to be applicable to a great majority of the farms in the Province, what justification can there be for launching upon the enterprise?

People overlook the fact that science is applicable to all branches or lines of agriculture. It is as much for the day laborer working after hours in his small potato patch, as it is for the largest land owner in the Province. With this in mind, as well as the fact that a uniform system of farming throughout the Province is unattainable, if not undesirable, we are forced to the conclusion that if our College farm is to be of the greatest value to the Province as a whole, it must illustrate the application of advanced methods to as many phases of farm work as practicable. But this broadening of operations is a source of weakness financially, because no farmer could hope to make money if he divided his operations into as many channels as we are forced to do here. On the other hand, if the scope of our work were narrowed down to meet the requirements of a money-making concern, the number of people who could derive benefit from our operations would necessarily be very small. Take for example our students, to whom I believe we owe our first duty on account of the expense they are incurring to avail themselves of what we have to teach. It is argued that no better object lesson could be given them than a farm run upon a paying basis. Possibly this is true, provided that a system of farming were followed that each student could put into practice upon his return home. But, as a matter of fact, there is a very wide variation in the requirements of our students, and our present efforts are directed towards giving each man something that will be of use to him in his particular line. According to the proposed plan of having a farm run on some special line, probably not one-tenth of our students would find it possible to adopt a similar line of farming, and the remainder would leave here without receiving any real help towards solving the problems which they have to encounter on their own farms.

I have dwelt upon the above points somewhat at length, because I know that in taking upon myself the responsibility of conducting the Farm Department, I am assuming control of perhaps the most imperfectly understood and the most unfairly criticised department in connection with the institution. I think it important, therefore, that at the very commencement of my duties, I should make an effort to explain what appears to me the proper functions of the Farm Department, in opposition to proposals which are made from time to time regarding it. I may add that I have no hope of making the farm show a profit so long as present conditions exist. I shall endeavor to conduct the department with as much economy as is consistent with its efficiency, and an effort will be made to have the various operations of the farm represent advanced methods, so that our students, or others who are interested, may derive therefrom some hints which will be of service to them in directing the operations of their own farms.

Trusting that this defence of the Farm Department as it exists at present may not be regarded as out of place,

I have the honor to be,
Your obedient servant,
G. E. DAY.
Professor of Agriculture.

ONTARIO AGRICULTURAL COLLEGE,
GUELPH, December 30th, 1899.

PART IX.

PROFESSOR OF HORTICULTURE.

To the President of the Ontario Agricultural College :

SIR,—I have the honor to submit herewith my seventh annual report. In accordance with your request, it has been very much condensed and all tabular results of experiments have been excluded. These we hope to be able to publish in bulletins which will be prepared from time to time as sufficient valuable data are accumulated. The present report, therefore, is merely a brief summary of the work carried on in this department during the past year.

Teaching.—A full course of lectures, as outlined in the College circular, was given to the students of the first, second, and third years; and the studies taken up in lectures were supplemented by demonstration and practical work in the orchard, vineyard, small-fruit plantation, garden, greenhouse, and laboratory.

Outside Work.—The regular work of this department, apart from that of teaching, is of a varied character, and includes the care and management of : 1, Orchards ; 2, Vineyard ; 3, Small-fruit plantations ; 4, Vegetable garden ; 5, Lawn and grounds ; 6, Forestry plantations ; 7, Conservatory and greenhouses. In each of these much work has been done, and considerable progress has been made during the year. We shall refer briefly to such features of the work as may be of the most interest to the general public.

THE ORCHARD.

In the young orchard, set out in the spring of 1897, we have a large collection of varieties of apples, pears, plums, and cherries. And we are pleased to report that all of these, even the Japan plums—Burbank and Abundance—have so far come through the winters uninjured. In the spring of 1898, twenty trees each of quinces, peaches, and dwarf pears were set out. These were given a slight protection by wrapping them with straw. Some of the quinces and peaches were more or less killed back at the tops, while others and all of the dwarf pears came through uninjured. This was to us an agreeable surprise, when we took into account the severity of the past winter, which is generally considered the most disastrous that Ontario fruit-growers have yet experienced. There was little or no snow to protect the ground all winter, while the mercury often ranged from 15 to 30 degrees below zero for several days at a time. The ground in many places was frozen to a depth of from five to six feet. That such trees managed to survive with us, while thousands were killed out, root and branch, in the best fruit sections, is more than we could have expected.

THE VINEYARD.

In the young vineyard, set out in the spring of 1898, we were not so fortunate, as nearly 35 per cent. of the vines were winter killed. The varieties planted in this vineyard were selected from amongst the earliest and most likely to mature their fruit in this section. A count of the survivors this year shows that there is evidently a marked difference in the hardiness of the different varieties. We had about thirty-five vines of each of the following varieties. The list gives them in the order of hardiness, and shows the extent to which each suffered from winter killing :

	Per cent.	
1. Moore's Diamond.	2.6	winter killed.
2. Worden	5.3	"
3. Early Ohio.....	7.8	"
4. Wyoming Red . .	7.8	"
5. Moore's Early....	10.5	"
6. Jessica.....	13.1	"
7. Brighton	34.2	"
8. Early Victor....	34.7	winter killed
9. Moyer	42.1	"
10. Lindley.....	47.3	"
11. Massasoit	47.3	"
12. Delaware	68.4	"
13. Green Mountain.	70.9	"
14. Hartford 100.0		"

Raspberries.

During the past three years we have been fruiting thirty-three varieties of raspberries, and careful records have been made of the yields from each variety. Among the reds, Columbian (purple), Shaffer (purple), and Cuthbert rank in the order mentioned for the heaviest yields during the past season. Highland Hardy and Marlboro rank first for earliness, giving the largest yields before the 15th of July. Golden Queen and London gave the largest late yields. These few varieties, including early, medium, and late, as well as those of red, purple, and golden color, would make a choice collection for either home use or market.

Among the black raspberries, Older, Gault, Eureka, and Hilborn, come in the order named for total weight of crop. Eureka holds the record for earliness, having given the largest yield before the 15th of July; while Mammoth Cluster and Gault made the largest late yields. The Palmer, which in 1897 held first place for total yield, dropped this year to sixth place on the list; and Gregg, which last year came third on the list, now stands tenth.

A new plantation of raspberries was set out last spring, containing about sixty varieties. And notwithstanding the exceedingly severe drouth of last summer the bushes have made remarkably fine growth. All of these varieties will in due time be thoroughly tested and reported upon.

Blackberries.

It has generally been considered that blackberries were too tender for sections of the country having a climate such as we have at Guelph. But after an experience of three years, including such a severe test as our bushes had last winter, we think we may safely say we have found some varieties which may be considered hardy, even at Guelph.

Eight varieties have now been fruited here, and among them Agawam, Western Triumph, and Stone's Hardy have so far come through the winters uninjured; and this year they rank in the order named for total weight of crop. Gainor, Ancient Briton, Taylor and even Snyder were more or less seriously winter-killed, and yielded in the order mentioned.

Currants.

Currants are among the hardiest of our small fruits; and, with reasonable care, they may be expected to yield a good crop in all sections, and all seasons. As with other fruits, however, there is considerable difference in the productiveness of the different varieties. During the past three years we have been fruiting thirteen varieties, two white, eight red and three black. In all these years, the *White Grape* has held first place as a white currant, and until last year it had not been beaten in point of yield by any other variety, either red or black.

For first place among the red varieties there has been a number of strong competitors. In 1897 that place was held by Raby Castle, which this year stands fifth on the list. In 1898 it was held by North Star, which this year has dropped to seventh place. And in 1899 Fay's Prolific stands first, with an average yield of 54 oz. per bush, while Cherry follows with an average yield of 39 oz. per bush. But as *Fay's Prolific and Cherry* bear much larger and finer looking fruit than any of the others mentioned, they have an additional claim to consideration by the planter. Belle de St. Giles, a new variety which this year ranks fourth on our list for productiveness, also bears very large, handsome fruit, and is well worthy of trial.

For an average of the yields of the past three years, the *Champion* ranks first among the black currants; but it has not, on the whole, very much outyielded Naples and Lee's Prolific. And none of the blacks have borne anything like the crops given by the best red and white varieties.

Gooseberries.

There are two quite distinct classes of gooseberries grown in this country—*the American varieties*, which have been developed from the native wild gooseberries, and *the European varieties*, the plants of which are mostly imported from England. The American varieties are, as a rule, better suited to our climate, are more healthy and vigorous, and bear more heavily, although the fruit is not so large as that of the English varieties. The

great trouble with the English varieties, in this country, is that they are so subject to mildew that it is seldom we can get a good crop from them, unless they have been regularly and thoroughly sprayed with potassium sulphide.

During the past three years we have fruited thirteen of the varieties most commonly sold by Canadian nurserymen. Six of them were American varieties, and seven were English; and all of the former have each year yielded better than the latter. For each of the three years *Pearl* has headed the list in productiveness. The contest for second place has been between Downing, Red Jacket and Houghton, each of which have held this place for one year. Downing very closely resembles Pearl in appearance, but has never yet come quite up to it in productiveness.

Red Jacket is one of the most promising of the American varieties; and although it is of English parentage, it has not yet shown signs of mildew, the berries being quite as large as some of the leading English varieties.

Strawberries.

Two hundred and fifty varieties of strawberries have been fruited here during the past four years. Careful notes have been taken on the habit of plant, and the character of fruit of each variety, and every picking has been carefully weighed and recorded. We are in a position, therefore, to speak with some authority upon a large number of varieties, and particularly upon those that have been under test for four years in succession. It is impossible, however, to give a satisfactory report in such a brief summary as is here necessary, because of the many and varied qualities which have to be considered in arriving at a conclusion as to what is really the best early, medium and late strawberry. We hope soon to be able to prepare a bulletin on this subject in which a fuller report can be be given. Only a few of the leading varieties can be here mentioned. Among two hundred and seventeen varieties fruited this year, *Irene* heads the list for productiveness, while Stone's Early comes second, and Clyde third.

Irene is a comparatively new variety, which has been fruited here only two seasons. The plant is vigorous and healthy, and makes plenty of runners. The blossoms are pistillate; and the fruit begins to ripen about mid-season, and holds on well till late. The berries are of fairly good size, firm, shapely, and of a beautiful rich dark crimson color, with bright yellow seeds, and a varnished appearance. Irene is certainly one of the promising new varieties.

Stone's Early has been tested for the past four years, and during that time it has made the highest average for total weight of crop. It is something of the Haverland type, both in plant and berry, having all the excellent qualities of that reliable variety, but it also lacks the firmness necessary for a good shipper.

Clyde is one of the most promising of recent introductions, and has made a grand record for the two years it has been fruited here. The plant is vigorous and healthy, the flower perfect, and the berry is large and moderately firm, but the color is hardly so dark as we would like.

Saunders ranks second for productiveness among the varieties which have been tested for four years. It possesses as many of the good qualities and as few of the faults as any variety on the list. The plant is vigorous, free from rust, makes plenty of runners, has perfect blossoms, blooms late, and thus often escapes injury from late spring frosts. The berry is large, firm, well shaped, and of a good color. As an all-round late variety, Saunders has proved one of the best.

As to which is *the best early variety*, it is more difficult to decide, as there have been a number of strong contestants for that honor. For two years in succession Van Deman held first place for the largest early yield, but in the drouth of last summer it fell far behind several others. But as far as earliness and fine berries are concerned Van Deman is hard to beat, its worst fault is that the plant lacks vigor, and thus requires a favorable season to make a good yield.

Anna Kennedy gave the heaviest yearly yield this year, and is altogether a very handsome, promising variety, but we have not tested it long enough to know how it will hold out. If we were asked to make *a selection of half a dozen* of the leading varieties which would pretty well cover the season, we would from our present experience select Van Deman for earliness, Saunders for lateness, and Stone's Early, Irene, Clyde, and Tennessee Prolific for general crop.

Tomatoes.

In view of the growing importance of the tomato crop, not only for home use but for canning and export, we have for the past two years been conducting a variety test of tomatoes. This year thirty-seven varieties were included in the tests. Careful notes were made on all the important characteristics of each variety, and at each picking accurate records were made of the weight of sound ripe fruit, the rotten fruit, and of the green fruit left on the vines at the end of the season. In this way some very interesting and valuable data were obtained.

In the amount of unripe fruit at the end of the season, there was comparatively little difference in the different varieties; the lowest having an average of 1 lb. per plant, and the highest having only 2 lbs, 7 ozs. per plant. In the amount of rotted fruit there was a wide range; varieties such as Atlantic Prize, Aristocrat, Earliest of All, Dwarf Champion, and Early Ruby were comparatively free from rot, while a number of otherwise excellent varieties lost the greater part of their crop in this way. This might have been prevented to a large extent by spraying with the Bordeaux mixture, but they were left unsprayed in order to ascertain the susceptibility of each variety to the tomato rot fungus; and the results show that there is a very marked difference in this respect.

Taking into account the amount of sound ripe fruit for the whole season, we fine a wonderful difference in the productiveness of the various varieties. *Atlantic Prize*, stands at the head of the list, with an average yield of 77 lbs. 10 ozs. per plant, while the so-called "Best of All" stands at the bottom of the list, with an average yield of only 8 lbs. 7 ozs. per plant. The first dozen varieties in the order of their yields of sound ripe fruit were Atlantic Prize, Earliest of All, Stone, Mayflower, Aristocrat, Ponderosa, Ignotum, Livingstone's Beauty, Long Keeper, Trophy, Fordhook First, and Dwarf Champion.

In this year's as well as in last year's tests the first variety to give ripe fruit was *Earliest of All* (Steele-Briggs's). This variety has made for itself a good record, being not only very early but very productive. The fruit is of good size and color, but lacks somewhat in smoothness and firmness.

Atlantic Prize, may be considered one of the standards for earliness, and it is only a few days later than Earliest of All, while the fruit is smoother and firmer. In sections such as this, where the seasons are short, these early varieties have proved to be the most satisfactory for main crop.

For handsome, smooth, firm, well-colored fruit, *Stone* and *Aristocrat* were two of the best. The former was about a week later than the Earliest of All, and ranks third on the list for productiveness, with an average yield of 46 lbs. 10 ozs. per plant, although it lost 12 lbs. per plant by rot. Aristocrat was about two weeks later than Stone, and ranks fifth for productiveness, with an average yield of 38 lbs. per plant, and was free from rot.

Tests of Ornamentals.

Floriculture is a branch of horticulture to which more and more attention is being given as our country becomes older. Some evidence of this may be seen in the greater attention being given to annual flower shows, and the increased space devoted each year to ornamentals in the catalogues of seedsmen and nurserymen. From the glowing and two often exaggerated descriptions given in many of these catalogues, the novice is often altogether at a loss to know which really are the most satisfactory species or variety. Of course these are questions about which there may be a great variety of opinions, nevertheless the difficulty of selection would be considerably lessened, if these lengthy lists of varities could be reduced to say a score or two of the choicest.

For some time past we have been testing a great many varieties of a number of the most popular species of ornamentals, and a few of what we have found to be the most satisfactory are here given.

Geraniums.—For several years past, we have been testing a large number of varieties of geraniums for bedding purposes; and for the past two seasons, careful notes have been taken on 230 varieties, which have been grown under the same conditions in the green house and have been tested side by side in the flower border. This collection is

made up from stock secured from some of the leading growers on this continent. In the list given below only those varieties are mentioned which have scored the highest number of points for two years in succession :

Scarlet—Aceton, Director Marmy, Garden Director, General Grant, J. J. Harrison, Louis Fages, Marvel, M. A. Bouleaus, Marquis de Garland and W. A. Chalfant. *Crimson*—S. A. Nutt. *Rose*—Fanny Thorpe and La Constable. *Pink*—Eulalie, Madonna and Mary Hill. *Salmon*—Dr. Verneuil, John Good and Mrs. E. G. Hill. *White*—Alpine Beauty, C. de Harcourt, La Favorite and Mad. Buchner. *Silver-leaved*—Mad. Salerol and Mrs. Parker. *Golden-leaved*—Crystal Palace Gem.

COLEUSES.—Probably none of the many plants used for bedding purposes make a greater color display of foliage than the coleus. To attempt to describe the coloring and markings in some of the varieties now grown would seem like presumption, yet, in addition to rich coloring a first-class bedding variety must have vigor and a free branching habit. During the past two years forty-five varieties have been tested side by side in our trial plots ; and while the colors have not been lost sight of, careful note has been taken of the vigor and habit of each variety. The following have been found to combine the greatest number of desirable qualities : Alhambra, Beckwith Gem, Chicago Bedder, Charming, Excelsior, Electric Light, Firecress, Firebrand, Golden Bedder, John Good, Pink Gem, Paroquet and Rob Roy.

CHRYSANTHEMUMS.—The chrysanthemum deservedly enjoys the distinction of being the "Queen of Autumn Flowers." It is a favorite not only with the professional, who grows it in all its perfection for the autumn shows, but with the amateur who delights in having bright and cheery flowers in the house at the Thanksgiving season.

To encourage its cultivation to a greater extent in the homes of the people, a commendable move was made last year by some of the local horticultural societies of the Province. In the spring, small collections of desirable varieties were given to the members ; and when the flowers were in bloom in the autumn, little chrysanthemum shows were held, when the beauties of the flowers were discussed and admired.

In order to assist any such societies as may make a similar effort next year, we give below a list, which may be considered the cream of about 250 varieties which we have tested for several years. This list includes not only representatives of most of the different types, but also a wide range of shades and colors.

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

GLADIOLI.—The gladiolus is one of the summer bloomers deserving of much more general cultivation. It is so easily grown that anyone who can plant the corms in the spring may reap a rich reward in bloom during the latter part of the summer. The flowers present a wonderful variety of colors and markings, and are often quite as choice as the rich man's orchid. If the spikes are cut and put in water in the house, when the first few lower flowers open, the upper flowers will open in succession, and often last for a week. A collection of mixed unnamed varieties will often give lots of bloom and good satisfaction ; but if something choice is wanted, there is much more satisfaction with a good collection of named varieties. A large number have been grown here during the past three years, and in the following list we give a score of those that have been most admired. This list includes good representatives of the Gandavensis, Lemoinei, Nanceianus, and Childsi types, and should give a succession of bloom from the middle of July to the end of October ; Achanti, Diamant, Deuil de Carnot, Domino Rose, Dr. Bailly, Erie, E. V. Hallock, E. Souchet, Formosa, La Parisienne, La Perle, Massena, Magenta, M. de Vilmorin, Nakomis, Nezinscott, Pacha, P. Hariot, Princeton and Snow-white.

Ontario Fruits for the Paris Exposition.

During the summer this department had charge of the preparation of a collection of Ontario fruits for display at the Paris Exposition. This work began with the small fruits early in July, and continued until the last of the winter apples were received about the end of the year. Excellent samples of different kinds of fruits were received from all sections of the country, and after careful selections the best were put up in glass jars, in preservative fluids best suited to retain the natural color of the different fruits.

The collection when complete made a very fine display, and, if it reaches Paris in good condition, it should be a credit to the fruit industry of this Province. On each jar was placed a neat label, giving the name of the variety of fruit, and also the name and address of the grower. After a good deal of culling and selecting of the best, the collection as put up for shipment consisted of 613 jars, made up as follows: 139 jars of apples, 84 of pears, 30 of peaches, 93 of plums, 5 of quinces, 2 of apricots, 54 of grapes, 80 of raspberries, 14 of blackberries, 34 of gooseberries, 39 of currants, and 39 of cherries.

Acknowledgments.

I beg to acknowledge with thanks the following donations to this department during the past year:

Roderick Cameron, Niagara Falls, Ont.—Some choice species of greenhouse plants.

Central Experimental Farm, Ottawa, Ont.—Collection of American plums, raspberries, strawberries and tricolor geraniums.

Robt. Marshall, Snelgrove, Ont.—Scions of Dutch Mignonne apple.

Chas. T. Ford, Stoke Canon, England.—Scions of Cornish Gilliflower.

E. Routledge, Clinton, Ont.—Plants or Ocean Wave and Lancashire Lad gooseberries.

S. C. Sunley, Guelph, Ont.—Plants of seedling strawberries.

Spramotor Co, London, Ont.—Spray pump.

A. E. Sherrington, Walkerton, Ont.—Plants of Superlative raspberry.

G. C. Caston, Craighurst, Ont.—Plants of Little's 44 strawberry.

A. H. Crosby, Markham, Ont.—Plants of seedling gooseberry.

E. Bromley, Barkerville, B. C.—Plants of B. C. blueberries.

Henry Gowling, Wandin Yallock, Victoria, Australia.—Strawberry plants.

S. Greenfield, Ottawa, Ont.—Cuttings of seedling currant.

S. Spillett, Nantyr, Ont.—Gooseberry plants.

My thanks are also due to the heads of other departments, who have rendered kindly assistance in various ways, and to the foremen and men of this department, who have faithfully contributed their share towards making the work of the year a success.

Respectfully submitted,

Ontario Agricultural College,
Guelph, Dec. 30, 1899.

H. L. HUTT.
Professor of Horticulture.

PART X.

BACTERIOLOGICAL DEPARTMENT.

To the President of the Ontario Agricultural College:

SIR,—In the absence of the Professor of Bacteriology, I venture to submit a brief report of some of the work done in the Department during 1899.

ROUP IN FOWL.

A considerable amount of work has been done in investigating the diseases known as roup, canker and distemper in fowls. Attacks of roup cause much loss and annoyance to poultry raisers, and it is seldom that one sees a number of any poultry journal which does not contain one or more inquiries about a cure for roup.

In the spring, several letters were sent by me to various poultrymen in Canada and to a few in the United States, in order to find out definitely the opinions of practical men on the subject. The results, however, were most disapppointing. Only two Canadian poultrymen answered the questions, but all letters sent to the Americans were most fully answered, and the writers requested that they might be furnished with any information obtained as a result of our work.

I may also say that I found it almost impossible to obtain diseased birds from poultrymen. In several cases known to me, birds have died from the disease or have been killed and buried; but I have not been able to obtain any information from the owners. They have simply expressed the hope that we would soon find some reliable remedy. It has, as a rule, been necessary to pay for diseased birds, even when they appeared to be almost dead. I must, however, thank Mr. Graham, the poultry manager at the College, for his assistance in obtaining roupy birds.

Roup is probably the most widely spread and destructive disease affecting domestic fowls. Hens, chickens, turkeys, pigeons and pheasants are affected. In some outbreaks the mortality is high; in others, there are no deaths.

Opinions differ as to the cause of roup, but by most poultrymen it is supposed to be due to exposure to draughts or cold. It is generally admitted that the disease is infectious, and, this being the case, we must look for some more substantial cause for it than draughts or cold; for we know that infectious diseases, both in animals and man, are the result of the growth of either vegetable or animal parasites in the body. Roup has been ascribed to the growth of various organisms, both animal and vegetable; in fact, it has been stated that there are three organisms which cause the symptoms usually found in connection with roup.

In my investigations I have discovered as yet only one organism which will produce a membrane in the throat of fowls similar to what is found in cases of roup. This is described in the paragraph at the end of this article. Another organism, a coccidium, has been found to be present in the tissues of diseased birds, but I cannot yet show that it is the cause of the disease, although certain writers have stated that some forms of roup are caused by a coccidium. Further investigation will no doubt throw more light upon the subject, and it is hoped that sufficient valuable material may be obtained to allow of the publication of a bulletin on the diseases of poultry.

My attention was directed to an article by H. A. Stevenson, M.D, published in the *Journal of Comparative Medicine*, July, 1898, in which he states that roup is "caused by a specific germ which appears to me to be identical with the Klebs-Löffler bacillus"; and again, "I believe roup and canker to be the same disease, a disease identical with diphtheria in man."

Now these statements, if borne out by experiment and found to be correct, would demand the most rigorous treatment of diseased birds; in fact, the disease would soon

occupy a place of importance as high as that now accorded to bovine tuberculosis; for Dr. Stevenson takes the position that diphtheria may be spread by roupy birds in exactly the same manner as tuberculosis is supposed to be spread by tuberculous cattle. But several questions occur. In the first place, does our experience of the occurrence of roup in fowls and diphtheria in the human being lead us to the conclusion that there is a probability of there being any connection between the two diseases? Is not diphtheria a disease which is more prevalent in towns and closely populated districts, where very few fowls are kept? Is not roup at certain seasons almost universally prevalent in some poultry yards in the country, where there may be hundreds of cases of the disease without a single case of diphtheria among those who look after the birds and treat them from day to day? Has it ever been observed that poultry raisers are more frequently attacked with diphtheria than those who keep aloof from poultry yards?

I may say, in a word, that I have not been able to obtain any evidence in support of Dr. Stevenson's contention.

Statements have been made by European writers that outbreaks of diphtheria have been found to occur in men, while at the same time poultry kept in the buildings in which the men lived were suffering from roup. They, however, do not note whether the roup commenced before the diphtheria or *vice versa*; and they give no good reasons for supposing that the outbreaks were actually connected with each other. In fact it is stated that the cases referred to, of alleged transmission of chicken diphtheritis to man, are on examination found to be mere assumption—due to utter ignorance of veterinary pathology.

Although the writer of the article in the journal referred to has stated that he has isolated a bacillus identical with the Klebs-Loffler (diphtheria) bacillus, yet Loffler himself, n studying the disease, has not mentioned the presence of the bacillus, but describes a totally different organism as the supposed cause of roup.

More recent investigations[2] have failed to reveal the presence of the diphtheria bacillus, as also have those of J. Barlow, Rhode Island Report for 1898.

My own investigations have also failed to confirm Stevenson's statement. In fact it may be said that they have proved the absence of the diphtheria bacillus in a virulent form in the roupy membranes examined, and no organism was found which could be imagined to correspond in appearance or action with that of *bacillus diphtheriæ*. Inoculation experiments with pieces of fresh membrane practised on both guinea pigs and rabbits have given negative results, which could not have been the case had the diphtheria bacillus been present in a sufficiently virulent form to cause the growth of a membrane. Again, sections of the membrane and underlying tissue, although numbers have been made, not only show that the characteristic clumps of Klebs-Löffler bacilli are absent, but that the structure of the membrane differs entirely from that of the diphtheritic membrane formed in the human throat.

Stevenson states that, in his experiments, when rabbits were fed from the same vessel as a roupy bird, they became infected with the disease and died as the result; but experiments conducted here have entirely failed to corroborate this statement. Not only did rabbits live for weeks in coups with roupy birds without becoming affected, but a doe brought up a litter in a coop in which were kept the worst cases of roup procurable; and these rabbits, though drinking from a vessel used by roupy birds, which was uncleaned for weeks, and eating hay and roots which were in constant contact with the birds, never showed any symptoms of ill health.

That there is sometimes a germ resembling the Klebs-Löffler bacillus in birds, I admit, for I have obtained it in numbers from the throats of pigeons which were perfectly healthy before examination, and remained so afterwards.

A similar germ has been isolated from pigeons by Macfadyen and Hewlett (Brit. Med. Journal, p. 1357, 1899), who found them in large numbers in the throats of pigeons suffering from canker. They, however, demonstrated that the disease cannot be produced in healthy birds by inoculation with pure cultures of this germ, and have shown that it has no toxic effect upon mice and guinea pigs, such as that produced by inoculation with *bacillus diphtheriæ*. They, therefore, conclude that it is not the same organism.

1. Triedberger and Frohner, Vet. Path., p. 233. 2. Infectious Diseases of Poultry by V. A. Moore, Bureau of Animal Industry, Bulletin No. 8, Washington, 1895.

There is at present no evidence to show that roup is caused by the Klebs-Loffler bacillus. On the contrary, there is a considerable amount of evidence which tends to show that it is not. In fact it has not yet been shown conclusively that the disease is due to the presence of any bacillus whatever.

It is clearly stated by Friedberger and Frohner that there are at least three varieties of organisms causing diphtheritic or roupy symptoms in fowls, two of these being of animal origin, and the third surmised to be a germ, although no evidence other than the infectious nature of the disease bears out this supposition.

The widely varying symptoms of roup are, no doubt, responsible for the various names by which the different forms are known, and for the difference of opinion as to what constitutes roup and what canker, and whether distemper develops into canker, as if generally supposed to be the case, or whether they are entirely distinct diseases; and it is only by careful and sympathetic observations, which may extend over years, that the real facts can be ascertained.

Antidiphtheric Serum as a Cure for Roup.—I was requested to make some tests as to the value of diphtheria antitoxin as a remedy and preventive agent for roup, as advocated in Dr. Stevenson's article already mentioned.

The use of this serum has been suggested by certain investigators in Europe; but I am unable to find any accounts of its use there.

Different lots of serum were obtained from well-known and reliable firms, and there can be no doubt as to its antitoxic properties when used in cases of genuine diphtheria.

The birds experimented on all presented the characteristic symptoms of roup, as given by Dr. Stevenson, and, therefore, I infer that I worked with birds suffering from the same affection as were those he used, and which it seems were invariably cured by the injection of the serum. The dosage and method of injection, as advised, were closely followed, with, however, very different results.

In only one hen was there a recovery closely following the injection, and it is extremely doubtful whether this was due to the action of the serum or to the care given to the bird; because in all cases the birds had contracted the disease while kept in buildings so cold that some of them had their combs frozen. While being experimented with, they were kept in a room warmed with steam pipes, and received the best possible attention, which was frequently sufficient to bring about a rapid recovery without any treatment. Even if the serum treatment were successful, the expense would prohibit its use, except in the case of valuable birds.

The action of any serum depends upon the fact that it contains substances, elaborated in the body of the animal from which it is derived, which are antagonistic to the products of the disease germ against which it is used. Hence the application of antidiphtheric serum would naturally give favorabe results in roup if that disease were caused by the diphtheria germ, which I have already shown is not the case; and I may add that in testing the serum, attempts have, on several occasions, been made to infect hens with the diphtheria bacillus, but without success.

The serum was also tried as a preventive. Healthy birds were injected and placed with diseased birds, and almost invariably they contracted the disease. Those that did did not do so could not be considered to have been immunised by the injection, because they had for some time previously been exposed with infected birds without becoming diseased. I have found that birds may remain healthy when exposed to the disease for several weeks, or even months, and then suddenly show the characteristic membranes in the throat, with no other injurious symptoms, and continue to lay eggs or gain in weight as usual.

Aspergilliosis in Fowls.

During my work on roup, I obtained several birds said to be suffering from that disease, but which on examination proved to be affected with *Mycosis* or *Aspergilliosis*. That this is a common and little understood disease can be seen by reference to the inquiry columns of the various poultry journals, in which diseases are frequently described that have all the symptoms of Mycosis.

The symptoms are much the same as those of some forms of roup, and the two diseases may be concurrent. There is usually a wheezing and rattling in the throat, with elevated temperature; and patches of membrane appear in the mouth and throat

The birds become thin and weak, the breath having in many cases a most offensive odor; and death usually ensues; but I believe birds do recover, and I have known some to be affected for over a year, remaining to all outward appearance in good health, and at length die suddenly from suffocation.

On post mortem examination, the air sacks of the thorax, and in some bad cases in the other portions of the body, are found to contain a hard, cheesy mass, which in some instances has an exceedingly foul odor. In advanced stages the lungs may be affected and exhibit numerous dark patches containg a viscid semi-purulent substance, while the other organs are healthy. Membranes or exudations may be present in the mouth and throat and also in portions of the intestines.

Cause.—This disease is caused by the growth in the tissues of different varieties of Aspergilli, which are species of mould. The Mycelia of the mould penetrate in all directions through the tissues, causing irritation and an exudation of blood cells, which, with the dead tissue cells and the mycelia of the fungus, form the chees mass already mentioned; and these in many cases cause suffocation by pressure on the air vessels.

Prevention and Cure.—As the disease is spread by means of spores, of which there are two kinds, the only method of prevention is by getting rid of the spores; but as these fungi are able to grow and produce spores on dead organic matter, it is practically impossible to do this. It must, however, be remembered that diseased birds are themselves scattering the spores freely while alive. One case examined showed the fungus in the spore stage in large quantities in the mouth. Hence all badly affected birds should be immediately killed. No remedy is known; but it has been recommended to make the birds inhale tar vapor, which is done by putting a piece of red-hot iron into some tar and placing the bird in the vapor.

Starters for Cheese-makers and Butter-makers.

During the past season, commencing in May, pure culture starters have been sent out to various cheese and butter-makers, 58 in all having been asked for—44 for cheese-making and 14 for butter-making; and a large number of letters have been received from those who have used the starters, all reporting favorably as to their value In some establishments, they are now in constant use. In butter-making, it is only by using the same starter for all churnings that the full benefit is obtained, the object being to produce butter of a uniform flavor. As it is now an established fact that the flavor in buttter made from good cream is due to the action of certain species of bacteria, it is evident that if a pure culture is used for a few days and then discarded for a week or more the object is not attained; because, although the butter made from naturally soured cream may, in some instances, be superior to that from cream ripened with a pure culture, it will not be uniform in quality like that from the latter. It is well known that the very delicate flavor of the best butter is not retained for any considerable length of time; and as the market for the greater portion of our creamery butter is so situated that much time must elapse between the date at which it is made and that at which it is consumed, the few packages of good butter from the naturally soured cream will have lost some of their flavor and in all probability have deteriorated owing to the presence of undesirable organisms, while that made with the pure culture will have retained its comparatively good flavor.

Directions for propagation are sent with each starter. Nevertheless, inquiries on a few points have been made by makers, the most frequent being as to the length of time that a starter may be kept without propagation and still retain its good qualities.

Experiments have shown that when properly prepared and kept cool in a refrigerator, the starter will be efficacious even at the end of four months. No doubt, it would keep for a longer period; but it must be understood that the lactic organisms are unable to grow in milk if it contains too much acid. After the acidity has reached a certain point, it seems to weaken the germs. Hence it is found that a larger quantity of an old starter is required to ripen a given quantity of milk than if the starter were fresh. It is not advisable to use an old starter directly; a new one should be propagated from it, in order to allow the bacteria to regain strength and vigor. In regard to the difficulty of keeping the starter over Sunday without danger of deterioration, it may be stated that as the only harm to be expected is the excessive souring of the starter, it should be re-

membered that the souring is caused by the growth of germs, and that as this is influenced by the temperature, the natural course to pursue is to keep the starter can at a slightly lower temperature in all cases in which it has, from any cause, to be left for a couple of days. The starter is at its best when thickening, and before it is completely coagulated.

Another difficulty seems to be in the selection of a suitable milk for a starter. All milk for starters should be pasteurized. That process may be relied upon to destroy all growing organisms; but it will not affect the spores of other germs which may be present and will commence to grow as soon as the milk is cooled. It has, however, been found that, as a rule, the higher the acidity of the milk the more spores it contains; and that, on this account, the acidity of the milk may be taken as a guide for its suitability for use as a starter—the lower the acidity the more suitable the milk; but this must be taken only as a general guide, for it is quite possible to have a badly contaminated milk with a low percentage of acid.

One point to which far too little attention is paid is to the covering of the starter can. I have frequently seen milk left exposed to the air from the time it was heated till long after it had cooled down. In this way pasteurized milk becomes contaminated to an extent which depends upon the length of time it is exposed and the number of organisms present in the air. Mould spores are usually present in considerable numbers in the air around buildings; and although they are not harmful during the ripening process, they are very objectionable in the butter when it is made up into pound packages to be kept for any length of time. Hence the milk should be covered carefully as soon as it is pasteurized; it should also be stirred and the temperature taken from time to time. A lid with a hole in it to admit the handle of the stirrer should be procured. If the water in which the can is placed is slowly heated there may be no necessity for stirring, and the lid need be removed only for a few seconds when the temperature is taken.

A few extracts from letters written by cheese and butter-makers who have used the starter are given below:

Cheese. Nov. 23rd.—"I had several for cheese-making and got good results from their use generally, although sometimes I had bad success with some of them. I fancy the fault is in the milk not being what it should be to start with."—J. W. Fotheringham.

Butter. Nov. 21st.—"Enclosed find stamps for another . . . the last gave good satisfaction."—W. Bragg.

Butter. Oct. 18th.—"Some time ago we received a butter starter from you. This has given us very good results; so good, in fact, that, as it is about used out, we should like to have another one from the same culture."—J. H. G., Ottawa Experimental Farm.

Cheese. Sept. 30th.—"Have been using one of your pure culture starters for cheese for some time and am well pleased with the results."

Butter.—"We got a bottle of starter from you the latter part of May or 1st of June, and have used starter made from it ever since . . . The work you are doing is of great advantage to creameries and cheese factories, and should be made use of by them all."—St. Marys Creamery.

Cheese Curing.

It has been conclusively shown by Russell and Babcock that much of the change occurring in cheese during the process of ripening is due to the action of an unorganized ferment which they call gallactase. At the same time, they admit that the action of bacteria may also have a great influence upon the flavor and quality of the cheese.

It is well known that the temperature at which a cheese is cured affects both the rate of ripening and the quality of the cheese,—cheese cured at high temperatures ripening quickly and possessing a texture inferior to that of cheese cured at a lower temperature. The flavor of the latter is usually superior, and it does not deteriorate nearly so quickly as that of hot-cured cheese.

Bacteriological examinations were made, in order to ascertain what effect the temperature of the curing-room had upon the bacterial content of cheese, and if possible to find out whether differences in bacterial content corresponded with the differences in the ripening cheese, in texture, flavor, etc.

Four batches of cheese were examined, each consisting of three cheese made from the same curd but kept in curing rooms at different temperatures. Samples were taken every three days, but, as a rule, owing to the small size of the cheese, plugs could be taken from only one end of each cheese; and on this account samples could not be obtained for so long a period as was desired, without danger of boring too close to an old hole and so obtaining a sample which might be affected by the presence of moulds.

A well-marked difference in texture and flavor was apparent throughout the examination; and althongh the scores given by the expert judges do not show a very marked difference in the cheese cured at different temperatures, they cannot be accepted as representing the actual difference between the ripened cheese, because the scores were all made at the same time and obviously cannot be taken as sufficiently accurate for experimental purposes, since the cheese were at very different stages of ripeness. While the hot-cured cheese were perhaps quite ripe, the cooler cured cheese were not nearly ripe; and it is impossible to say what change the latter would have undergone in the period of several weeks required to ripen it equally with the former

This difficulty is mentioned also by Lloyd in the Bath and West of England Society's Report for 1898-9, and he states that by ascertaining the acidity of the cheese and the soluble solids he was able to give definitely the period at which a cheese would become fully ripe, and beyond which it commenced to deteriorate. This method he has used to find out when the cheese is in the best condition for marketing, and has obtained satisfactory results by so doing. It was not possible, owing to lack of time, in the experiments conducted in this Laboratory to ascertain the soluble solids, but the acidity was found. It was found that there was a distinct instinct in the percentage of acids in the cheese as the ripening process proceeded, but it was not uniform. The amount of acid in the cheese examined showed that when at their maximum of quality they did not contain quite so high a per centage as did the English cheese according to Lloyd's work. Some standard sufficiently accurate for practical work may be found by making a sufficiently large number of acid determinations, and it is intended to continue work in this direction if possible.

The results of the bacteriological examination show that the cheese cured at a low temperature has a far larger bacterial content than one cured at a high temperature; although for a very short period, not extending over two or three days, the hot-cured cheese, often being in the curing room for about 7–10 days, showed a slightly higher bacterial content than the cool cheese. The germs continue to increase in the cool cheese for a very much longer period than in the hot cheese. At a certain period, soon after being placed in the curing room, the high temperature cheese contains for a very short time a slightly higher number of germs than one kept in a cool room.

Another interesting and probably important point, when considered in connection with the above results, is that the cheese made in the latter part of the season have a very much higher germ content than those made in the spring and summer. It is a well known fact that fall cheese are superior to those made earlier in the season; it is also indisputable that cheese cured at low temperatures are of better quality than if cured at high or ordinary temperatures. Now, in both the fall cheese and the cold-cured cheese, we find an enormous increase of bacteria over those made at other times and cured at higher temperatures; and it appears to be quite reasonable to assume that in all probability the improved quality in both cases is due to the action of these bacteria. If this is so, it is a strong point in favor of the addition of a starter. It is hoped that further experiments will throw light on this point.

It is difficult to account for certain of the differences in germ content and quality of the cheese. In three of the series, *p. coli* was present in fair numbers. This germ has always been credited with the production of bad flavor in milk and cheese, and an attempt was made to find out to what extent this was true in the cheese examined. The results in two of the series showed clearly that the number of coli germs in the cool cheese was very much greater than in the high temperature cheese; but at the same time the flavor of the cool cheese was more pleasant than that of the other. This peculiarity may, however, be due to another cause, viz., the action of liquifying bacteria, *i. e.*, bacteria which peptonise and break down the casein. These germs were found to be more numerous and to increase more rapidly in the cheese kept at a high temperature; and as they are found to produce a disagreeable taint in milk, it is probable that they do so in cheese.

Bitter Milk.

During the summer a considerable loss in value of cheese was due to a trouble which was known as "Bitter Milk", and samples of cheese so affected were secured from four factories. The trouble occurred at various times from the latter part of July to well on in September; it was widely spread, and was prevalent in most of the factories of the district.

I had no opportunity to investigate the origin of the trouble nor to determine in what manner it had become so widely spread. The following is a description of the unusual changes met with in such milk, and was given by a maker at one of the affected factories:

"This bitter flavor cannot be detected in either the milk or the curd till acid begins th develop. The acid comes on very rapidly after it starts, and it is almost impossible to get the curd dry enough before matting, and does not altogether leave the curd before salting; but if it is handled properly it does not seem to affect the cheese when cured. At times we will not have any of this flavor for days or weeks, and then for two or three days we will have it quite acid, and all at once it will disappear again."

Other makers evidently have not discovered the "proper way" of treating this bitter curd, for many complained that they were obtaining a lower price for the cheese from such milk.

The first sample was obtained on August 8th. An analysis was made, and milk was inoculated with the various organisms found. Only one of these appeared to cause any undesirable change, and a starter was made by using it with a culture of the lactic acid germ present. Curd made with this starter was said (by a dairyman who had visited the factory) to possess a peculiar flavor. In the College cheese-maker's report, the cheese is said to have an apple flavor, which, of course, refers to the aroma, not to the taste.

The next samples were not received till two months later, but the same organism was isolated and a starter made from it which produced the characteristic peculiarities during the process of cheese-making.

The organism which causes the bitter flavor is a yeast-like form known as the Torula. Torulas of various species are frequently met with in the air and also in cheese; but, as a rule, their presence does not cause any objectionable flavor.

The Torula isolated from the bitter cheese acts on the milk sugar, setting up a most vigorous and lasting fermentation, the sugar being converted into alcohol and carbon dioxide gas. When fermentation is completed, the milk contains fully as large a percentage of alcohol as the strongest beers; the bitter flavor, however, is noticeable before there is any distinct flavor of alcohol, and in cheese-making the smell of the alcohol does not appear until the curd is almost ready to mill.

It is interesting to note that what O'Callagan describes as a yeast (though he makes no mention of experiments to show whether it is a yeast or a Torula) frequently occurs in cream in New South Wales (New South Wales *Agr. Gazette*, Aug. 1899), giving it a sharp, bitter taste and forming alcohol. He also states that it would be injurious to butter-makers, and still more so to cheese-makers.

The Torula found in the Ontario cheese also produces a vigorous fermentation in other sugars, glucose, dextrose, and cane sugar undergoing this change and producing a clear, fermented liquid.

The source of this Torula, as already stated, has not been ascertained, and its intermittent appearance renders it extremely difficult to offer suggestions as to its exclusion from milk. If there be a reappearance of the trouble next summer, it is to be hoped that opportunity will be given for further investigation.

Experiments made to learn the effect of a lactic acid germ on bitter milk, have shown that the curd in such cases is just as bitter as when no starter is used. Very little gas is formed in either case.

Water Analysis.

Twenty nine samples of water have been examined bacteriologically and reported upon during the past year; and by the two departments, the Chemical and Bacteriological, twenty-seven samples have been analysed in order to ascertain their suitability for domestic and other purposes.

Two samples were sent for examination from cheese factories, in which the makers had experienced much trouble from gassy curd. In one case, a piece of the cheese was sent and on examination was found to contain a gas producing germ, which was present in large numbers in the water. In the second case, the water was also found to contain large numbers of gas-producing germs, but of a different species from that found in the former case. The makers in both factories were informed of the presence of the gas germs in the water and were advised to discontue its use. Both have reported that since doing so, they have had no trouble with gassy curd.

FIG No. 1—Curd made from vat No. 1.
FIG No. 2—Curd made from vat No. 2.

In connection with the second case, some experiments were made to ascertain what effect the addition of a pure culture would have on the progress of the gas formation, and the illustration in connection represents the appearance of pieces of the curd which were made from two vats of milk, numbers 1 and 2. To each of these an equal quantity of the gassy germ was added and at the same time to vat number 2 was added one per cent of a pure culture starter. The effect of this is well illustrated and clearly shows what a powerful influence lactic acid germs (the only germ in the pure culture) have over many undesirable forms found in milk.

ONTARIO AGRICULTURAL COLLEGE,
GUELPH, December 30th, 1899.

MALCOLM N. ROSS,
Fellow in Bacteriology.

[Mr. Ross's report does not deal with the manufacture and distribution of Tuberculin during the year, and is not so complete on one or two other points as he would have made it, had he not, during the time of its preparation, suddenly decided to enlist and start for South Africa.—PRESIDENT.]

PART XI.

EXPERIMENTALIST.

To the President of the Ontario Agricultural College:

SIR,—I have the honor of submitting herewith my report of the work done in the Experimental department during the year 1899. The work of this department during the past year has on the whole been quite satisfactory. The experiments throughout have been conducted with great care and accuracy. We submit the results with much confidence in their reliability and in their real practical value. The writer has good reason to believe that the work of the Experimental department is being appreciated by farmers of the Province, and that the results are being studied more and more each succeeding year:

In 1899, we conducted field experiments on about 2,300 separate plots in our experimental grounds. We also furnished material and instructions for experiments on 21,035 plots situated on 3,485 Ontario farms. For the results of the co-operative experiments, the reader is referred to the Annual Report of the Ontario Agricultural and Experimental Union. The correspondence during the past year has been heavier than ever before. For several weeks in succession we have received upwards of one hundred letters daily. Addresses have been delivered by the writer at the Fourth Annual Meeting of the Agricultural Students' Union at the Ohio University; at the Annual Meeting of the State Board of Agriculture at Columbus, Ohio; at two sessions of the Annual Meeting of the Ontario Agricultural and Experimental Union, and at several meetings of the Farmers' Institutes in the western part of Ontario. About fifty talks of from thirty minutes to two hours were also given in the month of June, when about thirty thousand excursionists visited our experimental grounds. It will, therefore, be seen that the past year has been a very busy one for those connected with the Experimental department.

For several years in succession we have been conducting experiments with a considerable number of special crops; some of which are not very well known over the Province. We are here presenting a fuller report of these special crops than on any previous occasion, and are saying but little on our experiments in methods of cultivation, dates of seeding, selection of seed, application of fertilizers, etc., which can be dealt with more fully in another year after the experiments have been again repeated.

The experimental grounds consist of about forty-five acres, and are located in the rear of the main college building. The land has a gentle slope towards the south-west. The soil is what might be termed an average clay loam. One-quarter of the land is manured each year with about fourteen good loads (20 tons) of farm yard manure per acre. It will thus be seen that the land receives farm yard manure once every four years. No commercial fertilizers are used except in distinct fertilizer experiments, which occupy from two to three acres each year, and on which tests are made to ascertain the comparative value of different fertilizers with different crops. The plots vary in size according to the requirements of the different experiments, and the yields per acre are determined from the actual yields of the plots in every instance.

OATS (*Avena Sativa*).

As in the case of other cereals, the early history of oats is enveloped in mystery. They have been grown so long in cultivation, with no distinct records to guide us to their original country, that it still remains unknown. The wide range of soils on which oats grow to advantage, and the comparatively low temperature in which they come to their maturity, have rendered them well adapted for cultivation in many countries. In Scotland, we find oats cultivated to its northern extremity, and in Norway they grow as far north as lat. 65°.

The area devoted to oats in Ontario annually, is greater than that used for all the other cereals combined. In 1899, no less than 2,363,778 acres were devoted to the cultivation of oats in this Province.

Our Experiment Station has spared no pains in conducting experiments with different varieties of oats, to ascertain the most suitable kinds for cultivation throughout the Province. No less than two hundred and eighteen varieties in all have been grown on uniform plots in our experimental grounds within the past thirteen years. The greater number of these have now been grown for five years in succession and definite data have been obtained each year regarding the height of the plants, the strength of straw, the susceptibility to rust, the yield of grain, the yield of straw, the weight per measured bushel, etc., of each variety. Seed of promising varieties has been imported from England, Scotland, Russia, Germany, France, New Zealand, and many other countries, and the foreign varieties have been tested under similar conditions with all our Canadian varieties.

The following list gives the weight per measured bushel, tons of straw per acre, and bushels of grain per acre of each of seventeen of the leading varieties grown for a period of nine years—the figures in every instance being the average of nine years' results.

No.	Varieties.	Pounds per measured bushel.	Tons of straw per acre.	Bushels of grain per acre.
1	Joanette Black	35.6	2.8	89.3
2	White Siberian	34.2	2.6	86.3
3	Oderbrucker	31.5	2.5	82.6
4	Waterloo	31.9	2.5	82.2
5	Vick's American Banner	31.4	2.3	81.9
6	Probsteier	32.8	2.3	81.3
7	White Schonen	32.7	2.2	81.2
8	Bavarian	31.4	2.8	81.0
9	Poland White	36.5	2.7	80.9
10	Improved Besthorne	33.0	2.3	80.0
11	Danebrog	33.0	2.4	79.5
12	Holstein Prolific	32.4	2.2	78.5
13	Wide Awake	33.6	2.3	77.2
14	White Egyptian	35.9	2.7	73.8
15	Early Gothland	36.2	2.3	67.4
16	Clydesdale	38.8	2.4	66.3
17	Black Tartarian	30.7	2.4	65.6

These seventeen varieties have given the best results among one hundred and twenty-nine different varieties.

The *Joanette*, which stands at the head of the list in yield of grain per acre, is a black oat which was imported from France in the spring of 1889. It possesses a very short straw, and is suitable only for sowing on land which naturally produces a large amount of straw. As this variety stools abundantly there is great danger of using too much seed. Four pecks per acre is usually quite sufficient. As the grain is apt to shell if allowed to become thoroughly ripe, it is best to cut while the crop is somewhat green. The crop should be bound in small sheaves, as the straw is fine and large sheaves are too slow in drying. The grain of the Joanette oats is of excellent quality, as it is one of the thinnest hulled varieties in cultivation. The thinness of the hull, however, makes it necessary to use caution in threshing the crop, in order to prevent a large amount of the seed from being hulled in passing through the separator. All things considered, the Joanette is an excellent variety of oats for some farms in Ontario and a very poor one for others. The *White Siberian*, which comes second in the list in average yield of grain per acre, was imported by the College from Russia in the spring of 1889, and has given excellent satisfaction. It produces a long straw, and is well suited for medium to poor soil. The grain is white in color and of excellent quality. A committee appointed by the Oatmeal Millers' Association of Ontario examined eighty-one varieties of oats a few years ago, and pronounced the White Siberian a variety well adapted for the manufacture of oatmeal. Not only has it given excellent results in the experimental plots, but it is now grown almost exclusively, and with very satisfactory results, in large fields on the College farm. It has made the highest record of all the varieties of oats sent out over Ontario for co-operative experiments within the past seven years. It is now grown

extensively by Ontario farmers ; in fact, it is one of the most popular oats in Ontario at the present time. It is also interesting to know that all the Siberian oats which are now grown in Ontario originated from $\frac{3}{4}$ of a pound of seed which were sown in our experimental grounds in the spring of 1889 The *Oderbrucker* variety, which comes third in point of yield per acre, was imported by the College from Germany. It is also a white oat of good quality. The straw, however, is not so stiff as that produced by the Siberian variety, and the grain weighs somewhat less per measured bushel. The *Vick's American Banner* has been a very popular oat in Ontario. It will be seen, however, that the Siberian variety has given an average of about $4\frac{1}{2}$ bushels of grain per acre more than that produced by the American Banner from the average results of the two varieties grown side by side for nine years in succession. It will also be observed that the grain of the Siberian oats weighs nearly three pounds per measured bushel more than that of the American Banner.

Among the varieties which have been grown for a shorter length of time than those given in the above list, we would specially speak of the *Peerless*, *Improved American*, *Daubeney* and *Early Blossom* as among those which have made the highest records. The *Daubeney* is the earliest oat which we have ever grown in our trial grounds. The grain is white and the straw is of medium length. The variety is now grown by several farmers in Ontario, and can be used to advantage in mixing with peas or barley for the production of green fodder or of grain.

Winter Wheat and Spring Wheat.

The wheat plant appears to have been known and valued from the earliest times. As it will thrive successfully in a great range of climate, the inhabitants of many countries enjoy the advantages of its cultivation. There are, in all, seven distinct types of wheat, and to one or the other of these types all varieties belong. The seven types are as follows: 1, the common, fine, or soft wheat (*Triticum sativum*), 2, turgid or toulard (*T. turgidum*), 3, hard or flinty wheat (*T. durum*), 4, Polish wheat (*T. polonicum*), 5, spelt (*T. spelta*), 6, starch wheat (*T. amyleum*), and 7, one-rowed wheat (*T. monococcum*). Nearly all the varieties of both spring and winter wheat which are grown in Ontario belong to type No. 1, the common wheat (*Triticum sativum*), although representatives of all the different classes have been grown in our experimental grounds. Some of the best known representatives of other types are as follows: Wild Goose spring wheat, Medeah spring wheat, Algiers spring wheat, Poland spring wheat, Miracle winter wheat, etc. For the sake of convenience, we have arranged our wheats for this report under three heads, namely: 1, winter wheat; 2, spring wheat with hollow straw, and 3, spring wheat with solid or semi-solid straw. All the varieties of classes No. 1 and No. 2 belong to the common wheat (*Triticum sativum*).

Winter Wheat.—In the autumn of 1898, eighty-seven varieties of winter wheat were sown on plots uniform in size and shape. The land on which these varieties were sown was quite elevated and had a general slope towards the west, and was in one of the most exposed positions possible, as it thus got the full sweep of the cold winds from the west. The snow did not remain on the plots in any large quantities; and, as there were no fences or obstructions near the plots, the snow was very evenly distributed over the entire surface devoted to the experiment. It will be remembered that the winter of 1898-9 was one of the severest for wheat of any for many years past. Hundreds of acres which made an excellent showing in the autumn were plowed up in the spring, owing to the wheat being so badly killed out. On examining our plots in the spring, we found that the wheat was very badly killed, but that some varieties had come through the winter much better than others. As this test was a fair one, a knowledge of the manner in which the different varieties came through the winter furnished valuable information regarding the relative hardiness of the wheats. Those varieties which came through the winter the best are given below, and they are arranged in order of merit starting with the best: 1, Tasmania Red; 2, Red Velvet Chaff: 3, Red Wonder; 4, Prize Taker; 5, Standard; 9, Soules; 7, Siberian; 8, Dawson's Golden Chaff; 9, Pride of Genesee, and 10, Early Arcadian. The varieties which were almost entirely destroyed were; 1, German Emperor; 2, Harvest King; 3, World's Fair; 4, Mealy; 5, Golden Drop; 6, Rudy; 7,

Poole; and 8, Diamond Grit. The Early Genesee Giant, Early Red Clawson, American Bronze, Treadwell, Londoerry No. 1, etc, occupied an intermediate place in regard to hardiness.

In connection with the above, it may be well to give a summary of the results of our experiments with winter wheat in former years, as follows :—

1. The average results of winter wheat growing on the experimental plots for nine nine years in succession are as follows: Weight of grain per measured bushel, 60 2 lbs.; yield of straw per acre, 2 07 tons; and yield of grain per acre, 39.5 bushels.

2. *Dawson's Golden Chaff* has given the largest average yield of grain per acre among seventy varieties of winter wheat grown at the Ontario Agricultural College for five years; also among eleven leading varieties tested over Ontario in 1893, nine varieties in 1894, 1895 and 1896, and seven varieties in 1897, 1898 and 1899.

3. The *Early Genesee Giant* variety of winter wheat is a close rival of the Dawson's Golden Chaff variety in the small plots in the Experimental department and in the large fields in the farm department of the Agricultural College, and also in the co-operative experiments conducted throughout Ontario.

4. Winter wheat which did not lodge until cut, produced a crop more than double the value of that which became lodged before it was ripe.

5. In five years' experiments with varieties of winter wheat, the American Bronze, Dawson's Golden Chaff, and Early Genesee Giant varieties possessed the stiffest straw of all the large yielders of grain.

6. Large plump kernels of winter wheat gave much better results than those which were small, plump, shrunken or broken.

7. In the average of six years' experiments in sowing winter wheat at different dates, it was found that when the wheat was sown later than September 9th, the crop was usually much poorer than when the seeding took place on or before that date.

8. As a crop to plow under for green manure in preparation for winter wheat, peas have given the best and buckwheat the poorest results.

9. In an experiment in cutting winter wheat at different stages of maturity for several years in succession, it was found that the largest yield of grain and the best quality of seed were obtained from the crop which was allowed to ripen fully before cutting.

10. Winter wheat, badly infested with "stinking smut," has been very effectually treated three different years by the use of either copper sulphate or hot water.

Spring Wheat.

We have grown one hundred and thirty-eight varieties of spring wheat within the past eleven years. The greater number of these varieties belong to the common or fine wheats (*Triticum sativum*). In the spring of the present year, thirty varieties of common spring wheat were sown. Of this number, the Welland Fife, New York, Red Fife, Lost Nation, Champion Bearded, Preston and Amethyst produced the largest yield of grain per acre.

In averaging the results of all the varieties of common spring wheat which we have grown under similar conditions for seven years, we find that sixteen varieties have given an average of upwards of 25 bushels each per acre. The following table gives the average of the results for the seven years.

The *Red Fife*, which stands at the head of the list in yield of grain per acre, is the old standard wheat well known in Ontario and Manitoba. The *Herison Bearded* variety, which comes second on the list, was imported from France in the spring of 1889. Although it has given an average of one-half bushel per acre less than the Red Fife, it will be observed that the grain weighs nearly three pounds per measured bushel more than that of the Red Fife variety. A committee appointed by the Dominion Millers' Association of Ontario examined fifty-seven varieties of spring wheat and pronounced the Herison Bearded a first-class milling variety. It grows a medium length of straw, which usually stands upwell. The head is very short and compact and is bearded. The variety which comes fourth in the list, namely, the *Wellman Fife*, is a wheat which is grown quite largely in some of the North-Western States of the American Union, and is prized very highly. It has made an excellent record in the co-operative experiments over Ontario, occupying first

place in yield per acre among the three varieties sent out and tested on forty-three Ontario farms in 1899, the average yield of grain of the Wellman Fife for the past season being 23.5 bushels per acre.

No.	Varieties.	Pounds per measured bushel.	Tons of straw per acre.	Bushels of grain per acre.
1	Red Fife	58.8	2.0	30.8
2	Herison Bearded	61.6	2.0	30.3
3	Saxonka	60.9	1.9	29.8
4	Wellman Fife	58.5	1.9	29.2
5	Red Fern	60.2	2.0	29.0
6	White Russian	57.8	1.9	28.9
7	Konisburg	60.7	1.8	28.5
8	Pringle's Champion	59.6	1.8	27.7
9	Blue Democrat	59.5	2.0	26.9
10	Lost Nation	57.9	1.8	26.6
11	White Fife	58.5	1.9	26.3
12	Colorado	59.0	2.0	15.8
13	Rio Grande	59.1	2.0	25.7
14	McCarlin	59.1	1.9	25.5
15	Manitoulin	58.5	1.7	25.2
16	Velvet Chaff Blue Stem	56.2	1.8	25.1

Among the varieties of spring wheat which we have grown for less than seven years, we have found the Speculation or Thick Set, the Salzer's Marvel, the Red North Dakota, and the Preston to be among the most promising.

Several varieties of spring wheat having a solid straw have been grown on our plot for a number of years, and some of them have shown themselves to be very heavy yielders; in fact five or six have given decidedly larger yields per acre than the very best of the common varieties. The following table gives the average yield per acre of each of six varieties of spring wheat belonging to this class for seven years in succession:

No.	Varieties.	Pounds per measured bushel.	Tons of straw per acre.	Bushels of grain per acre.
1	Wild Goose	61.9	2.0	39.5
2	Medeah	61.1	2.0	35.8
3	Bart Tremenia	62.5	1.8	34.9
4	Sorentino	60.3	2.1	32.9
5	Algiers	58.8	2.0	32.6
6	Ontario	57.7	2.0	22.9

It will be seen from the foregoing table that the *Wild Goose* has given decidedly the largest yield per acre of any spring wheat which we have grown. In former years millers paid much less per bushel for this variety than for the common varieties of spring wheat, which were much easier to grind. The Wild Goose is not only very hard to grind, but makes a yellow flour which gives a yellow appearance ance to the bread. During the last three years, however, there has been a considerable demand for the Wild Goose variety of spring wheat for export to Italy for the manufacture of macaroni; and this demand has become so keen that it has placed the price of Wild Goose wheat even higher than that of the finer varieties. So long as this demand keeps up, it is doubtful whether there is any other variety of spring wheat that will be so profitable for the farmers to grow as the Wild Goose variety.

Six-Rowed Barley (*Hordeum Hexastichum*).

Six-rowed barley has been under cultivation in the southern part of Europe from the earliest times. Barley is one of the hardiest of the cereals, and can be raised through

a great range of climate. It is cultivated with success north of the Arctic Circle and at high altitudes in the Torrid Zone. The grain is used for culinary purposes, for feeding to farm stock, and for the manufacture of beer.

In the summer of 1899 fifteen varieties of six-rowed barley were grown in the Experimental department. Of these varieties the Mandscheuri, Scotch Improved, Common Six-rowed, Mensury, Imperial Six-rowed, California Brewing, and Six-rowed Baxter's Improved gave the largest yields per acre. The heaviest weights per measured bushel were produced by the Oderbrucker, Four-rowed Canadian, North-western, Scotch, Silver King and Manitoba Six-rowed, each of which produced upwards fifty-four pounds per measured bushel. The heaviest weight per measured bushel of all the six-rowed barleys was produced by the Manitoba Six-rowed, which gave an average of upwards of fifty-six pounds.

A large number of varieties of six-rowed barleys have been tested in the experimental grounds for several years in succession. The following nine varieties have given the largest average yield of grain per acre among all those tested for five years in succession. The Success variety, regarding which so much has been said recently, is also included in the list.

No.	Varieties.	Pounds per measured bushel.	Tons of straw per acre.	Bushels of grain per acre.
1	Mandscheuri	51.2	2.0	77.9
2	California Brewing	47.8	1.8	68.2
3	Oderbrucker	53 0	1.8	67.6
4	Scotch Improved	52 5	1.8	67.6
5	Imperial Six-rowed	52.2	1.7	67.2
6	Four-rowed Canadian	52.0	1.8	66.4
7	Mensury	52 1	1.7	65.2
8	Common Six-rowed	52.4	1 7	65.1
9	Six-rowed Baxter's Improved	52.5	1.8	61.3
12	Success	47.8	1.3	41.5

The *Mandscheuri*, which stands at the head of the list in average yield of grain per acre, was imported by the Agricultural College from Russia in 1889. It produces a good length of straw, which usually stands up well and is comparatively free from rust. Not only has it given good results in the experimmental grounds, but it has been grown with most satisfactory results in large fields on the College farm. It has been also distributed throughout Ontario in connection with the co-operative experimental work, and as a heavy yielder it has given decidedly the best results of all the varieties of barley which have been tested over the Province. The *California Brewing* variety, which comes second on the list, possesses a very stiff beard, which is very difficult to remove from the grain. The grain weighs light per measured bushel, and the straw is apt to lodge considerably before it ripens. The third variety on the list was imported from Germany, and to the *Oderbrucker* variety belongs the credit of producing the barley which has given the heaviest weight per measured bushel of all the kinds which have been grown in our experimental grounds for five years in succession. It will be observed, however, that the Oderbrucker yields about ten bushels per acre less than the Mandscheuri when they are grown under similar conditions. The Oderbrucker is also considerably weaker in the straw than the Mandscheuri. Much has been said of late years regarding the variety known as the *Success*, which has the advantage of being very early and of producing no beards. The weight of barley per measured bushel, however, is light, and the yield per acre is much less than that of some other varieties. There is no other barley in Ontario which has given so good all round satisfaction in the production of grain as the Mandscheuri, and we are pleased to notice that it is now grown quite extensively throughout the Province. It will be seen that there is a greater difference between the Mandscheuri and the Mensury than there is between the Mensury and the Common Six-rowed varieties of barley.

Two-Rowed Barley (*Hordeum Distichum*).

The two-rowed barley is easily distinguished from the other species by the head being more elongated and by their being two distinct rows of grain from one end of the head to the other. The heads of some varieties are long and slender, while those of other varieties are short, very broad at the base, and taper towards the extremity. The two-rowed barley is largely cultivated in England and in Central Europe, but it is not grown to any great extent in Ontario, although great efforts were made a few years ago by the Dominion Government to have it grown more extensively by Canadian farmers for exporting to England. With this object in view, the Canadian Government imported 10,000 bushels of the Carter's Prize Prolific Barley from England and sold the same to Canadian farmers at $2.00 per bushel in order to get it introduced.

Within the last fifteen years we have tested upwards of fifty varieties of two-rowed barley at the College. The following list gives the average results in weight of grain per measured bushel and in yield of straw and grain per acre of the twelve varieties which have produced the largest average number of bushels of grain per acre in five years' tests.

No.	Varieties.	Pounds per measured bushel.	Tons of straw per acre.	Bushels of grain per acre.
1	New Zealand Chevalier	52.7	2.3	63.8
2	Gold Foil Hansford's	53.5	2.3	63.2
3	French Chevalier	53.1	2 3	63.1
4	Empress	52.8	2.2	62.5
5	Two-rowed Canadian	52.4	2.0	60.5
6	Kinna Kulla	52 0	2.0	58.9
7	Jarman's Selected Beardless	54.7	1.7	58.3
8	Two-rowed Italian	52.6	2.1	58.1
9	Selected Canadian Thorpe	52.8	1.9	56.8
10	Vermont Champion	54.4	1 8	56.1
11	Highland Chief	53.5	2.0	55.9
12	Duckbill	52.9	1.9	55.4

It will be observed that the *Carter's Prize Prolific* variety is not included in the list. We imported some of that variety from England in 1889; and after growing it for five years, we discarded it from our experiments, for the reason that it came twenty-ninth in yield of grain per acre among thirty-seven varieties grown for five years in succession. The *New Zealand Chevalier* and the *French Chevalier* both occupy a high place in the average results of the varieties grown within the past five years. The seed of the *Kinna Kulla* barley was originally imported by the College from Sweden in 1889. The crop produces straw of medium length, which stands up remarkably well. The *Duckbill*, which has perhaps been grown in Ontario more extensively than any other two-rowed variety, stands twelfth in the list of yield of grain per acre among the two-rowed barleys grown since 1895.

In the results of the past year, the French Chevalier, New Zealand Chevalier, Two-rowed Italian, Kinna Kulla and Duckbill varieties were among the largest yielders. The Jarman's Selected Beardless, however, produced grain which weighed the heaviest in weight per measured bushel of all the kinds under experiment; the weight being fifty-eight pounds, which is perhaps the heaviest weight produced by any barley in any one year in our experimental grounds since 1889.

An important point in connection with nearly all varieties of two-rowed barleys is that they are from one to two weeks later in reaching maturity than the six-rowed barleys. This characteristic gives some of the two-rowed varieties special value for mixing with oats or peas to be grown either for green fodder or for the production of grain. It has been found that barley and oats sown together produce more grain per acre than when sown separately; and unless a very early variety of oats is used, it is necessary to have a two-rowed barley for mixing with the oats, in order that the two grains may mature about the same time.

Hulless or Naked Barley (*Hordeum decorticatum*)

The grain of hulless barley usually weighs about 60 pounds per measured bushel, while the standard weight of the common varieties in Ontario is 48 pounds per measured bushel. The skin of the hulless varieties is fine and transparent and is white, purple or black in color. The grain resembled wheat more than barley. The straw is apt to be weak, and when ripe becomes so brittle that the heads are easily broken off. Some of the varieties possess heads with six-rows and others with two-rows.

We had eleven varieties of hulless barley under experiment during the last season. Of these varieties, the *Guy Mayle* gave the largest yield per acre, namely, 50.4 bushels per acre, and the Large Skinned gave the lowest yield, or 37.1 bushels per acre. The weight per measured bushel of both the Black Hulless and the Purple varieties was 65.9 pounds. All the varieties under experiment during the year produced grain which weighed upwards of 60 pounds per measured bushel.

The following table gives the average weight per measured bushel and the yield of straw and of grain per acre of six of the highest yielding varieties of hulless barley among those which have been grown in our experimental grounds for five years in succession.

Varieties.	Pounds per measured bushel.	Tons of straw per acre.	Bushels of grain per acre.
1. Guy Mayle	61.7	1.4	45.9
2. Purple	64.0	1.6	43.1
3. Black Hulless	63 7	1.5	42 3
4. Large Skinned	60 0	1.7	38.1
5. Hungarian	59.6	1.5	37.7
6. Winnipeg No. 2	60.3	1.7	37.4

The standard weight of 60 pounds per measured bushel has been used for the hulless barley throughout in reckoning the number of bushels per acre as given in the last column of figures in the preceding table.

The *Guy Mayle* variety which stands at the head of the list in yield per acre for five years produces a grain of purple color. The straw is of medium height and usually stands up fairly well. The *Black Hulless* variety, which comes third on the list, has perhaps been grown more extensively throughout the Province of Ontario than any other variety of hulless barley. It yields well and weighs heavily per measured bushel, but the straw is very weak, and is apt to be badly lodged before the crop is harvested. As some of the varieties of six-rowed barley grow a stiffer straw and produce a much heavier yield of grain per acre than any of the hulless barleys, it is usually found more profitable to grow the six-rowed varieties in general farming in Ontario. However, some of the hulless varieties may be grown to good advantage under certain circumstances.

Winter Barley.

In the autumn of 1898, one plot of winter barley was sown in the experimental grounds. The crop grew splendidly in the autumn of the year and was very promising at the commencement of the winter, but in the spring of the year there was not a living plant to be found. We have sown one or more varieties of winter barley during each of the past eleven years and have found that in mild winters it comes through admirably and produces a heavy crop which gives a large yield of grain per acre. In severe winters, however, it is generally killed out completely. Although some seedsmen recommend the growing of winter barley quite extensively, the results of our experiments go to show that it is not advisable to grow it as a general crop in Ontario, unless some varieties can be secured which are more hardy than any which we have yet obtained; and we have tested every variety which we have been able to secure from Germany, France, the United States, etc.

Rye (*Secale cereale*).

Rye is the characteristic food-grain of middle and northern Europe, and is used extensively by fully one-third of the population of Europe. It can be grown advantageously in those districts in which the soil is unsuited for other cereal crops. The grain is used for making bread, in the manufacture of malt liquors, and as a food for live stock. Rye is sometimes used when young as a pasture crop and when more fully grown for soiling purposes and for the production of hay. The straw of the mature crop, being long and straight, is used in the manufacture of hats, mats and fancy baskets; but it is of little use as a fodder.

Spring Rye.—Three varieties of spring rye were grown in our experimental plots in the past season. The yields of grain per acre of the different varieties were as follows: Dakota Mammoth rye, 50.9 bushel; Prolific Spring rye, 42.1 bushels, and Colorado Giant rye, 24.5 bushels. Two of these varieties have now been grown for five years, and have been given the following yield of grain per acre: Dakota Mammoth, 38.5 bushels, and Prolific Spring rye, 36.8 bushels. The Colorado Giant rye has been grown for only three years in succession, and has given an average of 22.6 bushels per acre, which is considerably less than either of the other varieties.

Fall Rye.—Several varieties of winter rye have grown in our plots for a number of years with good success. In the autumn of 1898, three varieties were sown in the same section of the field as the winter wheat. They all came through the winter well, and were very strong and vigorous in the spring, while the wheat standing near by was very badly winter-killed. The Mammoth winter rye and Monster winter rye appear to be the same variety, and have given about five bushel per acre more than the common winter rye of Ontario.

Buckwheat (*Fagopyrum esculentum*).

Buckwheat is a native of Northern Asia and has been grown as a cultivated crop for fully one thousand years It grows and produces a marketable crop on very poor soil, and it thrives admirably in cold climates. It is mainly grown for the production of grain, but it is also used for soiling purposes and for plowing under as a green manure.

We have grown six varieties of buckwheat in our experimental grounds, although two or three of the varieties are very similar in every respect. The three main varieties, namely, the Japanese, the Silver Hull, and the Common Grey, have each been grown in our trial plots for five years in succession. The crop in 1898, however, was failure, and that of 1899 was lighter than usual. In the average results of the three varieties grown for four years we find that the Japanese produced 20.4 bushels, the Silver Hull 16.2 bushels and the Common Grey 14.6 bushels per acre. In 1899 the Japanese gave 15.7 bushels, the Silver Hull 10.9 bushels, and the Common Grey 11.4 bushels per acre. *The Japanese* variety, which stands at the head of the list in yield per acre for 1899, and also in the average for four years, has given the largest yield of grain per acre in the co-operative experiments over Ontario for three years in succession. It is a very vigorous grower and produces grain of large size. The grain of the Silver Hull variety is smaller and plumper than that of the Japanese.

Indian Corn or Maize (*Zea mays*).

Indian corn is a native of America, and its cultivation in the United States is very extensive. The United States Department of Agriculture estimates the corn crop of the world for 1898 at 2,637,165,000 bushels. Of the total crop of 1898, the United States produced over two-thirds. The country which produced the next largest yield was Hungary, which was closely followed by Roumania and by Mexico. Ontario came ninth in the list, with about 24,000,000 bushels as the yield for that year. Indian corn is used for pasture, green fodder, dry fodder, and silage; and the mature grain is used in a great many forms for culinary purposes and as a food for live stock.

We have grown in all no less than two hundred and twenty-six varieties of corn in our experimental grounds within the past thirteen years. For general purposes, we have found (1) that the *Mammoth Cuban* and the *Mastodon Dent* are well adapted for the warmer soils of Southern Ontario; (2) that the *Wisconsin Earliest White Dent* for

Southern and Central Ontario, and (3) that the *Salzer's North Dakota*, *Compton's Early* and *King Philip* for Central and Northern Ontario.

More detailed information regarding varieties and experiments in methods of cultivating corn, etc., will likely be given in bulletin form on some future occasion.

Teosinte (*Euchlæna luxurians*).

Teosinte somewhat resembles Indian corn, and grows to a height of from eight to ten feet in the Southern States. The variety usually grown produces a great many stalks from each root, the number sometimes reaching as high as forty. The crop produced per acre is said to be very large, and the fodder is liked by all kinds of stock. The seed is sown in the spring, and in climates suited to its growth the plants will produce several cuttings during the season. It may be fed either green or dry. As the Teosinte has given such good results in the warmer sections of the United States, some of the seeds men of the North have been tempted to advertise it quite extensively. We have sown it in our experimental grounds for three years in succession. The germination has been rather slow and the crop has not reached a height of more than about three feet any year. From the knowledge gained from testing the crop during three years, we believe that it is entirely unsuited to the conditions which exist in Ontario, and we cannot at present recommend it to farmers as suitable to grow in Ontario for any purpose whatever.

Grasses.

Grasses are remarkably and evenly distributed in practically all portions of the inhabitable globe. In Ontario, no less than 2,505,422 acres were devoted to the hay and clover crop in 1899.

In all, forty eight varieties of grasses have been grown in comparative tests on the experimental plots at the College. These have included a large number of the cultivated grasses of England and America, and of several native varieties from Australia, Manitoba, etc. The following list gives the average yield in tons of hay per acre of each of twenty-one varieties of grasses grown for five years in succession:—1, Fringed Brome, 3.9; 2, Lime Grass, 3.3; 3, Western Rye, 3.3; 4, Bearded Wheat, 2.6; 5, Tall Oat, 2.5; 6, Timothy, 2.5; 7, American Lime, 2.4; 8, Orchard, 2.1; 9, Awnless Brome, 1.7; 10, Soft Brome, 1.6; 11, Meadow Foxtail, 1.4; 12, Canadian Blue, 1.4; 13, Meadow Foxtail, 1.3; 14, Red Top, 1.1; 15, Rhode Island Bent, 1.0; 16, Yellow Oat, 1.0; 17, Perennial Rye, 9/10; 18, Creeping Bent, 9/10; 19, Kentucky Blue, 4/5; 20, Fine Leaved Sheep's Fescue, 4/5; 21, Wild Timothy, 1/3. The varieties under the numbers 1, 2, 3, 4, 7, and 21 were imported from Manitoba, through the kindness of Mr. S. A. Bedford, Superintendent of the Dominion Experimental Farm in Manitoba. The hay of most of these varieties is somewhat coarse. It will be noticed that Timothy, which is so well known throughout Ontario, has made an average of exactly $2\frac{1}{2}$ tons per acre in the five years' experiments. This is nearly $1\frac{3}{4}$ tons per acre less than the crop produced by the Fringed Brome grass. The Awnless Brome grass (*Bromus inermis*) gave an average of 4.5 of a ton per acre less than that produced by the Timothy.

Besides growing the grasses separately, we have grown them in a great many combinations, especially with different varieties of clovers. Two mixtures of grasses and clovers have been under test for the last five years. The different varieties and the quantity of seed per acre used in each mixture were as follows: *Mixture No. 1.* Meadow Fescue 6 pounds, Meadow Foxtail 3 pounds, English Rye 2 pounds, Timothy 3 pounds, Canadian Blue grass 4 pounds, Orchard grass 3 pounds, Red Top 2 pounds, Yellow Oat 2 pounds, Lucerne 4 pounds, White clover 2 pounds, Alsike clover 2 pounds, Red clover 1 pound, and Trefoil 1 pound, making a total amount of 35 pounds of seed per acre; and *Mixture No. 2.* Orchard grass 4 pounds, Meadow Fescue 4 pounds, Tall Oat grass 3 pounds, Timothy 2 pounds, Meadow Foxtail 2 pounds, Lucerne 5 pounds, Alsike clover 2 pounds, White clover 1 pound, and Trefoil 1 pound, making a total amount of 24 pounds of seed per acre. The average results for five years show that the yields of hay per acre from each of the two mixtures were as follows: Mixture No. 1, 2.6 tons; Mixture No. 2, 3.6 tons. While these crops were not pastured, the results show that Mixture No. 2 produced decidedly the larger crop. All the varieties in Mixture No. 2 are exceedingly

hardy, and for general purposes it is one of the best and most permanent mixtures which we have found, and can be used for the production of pasture or of hay.

Other experiments with different combinations of grasses and clovers for the production of *hay* in short rotations are now in progress; also experiments in sowing grasses and clovers in the autumn of the year with and without a grain crop; likewise in the spring of the year with and without a grain crop.

Millet.

Millets are grown extensively in Siberia, India, Japan, and China, where the seed is used largely as a human food. It is estimated that the seed of millet in one form or another is used as a portion of the food of fully one third of the inhabitants of the globe. In Ontario, however, its chief use is for the production of pasture, green fodder, or hay. Some farmers grow millet more or less extensively as a regular crop, but as a rule it is sown to supplement some other crop which from one cause or other has proven a partial failure. For instance, in the year 1885, we had frosts during the first two weeks of May on six separate nights, the thermometer going twenty-two degrees below the freezing point on one occasion. This injured the young clover very much, and caused a great reduction in the amount of hay for that year. Hence the demand for millet seed became very great, some farmers paying as high as two and three dollars a bushel for the seed. In the farm department at the College, six acres of millet were sown that year and eighteen tons of good hay were grown, which did admirable service the following winter in supplementing the clover as a winter fodder. It is also found that in some seasons the amount of rainfall is so abundant during the latter part May and the early part of June that it is impossible to get the corn planted in good condition; in which case the land can frequently be used to good advantage in growing millet, as it does not require to be sown until comparatively late in the season. In this way the loss of the corn crop will not be felt so seriously as it would have been if no fodder crop had been secured from the land. It will, therefore, be readily seen that the millet crop is frequently an important one for the farmers of Ontario, as it can be used so readily when other fodder crops are apt to be deficient.

Thirty one varieties of millet have been grown under experiment at the College for the purpose of gaining information as to the most suitable kinds of cultivation in this Province. Fourteen varieties have now been grown for five years in succession. These varieties belong to four distinct classes, as will be seen by the classification here made The following list gives the average yield of hay per acre of each variety for five years:

1. Broom-Corn Millets. (*Panicum miliaceum.*)

	Tons of hay per acre.
Japanese Panicle	5.5
White French	3.1
Red French	2.7

2. Foxtail Millets. (*Chætochola italica.*)

Holy Terror Gold Mine	5.3
Japanese Common	5.0
Golden Wonder	4.9
German or Golden	4.6
Magic	4.1
Salzer's Dakota	4.0
Hungarian	3.8
California	3.3
Common	3.1

3. Barnyard Millets. (*Panicum crus-galli.*)

Japanese Barnyard	5.0

4. Pearl Millets. (*Pennisetum typhoideum.*)

East India Pearl	4.9

For hay.—From the above table it will be seen that *Japanese Panicle* millet has given the largest yield of hay per acre, and that the Red French has given the smallest yield, the difference between the two varieties being 2.8 tons in favor of the Japanese Panicle. It will also be noticed that the varieties which have given the extremes in yield

per acre both belong to the Broom-Corn class of millets. The Japanese Crus-galli variety, which has given an average of five tons per acre for the five years, yields heavily some seasons, but in others it gives rather poor results. In 1898, the crop produced by the Japanese Crus galli both at our Experimental Station and throughout Ontario were very light.

Three varieties of millet have been used in the co-operative experiments over Ontario for two years in succession ; and in averaging the results of successful tests made on ten farms, we found the varieties gave the following tons of green hay per acre, namely, Japanese Panicle, 6.4 ; Japanese Barnyard, 5 9 ; Hungarian Grass, 4.8.

For seed.—In 1899, twenty-two varieties grown in our experimental grounds were allowed to ripen and the crop was threshed. The following varieties produced the largest yields of seed per acre : Canadian, 35.8 bushels ; Chinese, 34.4 bushels ; California, 34.0 bushels, and Hog, 32.9 bushels. A number of varieties were also grown for seed in 1898 and in 1894. In 1898, the California gave a yield of 44.8 bushels per acre, which placed it second in yield of seed for that year ; and in 1894 the California stood at the head of the list, with a yield of 41.9 bushels of seed per acre. Taking the average of the three years, the *California* variety has produced the largest amount of seed per acre.

Sachaline (*Polygonum Sachalinense*).

Sachaline is a perennial plant, a native of northern Asia, where it grows in a moist climate and on wet land. A few years ago it was brought to this country and was most extravagantly recommended as a forage plant by a number of seedsmen in Canada and the United States. The following quotation is taken from a seedsman's catalogue for 1896 : "The claims made for it are : perfectly hardy—even in Siberia ; stands also the greatest heat ; ground does not need to be plowed before planting ; needs no cultivation, no manuring, no replanting ; grows in poorest of soil or in wet lands where no other forage plant will exist. Once planted it stands for an age. Stems or leaves, green or dry, are greatly relished by sheep, cattle and horses. It is more nutritious than clover or lucerne ; an excellent soil enricher. Grows 14 feet high by June and can be cut every month after till cold weather. The cultivation of Sachaline is very simple. Plant three feet apart each way at any season."

In the spring of 1895, twelve roots of Sachaline were purchased and also a quantity of seed. Both the roots and the seed were placed in good soil and plants were grown from each. The plants produced from the roots reached an average height of about two feet in 1895 and of three feet in 1896, and those from the seed an average height of from six to ten inches in 1895 and of seventeen inches in 1896. In 1897 and in 1898, the plants grew to a height of from three to five feet. The plants started to grow very early each spring and the new growth was nearly always frozen back, after which a fresh start was made. In the winter of 1898-9, all the plants but one were completely killed. The single plant which came through the winter alive did not start to grow until quite late in the season, and then the growth was very feeble. From our experience with the growth of Sachaline for four years we find it an unprofitable crop and entirely unsuited to our soil and climate.

Prickly Comfrey (*Symphytum Asperrimum.*)

Prickly Comfrey is a native of Caucasus and was very highly recommended and somewhat extensively introduced in this country a few years ago. It is a perennial and is propagated from the roots which are exceedingly hardy. The large coarse leaves grow luxuriantly, thus producing a large amount of forage.

In the spring of 1893, Prickly Comfrey roots were purchased and were planted in the experimental grounds, which were then located south-east of the main college building. The roots have been transplanted three times since that date and are still thriving fairly well, although the exceptionally severe winter of 1898-9 killed a few of them. Some of the others, however, were divided in the spring of the present year and we again have the full number of plants growing in the plot. We usually get three cuttings per season. The Prickly Comfrey is certainly a very hardy plant and an enormous producer of forage, but it is rather coarse and is not relished by the animals to which it is fed. It is said, however, that animals eat Prickly Comfrey fairly well after

they become accustomed to it. All things considered, it is doubtful whether Prickly Comfrey will ever be grown to any great extent in Ontario, where clover and other leguminous crops, which are valuable for fodder and as soil renovators can be grown so successfully. If, in some circumstances, it is very important to get a large amount of food annually from a small piece of land without fresh seeding each year, I know of no crop which is hardier or more abundant in its supply of fodder than Prickly Comfrey. The fodder from the plant may possibly be relished by cows, providing special care is taken in getting them accustomed to it by using it in small quantities at first and mixing it with meal, cut hay, etc., and then gradually increasing the quantity in the ration.

Giant Spurrey (*Spergula Maxima*).

The Giant Spurrey was grown quite extensively on the sandy soils in Michigan previous to 1893, at which time a bulletin was published by Prof. O. Clute, Director of the Station. In that bulletin the Spurrey was very highly recommended for light sandy soil. It is considered valuable, both as a soil renovator and for feeding to sheep and cattle.

As considerable was being said a few years ago regarding Spurrey, we wrote to the Michigan Agricultural College and secured a few pounds of seed and sowed it under different conditions in our experimental plots. The plants grew rapidly and produced seed in a very short time. The crop, however, was very light in all instances. Although it is some five years since the Spurrey was sown in our plots, we are not yet clear of the plants in those sections of the experimental grounds in which it was sown. Owing to the slow, slender growth of the plants and their rapid production of seed, it is almost impossible to pull all the plants before the seed is ripened and spread in the ground. We wish to caution our farmers against even testing the Spurrey on their farms, unless it is on the sandy soils in which almost nothing else will grow. Its rapid production of seed makes it a troublesome weed in cultivated land.

Yarrow or Milfoil (*Achillea millefolium*).

This plant is grown considerably in Europe and especially in England where it is considered to make a very valuable addition to sheep pastures. It is a perennial plant having white or pink flower clusters. In the spring of 1898, we sowed one plot in our experimental grounds with Yarrow seed. It germinated well and the crop made a good growth during the first year. Owing to the exceedingly severe winter of 1898-9, several of the varieties of grasses and clovers under experiment were badly winter-killed. The Yarrow, however, came through without any apparent injury from the cold weather. The plot was nicely covered with Yarrow plants which made a fairly even but not a very rapid growth. The crop was cut on the 11th of July, at which time the plants had reached an average height of 22 inches. The crop produced 3½ tons of the freshly cut Yarrow and 9-10 of a ton of the cured hay per acre. It is scarcely expected that this crop can be grown satisfactorily for the production of either green crop or of hay, but these figures give data regarding the hardiness of the plant during a very severe winter and its growth the following season. Those farmers specially interested in sheep raising in Ontario may glean some information from this experiment regarding the growth of Yarrow in our climate, and from a knowledge of its use in England can better determine for themselves whether or not it would be advisable for them to use Yarrow in their sheep pastures as is done in Europe.

Potato (*Solanum tuberosum*).

The potato plant, which is a native of Chili and as far north as New Mexico, is now cultivated very widely and produces a large portion of the food of mankind. Besides being used as a food, the potato is largely employed for the manufacture of starch, spirits, etc. No less than 168,148 acres were devoted to the production of potatoes in this Province in 1899.

A great deal of attention has been devoted to testing potatoes at our Experiment Station within the past few years. Upwards of two hundred varieties have been grown and twenty-four distinct experiments have been carried on with different methods of preparing seed, with different systems of cultivation, with the application of commercial

fertilizers, etc. The results of many of these experiments have been given in my annual reports from year to year. The most important results of the experiments conducted for several years in succession will form interesting material for a bulletin before long.

Of all the potatoes which have been grown in our experimental grounds, we have found the *Empire State*, *American Wonder*, *Pearl of Savoy*, and *Rural New Yorker No. 2*, among the very best varieties for general cropping.

Field Roots.

That root culture lies at the basis of good husbandry is the candid opinion of thousands of the most successful farmers of long experience. The root crop occupies an important place in a rotation, furnishes an excellent means for cleaning the land, prepares a splendid seed bed for a cereal crop, and supplies a large amount of succulent and palatable winter fodder which is rich in valuable food constituents and is easily digested by the animals. Roots assist greatly in the economical feeding of grain and coarse fodder, such as hay, straw, fodder corn, and corn silage, with which they are used. Root crops in general are much relished by all kinds of farm stock, but of special service are Swedish turnips for young stock and fattening animals; mangels for dairy cows, breeding ewes, and hogs; carrots for horses, and sugar beets for cattle and hogs.

I wish to emphasize the importance of securing the very best varieties of roots for the particular soil and locality in which they are to be grown. The following varieties are among the very best for Ontario: *Swedish turnips*, Hartley's Bronze Top and Buckbee's Giant; *mangels*, Evans' Improved Mammoth Sawlog, and Carter's Champion Yellow Intermediate; *carrots*, Pearce's Improved Half Long White; and *sugar beets*, New Danish Improved.

Not only is it important to get the best varieties, but it is of still greater importance to sow large, plump seed, having good germinating power. In the average of two years' experiments with turnips, mangels, carrots and sugar beets, we have grown from large seed an average of three and one-half tons of roots per acre more than from medium-sized seed, and twenty-four tons per acre more than from small seed of the same varieties. It pays, therefore, to sift out all the small seed and sow nothing but the best. We sow mangels, carrots, and sugar beets about the first of May, and the Swedish turnips about the 20th of June. The seed is sown one inch deep in rows twenty-eight inches apart, with an ordinary root drill. When we sow on the flat surface, we get an average of one-half a ton of roots per acre more than when we sow on ridges. If we thin the plants when they are from one and one-half to two inches high, we get an increase of four tons of roots per acre as compared with thinning the plants when they are eight inches high. As the result of much experimental work, we now thin the plants to the following distances apart in the rows: *carrots*, four inches; *sugar beets*, seven to eight inches; and *mangels and turnips*, ten to twelve inches. The reasons for thinning thus cannot be given in this brief report. Soon after the seed is sown, the soil between the rows is stirred with a weeder, from which a few of the teeth have been removed. The cultivation is then done at intervals of about two weeks by means of a one-horse scuffler which loosens the surface soil, destroys the young weeds and preserves the soil moisture.

Chicory (*Cichorium Intybus.*)

The plants of chicory are used as a fodder crop and also for culinary purposes. As a fodder plant, it is spoken of as being specially adapted to very poor soil; and its long tap roots help to carry it through dry seasons when grown even on very dry land. It is principally grown as a fodder crop in Europe, but alfalfa is now supplanting it largely as food for live stock. The large-rooted variety of chicory has been grown in our experimental grounds during the past four years, although in 1898 the crop was practically a failure. The average annual yield of fresh roots per acre for 1896, 1897, and 1899 is 7 tons. In some parts of Ontario, Chicory is grown quite largely and the roots are hauled to a mill where they are dried and prepared as a market product. If they wish, farmers can grow, dry, and roast chicory for themselves and use it either as a salad or in combinationwith coffee. Chicory is grown in much the same way as a crop of parsnips or carrots.

Rape (*Brassica Napus.*)

The rape plant resembles the Swedish turnip in its leaf, and the cabbage in its root. It is, therefore, the leaf and the stem which form the valuable portion for feeding purposes.

Varieties.—There are several varieties of rape, such as the Dwarf Essex, Victoria, White Flowering, Umbrella, and German Summer. Of these varieties the Dwarf Essex and the Victoria are the most extensively advertised. We have had these two varieties grown under similar conditions during the past five years. The average result for the five years show that the *Dwarf Essex* variety has produced 23.2 tons and the Victoria 20.3 tons per acre. There is no other variety of rape which has given nearly so good satisfaction as the Dwarf Essex. The German Summer (bird-seed rape) should never be grown for agricultural purposes, as it seeds the same season as sown, and is, therefore, a variety poor in feeding properties and difficult to eradicate. This point should be carefully observed, as serious trouble has sometimes resulted from sowing large areas of this variety.

Soils and Manures.—The most suitable soils for rape are fairly moist loams, rich in vegetable matter. Soils deficient in vegetable matter should receive a coating of stable manure. A dressing of eighty pounds of nitrate of soda per acre when the plants are two inches high will usually increase the crop fully two tons per acre. Land should be prepared for rape somewhat similar to that for corn or turnips.

Seeding and Cultivation.—About the middle of June, large, plump seed should be sown at the rate of one pound per acre in rows thirty inches apart and to a depth of about one inch. A thorough stirring of the first two inches of the ground between the rows every ten days or so increases the growth of the rape wonderfully. Flat cultivation is generally preferable.

Feeding Rape.—Rape makes an excellent late summer and autumn pasture crop for fattening cattle, sheep and lambs, for which purpose we have used it extensively. One season we pastured over 600 lambs on rape and sold them for the Buffalo, Halifax and English markets. When rape is pastured by hogs, it is considerably wasted, and when fed to cows it is apt to give the milk an undesirable flavor.

Animals should never be turned on rape when hungry. There is not much danger of animals bloating if they are turned on gradually at first, allowed free access to an old pasture field, and furnished with plenty of salt. There is practically nothing gained by feeding grain to animals when on rape. Lambs gain in weight from eight to twelve pounds per month on rape alone. We have cut green rape and fed it to hogs in the months of August, September, October and November with marked success. We have have also fed it to cattle and sheep in the stable until after Christmas with good satisfaction.

Other Uses of Rape.—Rape grows best in cool weather. When sown on land where a cereal crop has been harvested, it frequently makes a good growth of plants which can be plowed under as a green manure or used for late fall pasture. Owing to its broad and spreading leaves, rape has a wonderful power of smothering weeds, and is, therefore, an excellent crop for cleaning the land.

Kale or Borecole.

Kale is a cultivated variety of Brassica oleracea, differing from ordinary cabbage in the open head of the leaves which are used for culinary purposes as greens, and also as food for cattle. The Jersey Kale or tall Jersey cabbage is used very extensively in the Island of Jersey as a fodder crop. Seed of some of the varieties of Kale has been imported by our Experiment Station from Jersey Island, England, Quebec and the United States, and the seed of other varieties have been obtained in Ontario. The yield of green crop per acre produced by the different varieties in 1899 is as follows: Marrow Stem Kale, 11.5 tons; Thousand Headed Kale, 11.4 tons; Georgia Collards, 10.6 tons; Tall Green Curled Scotch Kale, 9.9 tons; Jersey Kale, 9.8 tons; Hardy Curled Kale, 9.3 tons; Purple Sprouting Borecole, 9.1 tons; and Large Tall French Brussels Sprouts, 6.7 tons. Five of these varieties have now been grown in our plots under similar conditions for three years in succession, and the *Marrow Stem Kale* has produced the largest average yield of green crop per acre of the five varieties grown for the three years, the yield being

24.9 tons per acre. In 1897, each of the varieties of Kale was fed to dairy cows, and the milk and butter produced by the animals was carefully examined and found to possess more or less taint in every instance.

Cabbage (*Brassica oleracea*).

Although the cabbage has been used to a considerable extent in Great Britain as a food for sheep and hogs, but little has been done with this crop for field culture in Ontario. The seed of a few of the varieties which are more commonly used as a fodder crop in England was imported in the spring of the present year, and sown in our experimental grounds in the month of June. The seed was bought from the well known firm of Sutton & Sons, Reading, England. The experiment was conducted in duplicate, the seed being sown similarly to that of rape. The crop of the one experiment was harvested on September 9th and the other on October 3rd, and the plants of each variety were weighed immediately on being cut. In average yield of total crop per acre, *Sutton's Earliest Drumhead* gave 14.7 tons, Sutton's Earliest Sheep Fold 13 tons, Sutton's Best of All Savoy 11.7 tons, and Sutton's Late Drumhead 11.5 tons. These yields compare very favorably with the yield of the Dwarf Essex rape grown under similar conditions, the average yield per acre of which was 12.1 tons. The experiment with the different varieties of cabbage will likely be continued for a time, in order to secure fuller information regarding the comparative values of cabbage and rape as a food for live stock, especially lambs.

White Mustard (*Brassica* or *sinapis alba*).

White Mustard is grown in Great Britain as feed for sheep and as a catch crop for plowing under for green manure. A smaller quantity is sometimes sown with rape in order that the two can grow together as a sheep pasture. It is claimed that a small quantity of white mustard sown with the rape prevents lambs from bloating when pasturing the crop. It is considered by some feeders to be better than rape for late sowing in the fall, as its growth is more rapid than that of rape and will give a good pasture crop for lambs in a shorter length of time. The white mustard has been tested in our experimental grounds for several years, and the growth has been satisfactory. When sown in July or August, it usually gives a larger yield than when sown in May or June, at which time it is inclined to produce seed to rapidly to make a good pasture crop. Mustard is, therefore, sometimes sown on land on which turnips or rape has failed and a fair-sized crop is generally secured.

One year we allowed the white mustard to ripen its seed, which was harvested and threshed, the yield being at the rate of 750 pounds of white mustard seed per acre. The well known codiment called "Mustard" is made from white mustard seed in much the same way that flour is made from wheat. The strongest flavored mustard, however, is produced from grinding the whole seed, as the bran contains the greater amount of pungent oil to which the flavor is chiefly due.

Field Pea (*Pisum arvense*).

The common field pea is a leguminous plant and a native of Italy. It has been in cultivation many hundred years and is chiefly grown for its grain. It is also used in mixing with oats for the production of green fodder or of hay. For soiling purposes, it produces a large yield of very nutritious food. The seed is exceptionally rich and is of great value for using with other grain in fattening cattle and hogs. The straw is used extensively as a food for sheep, and is sometimes mixed with other coarse fodder for feeding to dairy cows. Field peas can can be very satisfactorily used in Ontario as the cow peas are used in the Southern States for plowing under as a green manure.

Exactly one hundred varieties of peas have been grown in our experimental grounds within the past eleven years. The greater part of these have been tested for at least five years in succession. The average results for five years show that twenty varieties have produced a yield of upwards of thirty bushels per acre. The following list gives the average weight per measured bushel, and the average yield of both straw and grain per acre of the twenty largest yielding varieties. It also gives the results of few varieties which

come lower in yield, but which are quite well known throughout the Province, owing to the length of time they have been grown or to the recommendations which they have received elsewhere.

No.	Varieties.	Pounds per measured bushel.	Tons of straw per acre.	Bushels of grain per acre.
1	White Wonder	63.6	1.2	39.0
2	New Zealand Field	61.2	1.3	37.8
3	Glory	61.7	1.2	36.2
4	Early Britain	60.1	1.3	36.1
5	Egyptian Mummy	64.4	1.6	35.8
6	New Zealand Brown	59·4	1.4	35.3
7	Tall White Marrowfat	61.8	1.5	34.2
8	New Zealand Blue	62 5	1.2	33.9
9	Potter	61.8	1.4	33.1
10	Improved Grey	59 2	1.2	32.2
11	Chancellor	62.3	1.3	32 0
12	D'Auvergne	62.1	1.2	31.7
13	Common Grey	59 0	1.5	31.4
14	William the First	58 1	1.1	31.2
15	Princess Royal	60.4	1.2	31.2
16	White-Eyed Marrowfat	62.4	1.5	31.1
17	Early Racehorse	60.1	1.2	31.0
18	Nine Pod	59.5	1.4	30.7
19	Prussian Blue	61.7	1.8	30.4
20	Nimble Taylor	58.6	1.3	30.2
21	Crown	60.1	1.3	29.7
23	New Canadian Beauty	62.2	1.3	29.1
26	Black-Eyed Marrowfat	61.5	1 3	28.9
27	Sword	62.0	1.4	28.9
28	Golden Vine	62.7	1.3	28.5
35	Multipliers	61.9	1.6	27.2
36	Striped Wisconsin Blue	62.7	1.7	26.5
40	Pride of the North	60.4	.9	19.1

The *White Wonder*, which stands at the head of the list in average yield of grain per acre among all the varieties of peas grown for five years in succession, has a medium-sized white grain of good quality. This variety, however, requires good strong land, as the straw is shorter than that of most other varieties. The grain of the New Zealand Field pea is white and of about the same size as that of the Multipliers. The seed of both the White Wonder and the New Zealand Field pea was imported from New Zealand, and the supply of grain in Ontario is still quite limited. The Glory variety, which was imported from England, has a large white grain and a medium length of straw. *The Early Britain* is a brown pea imported from England, and one which has given excellent results both on our experimental grounds at Guelph and in the co-operative experiments throughout Ontario. It has been distributed with three other varieties in each of the past three years to Ontario farmers and has given the largest average yield of grain per acre of the varieties sent out in each of the three years. The Egyptian Mummy, which has been grown in Ontario for the past fifteen or twenty years, produces a large white pea, which weighs very heavy per measured bushel. The straw is usually quite coarse in growth. The Chancellor variety of peas, which comes eleventh on the list in yield of grain per acre, produces a small white pea and matures early. *The Prussian Blue* pea, which is extensively grown over Ontario, comes nineteenth on the list in yield of grain per acre. This pea, however, is well adapted to poor and average soil as it produces a large amount of straw; in fact, there are but few varieties which yield so large an amount of straw per acre as the Prussian Blue variety. The Golden Vine is the name of the little white pea known as the Common White pea of Ontario and as the Canada Field pea in the United States. The Golden Vine has given an average of about ten bushels per acre less than the White Wonder in the results from growing the two varieties under similar conditions for five years in succession.

In the spring of 1899, the Ontario Department of Agriculture received a communication from England to the effect that there was a big demand in England for what is known as *the Wisconsin Blue pea*, and that the price for that variety was

higher than for the small Canadian Blue pea. Samples of peas were also received by the Ontario Department of Agriculture from England, and the communications and samples of peas were forwarded to my office. I find the Wisconsin Blue pea to be identical with the Striped Wisconsin Blue, and the Small Canadian Blue identical with the Prussian Blue peas mentioned in the foregoing table. The following letter gives interesting information regarding the demand for each of the varieties of Blue peas for the English market:

CANADA GOVERNMENT AGENCY,
15 Water Street, Liverpool, England,

SIR,—By this mail I am sending you a sample of Wisconsin Blue peas which has been handed to me by a Liverpool firm (Kamm & Co.,) who state that these peas are grown largely in the district of Wisconsin, U.S.A., and that they have come into favor here as a cheap boiling pea, which is rapidly taking the place of the small Canadian Blue. They are shipped here in strong bags, holding about one and a half hundredweight, and the value to day is 36*s.* per 504 lbs. When steeped they swell well and boil soft and are in request for export and ships' stores. Last season there was a large trade, when the ruling price was 30*s.* for 504 lbs., but the higher price this year has checked the demand and small English Blue can compete successfully.

I beg to suggest that experiments be made with the samples that are being sent, so that the attention of Canadian agriculturists may be directed to the advantages they may be found to possess. There is no doubt that English buyers would prefer to purchase Canadian produce rather than that from the United States if a similar article can be exported from the Dominion. Believe me,

Yours very truly,
S. H. MITCHELL.

In order to glean more definite information regarding the productiveness of these two varieties of peas throughout Ontario, we distributed both kinds to a large number of farmers in the spring of 1899. Ninety of these experimenters conducted a successful test on their own farms and forwarded good reports. From these reports we learn that an average of 27.15 bushels per acre were produced by the Prussian Blue and an average of 25.15 bushels per acre by the Striped Wisconsin Blue. It might be well for the farmers in the Northern part of Ontario, around Owen Sound for instance, where there is no trouble from the pea weevil (*Bruchus pisi*) to consider the advisability of growing the Wisconsin Blue peas for the English market. The information here given regarding the comparative price of the two varieties in England, and the comparative yield of the two varieties at the Agricultural College for five years and on ninety farms throughout Ontario in 1899, should be of much service in coming to a conclusion as to the advisable course to pursue in trying to meet the demand for the English market.

The pea weevil (*Bruchus pisi*) is causing great damage in the pea crop in the southern part of Ontario, and we have found only two varieties which are entirely proof against its ravages. The two varieties are *the Egyptian* and *the Grass*, which are quite different from other varieties of peas in their character of growth. These two varieties of peas are described in this report under separate headings. Of the ordinary varieties of field peas we have found that *the Oddfellow* has been freest from the ravages of the weevil, and that *the Mummy* has taken the second place in this particular.

COWPEAS.

Cowpeas are extensively used in the Southern States as a green manure. It is somewhat difficult to make hay out of cowpeas, but with care an excellent quality of hay can be produced. Owing to the high feeding quality of cowpea hay it is frequently considered advisable to feed the crop and return the manure to the land.

There are over one hundred named varieties of cowpeas grown in the United States. Nearly all of these, however, require such a long season of growth that they are suited only to the warm climate of the South. A few of the earlier kinds have been grown in the Northern States, and have been tested at our Experiment Station at Guelph. One or

more varieties have been sown in our experimental grounds during each of the past eight or nine years. It has been found, however, that nearly all varieties are too late for the climate of Ontario, unless it is in some instances for producing a green crop for plowing under. They seldom grow to a height of more than ten to twelve inches, although an average height of twenty-five inches was made by the Black-Eye variety of cowpeas in 1899. The varieties which we have mostly grown are the Warren's Extra Early, Black-Eye, New Era and Whip-o-will. Of these varieties the New Era and the Whip-o-will proved to be the earliest. None of these varieties, however, have produced an average of more than about one and a half tons of green crop per acre during each of the past two years. During the entire period in which we have had the cowpeas under experiment no grain has been produced until the present year, when the plants became sufficiently well matured to produce a crop of peas, which was, however, very light. The yield of the New Era was the largest, but it was only a little over two bushels per acre. The Experiment Station will still be on the watch for some varieties of cowpeas which will be sufficiently rapid in growth to prove of value for cultivation in Ontario. We are at present unable to recommend any of the varieties which we have grown as being suitable for our northern climate.

Grass Peas.

The Grass pea is an annual legume which has been grown to a limited extent in Ontario for several years. The stems of the plants are flat and the whole crop is greatly relished by animals when used as a green fodder. It produces a moderate amount of grain, which is angular in form and very hard. One marked advantage of the grain of the flat pea is that it is entirely proof against the ravages of the pea bug (*Bruchus pisi*). We have grown the Grass pea for several years at the College, both as a grain and as a fodder crop. In the average results of four years' experiments, the Grass pea has produced 8.9 tons of green fodder per acre. This is more than double the yield produced by horse beans when both crops have been grown under exactly similar conditions. It is also a little over two tons per acre more in yield than the green crop produced by the Prussian Blue variety of peas when both were grown side by side for four years. As a producer of grain it has given a yield of 17 1-2 bushels per acre in the average tests for four years. The Grass pea has been sent out over Ontario in connection with the co-operative experiments for three years in succession and has been very popular among the experimenters as a producer of green fodder. We believe that in those districts of Ontario where the pea bug (*Bruchus pisi*) is doing so much havoc with the common varieties of peas, the Grass pea can be used to good advantage, and the crop can be utilized either as a green fodder or for hay, or can be allowed to mature and the grain and the straw both can be used for feeding to the live stock in the winter.

Egyptian Pea, Coffee Pea, Chick Pea, Etc. (*Cicerarietinum*).

The Egyptian pea is a leguminous plant grown extensively in the Mediterranean regions and in Central Asia. It has been used as feed for cattle and also as an article of human food for upwards of three thousand years. The seed is somewhat larger than the common pea and is enclosed in a short thick hairy pod, there being from one to two peas in each pod. The plant itself is seldom used except as a soil renovator, but the yield of grain is large and is ground into meal which makes a very valuable cattle food when fed in much the same way as cotton seed meal. As a human food, the peas are used in various ways. The ripened grain is sometimes prepared for the table in much the same way that we prepare our Canadian beans for culinary purposes. Egyptian peas are sometimes roasted and used as a substitute for coffee.

We have had the Egyptian pea under experiment since the spring of 1893. The crops of 1897 and 1898, however, were injured, and the results for these years are of no value. The average yield of grain per acre for 1893, 1894, 1895, 1896, and 1899 is 40.3 bushels, and the weight per measured bushel for the same period is 61.6 pounds. This variety of peas was sent out over Ontario in connection with the co-operative experiments along with three other varieties of peas in each of the years 1896 and 1897. In 1896, it was successfully tested on seventy-three Ontario farms, and gave an average of

27.4 bushels per acre, and in 1897 it was successfully tested on fifty-six Ontario farms and gave an average of 19.8 bushels per acre. It was found a little difficult to compare it properly with the other varieties of peas owing to the Egyptian variety requiring a somewhat longer period to mature. It usually takes about four months from seeding time until the crop is ready to harvest. The Egyptian pea requires good strong soil, giving poor results when sown on light and dry sandy soil, but producing a large crop which stands up well on rich low-lying ground. This variety seems to be well adapted to soils which usually cause the ordinary varieties of peas to produce too much straw that is apt to mildew. One very important point in favor of the Egyptian pea is that it is never troubled with the pea weevil, usually called pea bug (*Bruchus pisi*), which is causing very serious trouble to the pea crop of the southern part of Ontario.

Flat Pea (*Lathyrus sylvestris*).

The Flat pea is a perennial, legume, and is a native of Eastern Europe and Northern Asia. The plant grows very slowly at first and requires three years to reach its full size, after which it holds the ground for many years when grown under favorable conditions. It seems best adapted to arid regions where the system of irrigation is followed. Some of the Northern seedsmen have made extravagant claims for the Flat pea.

The seed of the Flat pea has been sown on the experimental plots at various times within the past nine years. The growth on some occasions has been quite satisfactory, and on others the crop has been poor. From our study of this plant, it seems unsuited for Ontario. The seed is very expensive; three years is required to bring it to full size, during which time there is much labor in keeping the land free of weeds; and the fodder produced is evidently less relished by animals than would be supposed from the claims made by those who are specially interested in its introduction. The following quotation is taken from the catalogue of a seedsman located in one of the Northern States: "All cattle, hogs, horses, indeed everything, relish *Lathyrus sylvestris.*" They have grown *Lathyrus sylvestris* at the Experiment Station at Lansing, Michigan, for several years past, but have found in the feeding tests made there that live stock showed a decided distaste for the forage. Both sheep and cattle lost in weight when either the green or ensiled forage was fed as part of the ration.

Field Beans.

The common bean has been in cultivation from remote antiquity in Europe as well as in Asia. According to the report of the Bureau of Industries for Ontario, we learn that 40,485 acres of land were devoted to the cultivation of beans in the present year.

We have grown forty one varieties of beans in our experimental grounds within the past thirteen years. Of this number thirty varieties have been grown in two different places in our experimental grounds in each of the past three years. The following list gives the average of each of fifteen of the heaviest yielding varieties for the three years:

	Varieties.	Pounds per measured bushel.	Bushels of grain per acre.
1	White Wonder	65.8	23.3
2	Burlingame Medium	65.4	22.0
3	Schofield Pea	62.2	21.9
4	Pearce's Improved Tree	66.2	21.0
5	Medium or Navy	65.7	20.7
6	Snowflake	67.3	18.8
7	Wisconsin Tree	65.9	18.8
8	Burpee's Electric Tree	66.0	18.7
9	Day's Improved Leafless	[illegible].6	18.6
10	Great Western	66.2	17.6
11	Boston Pea	66.0	17.2
12	Marrowfat	64.6	15.8
13	Dwarf Horticultural	60.1	15.3
14	Extra Early Field	62.8	14.5
15	Zealand Haricots	62.5	14.1

The White Wonder variety, which stands at the head of the list in average yield of grain per acre, is early in reaching maturity and produces a small white bean of good quality. The White Wonder is a good representative of the small white beans; the Navy, of the medium white beans, and the Marrowfat, of the large white beans. It will be seen, however, from the results in the foregoing list that the White Wonder gave an average of about $2\frac{2}{3}$ bushels per acre more than the Medium or Navy variety, and about $7\frac{1}{2}$ bushels per acre more than the Marrowfat variety. The Small White Field bean, which is not mentioned in the above list, comes seventeenth in the yield per acre. Three varieties of beans, under the names of Zealand Haricots, Giant Haricots, and Large White Haricots, which were reported by an English firm in the spring of 1897 as likely to give excellent results in Canada, have so far made low records. A quantity of each of these varieties was imported from England in the spring of 1897, and the seed of two varieties was sown in each of the past three years. The Giant Haricots, however, did so very poorly in the experiments of 1898 that they were dropped from the tests of the present year. In the average results of the three years' experiments, the Large White Haricots now occupy the last place in yield of grain per acre, the average being only 8.2 bushels, or not much over one-third of the yield produced by the White Wonder variety. The Zealand Haricots, however, stands fifteenth in point of yield of grain, as will be observed in the results given in the foregoing list.

Soy, or Japanese Beans.

The Soy beans, which are also called Soja beans, have been grown for a great length of time in Japan and in South-eastern Asia. The Soy bean is a leguminous plant, being similar to clover, peas, and our common beans in this respect. The plants are upright in growth, branch considerably, and usually contain a very large number of pods. The varieties of Soy beans are numerous, but many are late in maturing and are best suited to the warmer climates. There are some of the varieties, however, which are much earlier in maturing and are better adapted to the colder climates. About eighteen years ago Prof. Georgeson, then connected with the Agricultural College in the State of Kansas, imported from Japan fifteen varieties of the Soy beans, with which he conducted practical experiments on the Experiment Station grounds and found that five of the varieties gave good results. These five varieties were imported from Kansas some seven years ago for growing in our experimental plots. The Yellow Soy bean has given decidedly the best results among the five varieties which were obtained from Kansas. A few years ago the Agricultural College of Massachusetts also imported a number of varieties of the Soy beans from Japan, and three of these have now been tested in our experimental grounds here at the College.

The *Yellow Soy* bean which was imported from Kansas has given an average of eight tons of green crop per acre, being two and one-quarter tons per acre more than that produced from the common beans, and three and one-quarter tons per acre more than that produced from the horse beans. In each of the past three years the *Medium Green* Soy bean has given the largest yield of green crop per acre among the three varieties imported from Massachusetts, but in each of these years the Yellow Soy variety has given better satisfaction than the Medium Green in yield of crop per acre, although the results in 1898 were practically equal. We hope to grow these two varieties in larger lots, in order that we can compare them thoroughly in regard to their qualities for green fodder and for hay.

In the production of grain the Yellow Soy variety has produced the greatest yield in each of the tests made at the College. Of the different varieties tested during the past three years, the Extra Early Dwarf is the earliest, the Yellow Soy the second earliest, the American Coffee Berry the third earliest, and the Medium Green is the latest to reach maturity. In many of the localities in Ontario the Medium Green variety of Soy beans would be too slow in maturing to produce seed.

In the spring of 1899 three varieties were sent out over Ontario in connection with the co-operative work, to find out how these varieties would succeed over the Province. The varieties distributed were the Medium Green Soy beans, American Coffee Berry and the Extra Early Dwarf Soy beans. The Medium Green and the American Coffee Berry gave upwards of twenty bushels of seed per acre, and the Extra Early Dwarf an average

of about thirteen bushels per acre. The Yellow Soy bean was not included in the experiment, as the seed of that variety was not available at the time. Arrangements have been made, however, to secure seed of this variety from the Kansas Experiment Station, for 1900. We feel justified in making somewhat extensive experiments with the Soy beans on account of the strong claims made for these beans in a few places where they have been grown. The following is taken from the bulletin issued by the United States Department of Agriculture on the Soy bean as a forage crop :

"The Soy bean thrives best in soil of medium texture well supplied with lime, potash and phosphoric acid. It endures drouth well, is not easily injured by excess of moisture, and may be grown about as far north as corn.

"The early varieties are best for seed crops, and the medium or late varieties for hay, forage and silage. Seed may be planted at any time during the spring and early summer, but preferably as soon as the ground becomes well warmed up. Drill one-half to three-fourths of a bushel to the acre; broadcast, three-fourths to one bushel.

"Little cultivation is needed when growing for forage; when for seed, keep weeds down until plants shade the soil. The Soy bean may be used for soiling, pasturing, hay, and ensilage, or the beans may be harvested and fed as grain.

"The forage is very rich in fat and muscle-making materials, and should be fed with fodder corn, sorghum, or some other feeding stuffs rich in fat-forming nutrients. The seed can be fed to the best advantage when ground into meal, and is almost equal as a concentrated food.

"Cut for hay when the plants are in late bloom or early fruit; for ensilage the crop can be cut later, but it is better to cut before the pods begin to ripen; for green forage cutting may begin earlier and continue rather later than for either hay or ensilage; the crop may be cut for seed after the pods become about half ripe.

"The Soy bean is excellent for green manuring and for short rotations with cereal crops. It should be well limed when plowed under as a green manure."

The Experiment Station at Kansas is growing the Soy beans very extensively; they had no less than sixty acres in Soy beans this year. From a bulletin issued from that Station on September 25th, 1899, we quote the following: "The sixty acres of beans average fifteen and one-half bushels per acre, making the cost of production fifty-five cents per bushel, or about eight dollars and forty cents per acre. Soy beans as a feed take the place of oil or gluten meal, and in composition are richer than oil meal. In feeding them to milch cows, fattening cows and hogs, they have given astonishing results. When the beans are let thoroughly ripen in the field, the straw is worthless, but if cut and cured while green makes excellent hay. They make excellent hog pasture and are a good crop for soiling."

We understand that at least five complex food products are prepared from the Soy beans in Japan, although the beans are seldom used alone as a vegetable. They are also frequently dried and roasted, and used as a substitute for coffee.

Horse Beans (*Fava vulgaris.*)

The horse bean is a coarse, rank-growing annual legume which is used quite extensively in Europe as a forage plant. There are several named varieties of horse beans, a number of which have been grown at the College. During each of the past nine years, from one to six varieties have been under test, but in most of the years the crop has proved unsuccessful. During the hot, dry weather of the summer the leaves drop from the plants and the stems become dry and turn black. In some instances there was a second growth from the roots after the fall rains saturated the ground. Among the different varieties tested, the *small horse bean* has given the best results, the average yield of green crop per acre produced from this variety in the average of five years' experiments being 4.8 tons per acre. Even this variety, however, has not given general satisfaction as a fodder crop. We have found it to answer very nicely, however, for sowing late in the season with other leguminous crops, such as peas and Crimson clover, for plowing under as a green manure. The erect growth of the plants helps to hold the common peas up from the ground and thus assists in producing a satisfactory crop for plowing under. The horse bean seems to grow better in cool, moist weather than in the hot, dry seasons which occur so frequently in Ontario.

Velvet Bean (*Mucuna utilis.*)

The Velvet Bean, or Banana Field Pea, is a leguminous plant, and is becoming rec nized more and more as a valuable crop for forage and for soil renovation in the Americ Southern States. In some places it is becoming a close rival of the Cow Pea. The vin grow long, and the forage closely resembles that of other beans.

It is quite doubtful whether the Velvet Bean will thrive so far north as Ontari It has been sown in our experimental grounds for only one season, and in that test the sults were quite unsatisfactory, but mainly owing to the poor germination of the see The crop will likely be tested again in our experimental grounds.

Clover.

Clover belongs to the order leguminosæ, or bean family. There are several varieti of clover grown more or less extensively throughout this Province, the most prominer of which are the Red Clover (Trifolium pratense), Mammoth Clover (Trifolium mediun Alsike Clover (Trifolium hybridum), and Crimson Clover (Trifolium incarnatum). these the Red Clover is decidedly the most popular and is grown the most extensively.

Each of the varieties of clover mentioned above, and also several other kinds, ha been grown in our experimental plots more or less in past years. We have just co pleted an experiment in which we had the Common Red and the Alsike grown side side in three different places in our experimental grounds. The following gives the ave age results of each variety for the first and the second cutting the same season :

Varieties.	Tons per acre of first cutting.	Tons per acre of second cutting.
Common Red Clover	2.9	.80
Alsike Clover	2.9	.08

These figures show that the yields of the first cutting of the two clovers were equ It also shows that the second cutting of the Common Red was ten times as great as th of the Alsike variety.

The average annual total yield of Green Clover per acre for five years, includir three separate seedings of each of three prominent varieties of clover, is given in t following summary results :

	Tons of green hay per acre.
Mammoth Red, seeded 1891, 1894 and 1897	7.2
Alsike, " " "	7 0
Common Red, " " "	6.2

The Mammoth Red variety is somewhat coarser and is several days later than t Common Red variety. The first crop of the Mammoth Red is generally large, but t after growth is usually very small.

Crimson Clover has been tested in each of the past six or seven years, and wh sown in the spring produces an average of about one and one-fifth tons of hay per ac the same season ; but if sown in the autumn, as is the custom in some of the Easter States, we find that on the average about four-fifths of the plants are killed during o severe winters. Although Crimson Clover has been very extensively advertised, we fi that, unless in exceptional cases, it is very unreliable in our climate, and we cannot advi its general cultivation in Ontario.

Alfalfa or Lucerne (*Medicago Sativa*).

Lucerne is a native of Western Asia, and has been under cultivation for upwards twenty centuries. It is considered the best crop for hay and for green fodder which ca be grown in the Western States. It is a perennial legume which does not reach its fu size until the third year. From two to four cuttings can usually be secured annuall from a well-established Lucerne field.

That Lucerne is a crop of great importance for California, Colorado and other Wes ern States is a well-established fact. As a plant suitable for general cultivation in t

extreme Northern States and in Ontario, however, it is not so certain. It has been tested here and there over the Province of Ontario for many years, but as yet it has not been grown to any large extent, except in two or three localities which seem to be specially adapted to its growth. In order to allow the farmers of Ontario to test Lucerne upon their own farms, we have distributed seed to Ontario farmers through the medium of the Experimental Union during each of the past nine years, sufficient seed being sent some years for plots containing sixteen square rods. The reports of these experiments are furnishing most valuable information regarding the growth of Lucerne in Ontario. Those who report success are certainly in the minority, although in some cases it has been grown quite successfully. Within the past year I have received letters from upwards of one hundred Ontario farmers who have grown Lucerne upon their own farms. These replies have been received from thirty-two counties. There appears to be more Lucerne grown in the counties of Brant, Haldimand, Wentworth, Welland and Lincoln than in all the rest of the Province combined, although there is a fair amount grown in Lambton and Middlesex, and a little in some of the other counties.

Lucerne is used for green fodder, for hay, and sometimes for silage. It is also sown alone and in combination with other grasses and clovers for pasture.

We have sown Lucerne as a separate crop, and also in mixtures of grasses and clovers, on a large number of plots on our experimental grounds within the past thirteen years. We have sown it alone in the autumn and in the spring, with and without manure and with and without a grain crop. We have also sown it on soils of different elevations. The accumulating results of these experiments are becoming more valuable year by year, and should be of service to the farmers of Ontario in reaching a reliable conclusion regarding the crop. In summing up our results we find that we get an average of between 17 and 18 tons of green Lucerne per acre annually.

Great caution should be used in pasturing Lucerne or considerable loss by death of animals may be the result. From a bulletin issued by the Department of Agriculture at Washington, giving the summary results of experiments conducted throughout the United States, I make the following quotation: "It is not safe to pasture either cattle or sheep on Alfalfa, as they are liable to bloat when it is fed green. Feed them the hay or practice soiling." Within the last year, I have received reports from three different farmers in Ontario, each stating that he had lost at least one cattle beast when pasturing on Lucerne. One report states as follows: "I am well satisfied with Lucerne for hay but did not like it for pasture. After being on it about two weeks, my cows began to bloat and I lost one from this cause. I think it was from eating the tops. The cows were not left on it very long at first and did not have access to water. Last summer, instead of letting the cows on the clover, I cut it and fed it to them green, although I fed all that the cows could eat." From another letter I make another quotation: "The cows bloated a little at first when pasturing on Lucerne, and after I had them in it for six weeks I lost one from bloating." It will, therefore, be seen that great care needs to be exercised in using Lucerne alone as a pasture crop.

We have also conducted a considerable number of experiments in curing Lucerne for hay, and find, when it is cut at the right time and cured rapidly so as to retain the leaves, a good quality of hay can be produced; in fact, we have produced hay which has been considered second to none produced on the farm. From a bulletin issued at Washington giving the summary results conducted at different Experiment Stations, I make the following quotation: "Cut Lucerne for hay when the first flowers appear. If cut in full bloom the hay will be woody and less nutritious. As Mr. Robert Harcourt, Assistant Chemist of our own Experiment Station, has been conducting an experiment by cutting Lucerne at different stages of growth and feeding the hay to sheep, some additional information of much value should be thus obtained. The Lucerne which is used was sown in the experimental grounds in the spring of 1895, and Mr. Harcourt used the crop of the fourth year for the investigations referred to.

We have sown Lucerne in at least nine different mixtures of grasses and clovers, and find that when used in a mixture the crop has been very permanent.

The results in the cultivation of Lucerne, both at our Experimental Station and throughout Ontario, should soon furnish valuable information regarding the practical side of Lucerne growing in this Province.

Sainfoin (*Onobrychis sativa*).

Sainfoin, also called Esparcette, is a perennial legume having a long root which penetrates deeply into the soil. It is mainly grown on dry calcareous soils which are either naturally or artificially well underdrained. It is grown for green fodder and for hay, and the hay is said to be better and more nutritious than that of red clover.

The seed of the Sainfoin has been sown in the Experimental department several times within the past fifteen years. As the seed of the Sainfoin loses its vitality in a short time, we find it rather difficult to purchase seed which will produce a good stand of plants. The young plants seem tender at first, and are apt to be crowded with weeds or grass unless the land is carefully looked after until the Sainfoin gets well established. The plants have proven themselves to be very hardy, and in nearly all cases have remained in the land until a change in the arrangement of the plots made it necessary to plow them up. In one plot, however, they remained for eight or ten years, holding their own throughout that length of time. The crop usually grows to a height of about two feet; and when in full bloom, the bright pink flowers are beautiful in appearance. The crop is cut for green fodder or for hay as soon as in full bloom. The average yield per acre of green fodder produced from the Sainfoin grown in our plots from seed sown in the spring of 1894, has been twelve tons. The crop is better suited for forage than for pasture. Good fresh seed should always be secured, and this shall be sown on land which is naturally dry as early in the spring as it can be worked to good advantage. The seed should be sown from an inch to an inch and a half below the surface, and may be grown with a light seeding of barley. An average of twelve tons of green Sainfoin per acre was produced from seed which was sown with about one bushel of barley per acre. This seeding of barley produced a very good crop, and was not thick enough on the ground to smother out the young Sainfoin plants.

Common Spring Vetch (*Vicia sativa*) and Hairy Vetch (*Vicia vellosa*).

For three years in succession the Common Spring vetch (*Vicia sativa*) and the Hairy vetch (*Vicia Vellosa*) have been grown under similar conditions in the Experimental department, in order to ascertain the comparative results of these two varieties in the production of green fodder. The Common Spring vetch is familiar to many of the farmers of Ontario, especially to the dairymen, who have used it in sowing with oats for the production of a green succulent food to supplement pastures during the dry part of the summer, or for making into hay for winter fodder. Common vetches have been tested over a large part of the American Continent, but seem the best adapted to Canada and to the North Eastern States.

The Hairy vetch is an annual, the seed of which was originally obtained from Western Asia. It is sown during April, May, and, June for summer forage, and in the warmer climates in August and September for winter forage. The hay produced from the Hairy vetch is of excellent quality. This variety has proved itself to be fairly well suited to the greater part of the American Continent.

The average results of the experiments conducted at the College during each of the past three years show that the Spring vetch gave a yield of green crop per acre of 1.9 tons in 1897, 3.4 tons in 1898, and 7.3 tons in 1899, or an average of 4.2 tons for the three years; and that the Hairy vetch gave a yield in green crop per acre of 12.7 tons in 1897, 7.8 tons in 1898, and 10.1 tons in 1899, or an average of 10.2 tons for the three years. These results show that the *Hairy vetch* has given an average of about two and a half times as much green fodder as the Common vetch in the average of three years' experiments. The seed of each of these two varieties of vetches was sent to experimenters throughout Ontario in the spring of 1898, and five reports of successfully conducted experiments were received. The average of these five experiments shows the Hairy vetch to have given 9 tons of green crop per acre and the Common vetch 6.9 tons of green crop per acre. It will thus be seen that the Hairy vetch has given much better results than the Common vetch in all the experiments conducted both at the College and over Ontario. Not only does the Hairy vetch produce a large yield per acre, but the crop is well suited for soiling purposes and appears to be relished by all classes of farm stock. The greatest draw back to the more extensive cultivation of the Hairy vetch in Ontario is the high

price at which the seed is sold. It may be possible, however, to obtain seed of the Hairy vetch at a much less cost in the near future. We hope to conduct more extensive experiments with the Hairy vetch in 1900 than on any former occasion, in order to glean as much information as possible in regard to this promising crop.

Tufted Vetch (*Vicia Cracca*).

The Tufted vetch, also called Cow vetch, Blue vetch, Bird vetch, and Chicken vetch, is a leguminous plant with numerous blue or purple flowers. It is grown in Europe as a fodder plant, and is specially recommended for cultivation on moist land. It is said to give excellent results when grown in shady places, as in orchards.

In each of the two years that we have tested the Tufted vetch in our plots it has grown quite successfully, producing 2.2 tons per acre one year and 3.9 tons per acre the other, making an average of a little over 3 tons per acre of the green crop. This yield was $\frac{2}{3}$ of a ton per acre more than that produced by the Common vetch in the same period. The fodder produced was tender and succulent, and appeared to be of good quality for feeding either as a green crop or as hay. As the yield, however, is so much less than that of the Hairy vetch, we cannot recommend it at present for general cultivation, although specially mentioned by some seedsmen as affording a provender of good quality,—a claim which undoubtedly is quite correct.

Kidney Vetch (*Anthyllis vulneraria*).

The Kidney vetch is a perennial plant which belongs to the leguminous family, and is a native of Europe. It is naturally well suited to very dry and barren soils, and especially those containing much lime. It is grown on poor soil as a forage plant, and is said to produce a very palatable fodder for live stock.

The seed has been sown in our experimental plots several times, and we have usually secured a good stand of plants. In the average of two years' experiments, we obtained 3.6 tons of green crop per acre. As a rule, the crop furnishes only a small amount of forage. In some seasons there is scarcely enough to make it worth while harvesting, and we believe that it possesses no real value as a crop for Ontario, unless it is for sowing with some other crop for a permanent pasture on a very poor sandy soil.

Lupines.

Two varieties of lupines, namely, the Yellow and the Blue, were sown in our experimental plots in the spring of 1899. The germination was fairly good. The Blue variety produced plants which averaged 18.7 inches, and the Yellow variety plants which averaged 13.5 inches in height. This growth was rather better than we obtained from growing lupines on former occasions. The plants, however, were very slender and did not mature any seed. Although the plants did better this year than formerly, we cannot recommend any varieties of lupines which we have yet tested for cultivation in Ontario.

Lentil (*Ervum lens*).

The lentil is cultivated largely in Europe and furnishes a good crop for forage. The grain is very rich, and is used as food for man and for domestic animals. Calcareous soils are said to be best suited to the growth of the lentil, which is an annual legume.

We have grown lentil in our experimental grounds during the past three years, and find that it produces plants from nine to twelve and a half inches in height, which are rather delicate in growth. The crop of green fodder produced is small, and the plants seldom ripen their seed. The past results from growing lentils at the College indicate that the crop is not likely to give satisfaction in Ontario.

Serradella (*Ornithopus sativus*).

The Serradella is an annual leguminous forage plant, native of southern Europe and of northern Africa. It somewhat resembles the spring vetch in appearance, and is said to do best on moist sandy soil. The forage is about the same in composition as red

clover, and is fed to cattle and sheep. As a green manure, it is said to be specially suitable in the improvement of sterile fields. Serradella seed was sown in the experimental grounds in the spring of the present year. The plants grew to an average of seven and one-half inches in height, and the yield of green crop was at the rate of 4.7 tons per acre. The plants were low and spreading in their growth, and from the general character of the crop it would appear to be better suited as a crop for pasture or green manure than for the production of green fodder or of hay. From the study of the growth of the serradella during the past year, we would consider that its general cultivation would not prove profitable in Ontario.

Peanut (*Arachis hypogæa*).

The Peanut plant is a legume which ripens its fruit under ground. The nuts are also called groundnuts, earthnuts, groobers, etc., and are grown as a commercial article. Virginia, North Carolina and Tennessee produce a large proportion of the peanuts grown in the United States. The soil in these States seems to be specially adapted to the successful growth of this plant. It is stated that the average yield of nuts per acre is about twenty bushels.

We have tested several varieties of peanuts during the past five years with varying results. In some seasons none of the varieties have produced nuts of value, while in other seasons the yields have been fairly good from a few of the varieties. The varieties which gave the best satisfaction in each of the past three years were as follows: In 1897, the White, Red, Root Hog or Die, Spanish, and Rennie's New Canadian; in 1898, Root Hog or Die, Savatilla, Spanish, Rennie's New Canadian, and White; and in 1899. Savatilla, Root Hog or Die, Inverson's Improved, White, Spanish, and Rennie's New Canadian. These varieties are arranged according to their yield per acre, starting in each year with the heaviest yielder. By taking three years into consideration, it will be seen that the *Root Hog or Die* variety has produced the largest average yield per acre, which has been followed pretty closely by the Savatilla, Spanish and White varieties. The yield of the Savatilla in 1899 was at the rate of 14.3 bushels per acre, but the nuts were not quite so plump as those which were used for seed. From the results of our past experiments, the indications are that some of the earliest and best varieties of peanuts can be grown to good perfection on the sandy loam soils in the warmest portions of the Province.

Flax (*Linum usitatissimum*).

The cultivation of Flax is carried on more or less extensively in a large number of the countries of the world. It has been grown to a limited extent in Ontario for its seed and for fibre. We have grown three varieties of flax in our experimental grounds during the past three years, namely, the Russian, the Manitoba, and the common Flax of Ontario. These all possess a blue flower and are much similar in character of growth, but there is a considerable difference in the size of the seed; the *Russian* variety being decidedly the largest and the common Ontario variety the smallest. In 1897 and in 1898, it was found that the Russian variety gave the best yield of seed per acre; the average being 15.6 bushels. In 1899. the experiment was not so satisfactory as in each of the two years previous, owing to the lack of the full germination of the seed on account of the exceedingly dry weather at the time of sowing and a second growth occuring after the rains came. In the average results for the three years, the Russian flax still occupies first place in yield of seed per acre.

Hemp (*Cannabis sativa*).

Hemp is supposed to be originally a native of the warmer parts of Asia, its wild locality extending from Syria to the mountains of India, in all of which districts it is met with at the present day in the natural state. It is now to be found both in a wild and in a cultivated state over the milder climates of Europe, over most of which country it is grown for its fibre and for its seed.

The subject of Hemp has not received very much attention in Ontario, but there are some enquires regarding it. Tho following quotation is taken from a letter just received from the vicinity of Leamington, Ontario: "Would you kindly give me what information you can in regard to growing Hemp. Is it grown in Canada, and where, and how is it treated for making rope? Also, do the binder twine factories use it in making twine?" We have done but little experimental work with this crop in our trial grounds. Hemp, however, has been tested in our plots for a few years, and has nearly always made a good growth. In 1899, Hemp grown on low land reached an average height of 56 inches, and that grown on high land reached an average height of 34 inches. The total crop was also considerably heavier on the low than on the high land, the yield in the former case being 3½ tons per acre. As birds are so very fond of the seed, it is difficult to determine the amount produced on the plots. Only eight bushels of seed per acre were harvested in the past season. We hope to give this plant more attention in the future.

Ramie, Rhea, or Rhea Grass (*Bœhmeria nivea*).

Ramie is a Chinese and East India perennial shrub which is said to grow on an average from four to six feet in height. Within the last twenty years it has been grown over a considerable part of the United States, and is said to furnish a large amount of forage of fair quality, which is eaten by all kinds of live stock. It is also grown for its fibre, which is secured from the stem and which is now coming into use for almost every purpose for which cotton is used.

We have sown Ramie in our trial plots for two years, but the germination of the seed has been very poor and the results so far have been quite unsatisfactory. It is quite probable that Ramie will not prove to be a success in Ontario, although we hope to secure seed in the future which will possess greater vitality than that which we have used hitherto.

Chufas, or Earth-Almonds (*Cyperus esculentus*).

The Earth-Almond is often cultivated on rich sandy loams with good success. It is a perennial plant which produces a great many edible tubers. The cultivated variety is a very fine flavored edible nut when well dried or parched. The crop, however, is usually fed to hogs, which are turned into the field and allowed to root up the plants and eat the tubers, which are said to be very rich in fattening properties. In experiments conducted in the growing of Chufas or Earth-Almonds in our experimental department in 1897 and in 1899, we found the plants to grow well. The average yield of the tubers or nuts per acre has been 22.6 bushels.

Field Pumpkins and Field Squashes.

The following varieties of field Pumpkins and field Squashes have been tested in the experimental grounds from one to three years: Rennie's Yellow Mammoth squash, King of the Mammoth pumpkin, Thorpe's Mammoth pumpkin, Mammoth Bright Red Etampes pumpkin, Mammouth Tours pumpkin, Rennie's Green Mammoth squash, Backbee's New Sandwich Island pumpkir, Large Cheese pumpkin, Grey Boulogne pumpkin, Hundredweight pumpkin, True Potiron, Large Mammoth Yellow Chili squash, Mammoth Whale squash, Thorpe's Yankee squash. These fourteen varieties are all advertised as being heavy yielders. The varieties were grown on heavily manured, and also on unmanured, land each year. The yields from the heavily manured land were very large, as compared with those from the land which received no manure. The varieties which produced the largest yields were as follows: In 1895, the King of the Mammoth pumpkin, Rennie's Yellow Mammoth squash, Thorpe's Mammoth pumpkin, Mammoth Tours pumpkins and the Mammoth Bright Red Etampes pumpkin; in 1898, Rennie's Yellow Mammoth squash, Mammoth Bright Red Etampes pumpkin, Thorpe's Mammoth pumpkin, Grey Boulogne pumpkin and Hundredweight pumpkin; and in 1899, Thorpe's Mammoth pumpkin, Large Mammoth Yellow Chili squash, Rennie's Yellow Mammoth squash: Mammoth Bright Red Etampes pumpkin, and Large Cheese pumpkin. Taking the average results for the three years, we find that the *Rennie's Yellow Mammoth Squash* produces

the heaviest yield per acre, that the Thorpe's Mammoth pumpkin comes second, and Mammoth Bright Red Etampes third, and the King of the Mammoth pumpkin fourth.

This information should prove of service to farmers who are growing pumpkins and squashes to feed stock, as the largest yielding varieties of both pumpkins and squashes appear to be of good quality; in fact, they are frequently used, and are considered valuable for culinary purposes, as well as for feeding to cows and hogs.

Sunflower. (*Helianthus annuus*).

The Sunflower is a tall, erect, stout, rough herb, which is grown more or less over the greater part of North America. Champlain found it growing in Lower Canada, where the natives grew it for the oil which they secured from the seed. The seeds, after being shelled, are said to contain 34 per cent. of oil, of which from 28 to 30 per cent. is said to be superior to both Almond and Olive oil for table purposes; and it is also used for making soap, candles, and for lighting. The cake which is left after the oil is extracted is used for feeding cattle. In some of the European countries the seed is used as a human food, and also as a food for sheep, pigs, and especially poultry. The flowers are used to produce a yellow dye; the leaves as a food for cows and also as a fertilizer; and the stalks for fuel, for fertilizing the land, and for the production of an excellent fibre when treated the same as flax.

We have grown no less than eleven varieties of Sunflowers in the Experimental department, and have found that nearly all the varieties have grown satisfactorily. The *Mammoth Russian* has been grown for seven years with an average total yield of 13.1 tons per acre. The average yield of heads of the Mammoth Russian for six out of the seven years has been 5.1 tons. The Black Giant has been grown for five years in succession, and has surpassed the Mammoth Russian variety in the total yield per acre by 1.3 tons, and in yield of heads per acre by 200 pounds in the average results for the five years. The White Beauty variety has been under experiment for the past three years, but the yield of the total crop and the yield of heads per acre have been less than those of the Mammoth Russian variety. The common Sunflower has given an average of 2½ tons of total crop per acre, and ⅘ of a ton of heads per acre less than the Mammoth Russian in the three years that these two varieties have been grown under similar conditions. The results of our experiments with Sunflowers up to the present time show that the *Black Giant* has given the largest yield per acre of total crop and also of heads, and that the Mammoth Russian occupies second place in point of yield.

Conclusion.

We have aimed to make all our work practical, accurate and reliable, and we hope that the record of the results here presented may be of some service in the advancement of agriculture in Ontario.

Respectfully submitted,

C. A. ZAVITZ,
Experimentalist.

Ontario Agricultural College,
Guelph, Dec., 30th, 1899.

PART XII.

MANAGER OF THE POULTRY DEPARTMENT.

To the President of the Ontario Agricultural College :

Sir,—I have the honor to submit herewith a brief report of the work, etc., in the Poultry department since the seventeenth of April last, when I commenced my duties as manager of the department.

I beg to thank you for the several improvements that have been made in our equipment during the year, especially the purchase of necessary appliances and the construction of a new incubator and brooder house. After the date at which I was appointed it was not possible to do much in the hatching of chickens. Hence there is nothing special to report under this head.

Summer Layers.

During the past season Brown Leghorns and Andalusians made the best record. The eggs from both varieties are white in color, but those from the Andalusians are much larger. The average weight of a dozen Andalusians was one pound ten ounces, while that of Brown Leghorn eggs was only one pound seven ounces. The great objection to the Andalusians is that they do not breed true to color : some are black, others mottled, and about sixty per cent. blue.

Early Winter Layers.

The Plymouth Rocks, the Wyandottes and the Langshans are doing best. They all lay medium-sized brown eggs, but the Langshan egg is the most uniform in color.

Feeding.

Morning ration.—Whole grain (wheat, barley and oats, but chiefly wheat,) scattered in the litter on the floor of the pens, care being taken that it was well mixed with the litter. The quantity fed was usually in the proportion of about one-half handful to each bird.

Noon ration.—Roots, such as mangels, sugar beets, turnips or carrots. About once a week they were cooked by way of variety.

Afternoon ration.—About 3.30 a mash, composed of equal parts bran, barley meal, ground oats, refuse bread and cut clover hay. During cold weather corn meal was given in addition. The clover hay was prepared by placing the amount thought sufficient in a vessel containing boiling water the morning previous, covering and allowing it to steam all day. The fowls were allowed what mash they would eat readily, which was about one quart to every twelve hens. If all the food was not readily eaten it was removed. Whole grain was boiled with vegetables and refuse meat, and fed as a change in the place of mash. After the mash, a small quantity of whole grain was fed in the litter to secure exercise and maintain good health. Cut bone was fed two or three times a week in the proportion of one pound to every fifteen birds. This was usually fed in the evening instead of the mash or the whole grain.

It is necessary to study the surrounding conditions as to convenience, expense, results aimed at, etc., before deciding what method of feeding will give best results.

Artificial Incubation.

Not having a proper incubating room, the manager hitherto has found the results from this method of hatching rather unsatisfactory. The machines have been operated in a small room into which the direct rays of the sun have shone, and the wooden floor of the room has been a thoroughfare from the front to the back of the main poultry building. Hence an uneven temperature, more or less jarring, and a small percentage of chickens.

Artificial Versus Natural Incubation.

Notwithstanding the unfavorable conditions, the percentage of chicks from the machines has been nearly equal to that from the hens, while much less labor has been required to care for the incubator than to look after the hens necessary to cover an equal number of eggs. A few hens have hatched the full percentage, but others have broken several of their eggs, and some have failed to remain on the nest the full twenty-one days.

Egg Preservation.

Several methods of preserving eggs were tried. The eggs for this purpose were taken early in July, and were tested during the latter part of December.

Method No. 1.—A solution was used composed of one part water-glass (sodium silicate) and six parts water. This was as strong a solution as would allow the eggs to sink and might therefore be termed a saturated solution.

The eggs from this solution were superior to all others, especially in flavor.

Method No. 2.—This was similar to that in No. 1, except that eight parts of water were used instead of six parts. These eggs were slightly inferior in flavor.

Method No. 3.—This was composed of ten parts of water to one part water-glass. The eggs from this solution were inferior to those from No. 1 both in flavor and poaching.

The results of these experiments do not coincide with those obtained by my predecessor; hence further work will be necessary before reliable conclusions are reached.

Method No. 4.—A lime solution, made as follows:

Two pounds of fresh lime were slacked in a pail and a pint of salt was added thereto. After mixing, the contents of the pail were put into a tub containing four gallons of water. This was well stirred and left to settle. Then it was stirred thoroughly the second time and left to settle; after which the clear liquid was poured over the eggs, which had previously been placed in a crock or tub. Only the clear liquid should be used.

The eggs from this pickle were inferior to those from the water-glass solution. They had a slight taste of lime.

Method No. 5.—The eggs were immersed in melted vaseline, after which they were packed in egg cases. When broken, the eggs appeared to be well preserved, but they had absorbed the very undesirable flavour of the vaseline.

Method No. 6.—Common salt was used, in which the eggs were placed, small ends downwards; and no eggs were allowed to touch the abjoining ones or the box. Only a small percentage of bad eggs was found; but they had all suffered a good deal from evaporation.

Method No. 7.—Good dry oats were used for this lot, in the same way as dry salt in No. 6. These eggs were musty, and had evaporated fully as much as those in the salt.

Method No. 8.—These eggs were immersed in pure water-glass and dried on a greased board, after which they were packed in an egg case. They were fairly well preserved, but lacked flavor.

This method necessitates a large amount of labor.

Raising Ducks.

Early in June, thirteen Pekin Ducks were hatched. These were divided into lots of six and seven each. Lot 1, six in number, were fed on a mixture of equal parts of bran, shorts, and corn meal, moistened with skim-milk. Lot 2, seven in number, were fed the same mixture, with the exception that the food was moistened with boiling water. After

the ducks were one week old, a small amount of animal meal was added to their ration. Lot 1 during the first six weeks consumed 90 lbs. of the mixture and 90 lbs. of skim-milk. They then weighed 25 lbs., or a little more than four lbs. each. Lot 2, during the same period, consumed 79 lbs. of the grain and 7 lbs of animal meal, and the lot weighed 21 lbs., or three lbs. each.

The following four weeks both lots received the ration which was fed to Lot 1. Both lots gained practically the same amount, the average weight of Lot 1 being six and one-half pounds each, and that of Lot 2, five and one-half pounds each. From this experiment it would appear that there is no advantage in mixing the food with boiling water. Before drawing final conclusions, however, it would be well to bear in mind that this is only one experiment and that it was conducted during a very warm, dry season of the year.

Fattening Chickens.

On October the thirteenth, one hundred and fifteen chickens were placed in small coops for fattening. They were carefully weighed when cooped, and again after being fed for five weeks, and the gain noted. Those of pure breeds and high crosses, representing the Plymouth Rock, Wyandottes, Brahma, and Langshan breeds, made an average gain of nearly two and one-quarter pounds each. Those representing the ordinary barnyard fowl gained only about one and three-quarters pounds each. Both lots received the same kind of food, and the general treatment was identical in every particular.

Feeding.—They were fed on a mixture of 3 parts of finely ground oats and one part buckwheat meal, moistened with skim-milk and placed in small V-shaped troughs arranged in front of the coops. They were given grit once a week and also a small feed of green cut bone. The bone appeared to have particular value in keeping the birds healthy. They were fed from the trough for four weeks, after which they were fed by means of the cramming machine for ten days. The food used in the machine consisted of very finely ground oats and skim-milk, to which was added about one pound of tallow for every seventy birds. They were allowed all the water they would drink. During the period of five weeks, the one hundred and fifteen birds consumed 910 lbs. of oats, 305 lbs. of buckwheat, 900 lbs. of skim-milk, and 9 lbs. of tallow ; and the total gain in flesh was 216 lbs.

Killing.—The birds were fasted thirty-six hours, in order to empty the crop and intestines before killing. They were killed by dislocating the neck and were immediately dry-picked. There is less work and less risk of tearing the flesh, if the plucking is done while the bird is warm.

Preparing for Market.—After being plucked the fowls were placed on the shaping board, which consists of a board about six inches wide fastened to the wall or other suitable board at an angle of about 65 degrees. As soon as plucked, the chicken was placed on this board or trough, the legs being laid alongside the breast, and the stern pushed against the wall. The breast was kept downwards and pressed into the shape of the trough by placing a glazed brick or other weight on top. When birds are left in this shape it gives them a more compact appearance and allows the blood to drain into the neck. The chickens were placed side by side in the trough and allowed to remain until thoroughly cool, when they were packed for shipment.

The crates used for packing were 33 inches long by 19 inches wide and 6½ inches deep, and usually held twelve birds. The ends and centre of the boxes were one inch thick ; the remainder of the box was five eights of an inch thick. The fowls were graded as to size. Before packing the bird should be wrapped in the best parchment paper, the neck and head projecting at one end and the feet at the other.

Feeding for Color.—Six grade Plymouth Rock pullets (full sisters) were divided into two equal lots. One lot was fed on a mixture of finely ground oats and buckwheat, which was moistened with skim-milk ; the other lot was fed on yellow corn, moistened with water. They were fed in this manner for eleven days, when they were killed and dressed. Those on the oat and skim-milk ration presented a creamy white appearance, while those fed on the yellow corn were of a deep yellow color. It will thus be seen that it is possible to supply customers of opposite tastes in regard to the color of flesh, from the same breed of fowl, by feeding different kinds of food.

Cramming Machine.

In forcing fowl for the British market, some feeders in this country and many on the other side of the Atlantic use a cramming machine during the last nine or ten days of the feeding period. Birds cannot stand it much longer.

For the information of those who have not seen such a machine I submit the following cut and description of the one which we use :

The crammer consists of a food reservoir, to the bottom of which is attached a small force pump actuated by a lever and treadle worked by the foot of the operator.

Cramming Machine.

Communicating with the pump is a nozzle, through which the food passes to the bird. A is the food reservoir. B the pump. E the pump rod. O is the lever which, on being depressed at the lettered end, causes the pump rod E, to which it is attached, to move downwards and to eject the contents of the pump B out at the nozzle K. On relieving the pressure at O, the lever and the parts connected therewith are drawn up by the spring C, until a motion is arrested by a stop M, which serves to determine the the quantity of food ejected at each depression of the treadle.

The charge may also be varied by arresting the pressure at any point in the downward thrust of the lever O.

The method of operating is as follows : Take the tube of the cramming machine in the right hand and the bird's head in the left, then with the assistance of the finger and thumb of the right hand, open the bird's mouth and slip the forefinger of the left hand into it and hold down the tongue,, quickly insert the end of the tube and push it down seven or eight inches, (according to the size of the bird), at this moment depress the right foot (which up to this time has been resting on the treadle) and force the contents of the cylinder into the bird's crop. If the crop be full enough the tube may now be withdrawn, taking care, however, to relieve the pressure on the treadle for a second or two before taking the tube out, otherwise a small quantity of food will continue to flow after the tube is removed. When not in use hang the nozzle over the edge of the food reservoir.

The advantages gained by using the cramming machine are :

(1) Birds can be made much fatter by the use of the crammer than by feeding in the ordinary way.

(2) The quality of the flesh is improved ; it is made more juicy and tender and is improved in flavor.

(3) The general appearance of the bird is improved, which is an advantage in the market.

The disadvantages are :

(1) The present cost of the machine is too high for general use. The machine for this department cost nearly thirty-five dollars. This price includes freight and duty.

(2) More labor is required in caring for the fowls when the machine is used.

(3) Inexperienced persons are apt to strangle birds by giving them too much feed or by failing to operate the machine according to directions.

(4) As a rule, ground oats require sifting before they are suitable for use in the machine, and many are so situated that they cannot get the very finely ground article.

Since writing my report, I have received from Mr. Ruddin, of Liverpool, an important communication regarding packages and the method of packing poultry for export. I believe the information given in the following letter to be of special value, considering that it comes from one of the largest and most successful dealers in England.

DEAR SIR : Liverpool, Jan. 6th, 1900.

Owing to the disarrangement of the postal service by the "war" I have not been able to communicate with you earlier.

Your poultry is very fine ; well fed and properly handled ; and the only points on which you failed to make a complete success of your initial venture, were the packing and the cases used.

When packing your poultry in the future, use for wrapping purposes the best parchment paper obtainable. Do not on any account put straw in any of the cases, as it will attract and hold moisture and will in consequence make your birds clammy, which it did in the present lot.

If you use parchment paper and carefully cover each bird, nothing else is necessary. If the box is too large for a dozen birds, put in thirteen, fourteen, or fifteen, but always fill it up. Do not make up space by using paper, excelsior or straw.

The cases used were only suitable for hard frozen poultry, for which purpose it is desirable to have the box as nearly airtight as possible. On the other hand, chilled poultry requires cases made with inch openings left between each board that goes to make up the top, bottom, and sides.

Yours truly,

JAS. RUDDIN.

I may add that the brown paper used for wrapping was the same as that recommended by Prof. Robertson, and the boxes were made of well seasoned wood, with half inch openings between the boards. No doubt the dampness caused them to swell so as to bring them nearly together.

ONTARIO AGRICULTURAL COLLEGE,
GUELPH, Dec. 30th, 1899.

W. R. GRAHAM,
Manager Poultry Department.

PART XIII

LECTURER ON APICULTURE.

To the President of the Ontario Agricultural College:

SIR,—Herewith is submitted for your consideration my first report of the department of Apiculture.

This report, in view of the fact that I was appointed in November merely to deliver a short course of lectures occupying less than a month's time, must necessarily be confined to the work done during that period. Replying to your memorandum specifically:

I delivered 18 lectures to each division, viz., A and B, of the First Year. The lectures dealt with the following divisions of the subject:

1. Physiology of the honey bee.
2 and 3. Explanation of brood rearing.
4. The handling of bees and description of the various conditions in which colonies are expected to be found in the first week or so of May.
5. Fertile workers. Introducing queens. Building up by stimulative feeding and spreading of brood.
6. Spring flowers useful for building up. Poisoned, chilled, and foul brood.
7. The prevention of early swarming by giving ventilation and room. Returning early swarms.
8. Buying and moving bees. Preparing for clover flow. The commercial honey plants.
9 and 10. Swarming.
11, 12, and 13. The taking of extract and comb honey.
14. Storage and marketing of honey.
15. Construction of hives and appliances by bee-keepers. Building up, uniting and feeding back for wintering.
16. Cellar wintering.
17. Outside wintering. Queen rearing.
18. Resumé of the essentials of successful bee-keeping, giving each its relative importance.

Of course, there was no practical work in November or December.

From the nature of the subject I have been able to follow only in part note 3 of College Circular, p. 23. I have set a written examination in Apiculture.

Far more interest was shown in the lectures than I had expected to find. Many of the students had dabbled more or less with bees at home and were eager to obtain the information necessary for the scientific management of an apiary. From the questions asked, I should judge that they were acquiring the details with considerable accuracy. Of the remainder who had had no experience whatever with bees, several were indifferent, but the great majority really sought information. It did not appear at all to be forced upon them. Some have a pretty clear conception, and others more or less hazy impressions, on this subject, according to the capacity and interest of the student.

I have, in these lectures, detailed a simple and scientific system of bee-keeping, taking up the conditions of colonies in the beginning of the season and following them through the year; I showed what operations were to be performed and what difficulties were to be met with at each part of the season. I avoided as far as possible the division of the subject into chapters, after the manner of books, but have followed the same order as if I were handling an apiary from the beginning of the season to the end. If a student has taken full notes, he may with considerable confidence assume the responsibility of managing a few colonies during his first season. He will have at his command the little hints and scraps of information not to be found in books, and which may not be obtained in perhaps ten years' experience. The student must acquire facility in managing an apiary by several years' experience. This cannot be obtained here unless a large apiary is maintained on the Farm and the students remain at the College during the summer months.

I have furnished information to correspondents, and expect to conduct some experiments in my own apiary during the coming summer.

Respectfully submitted,

H. R. ROWSOM.

GUELPH, December 18th, 1899.

PART XIV.

COLLEGE PHYSICIAN.

The President of The Ontario Agricultural College :

SIR,—A few days ago I received from you a communication requesting me to present my report for the year now ending. In performing this duty I need not make any observations to you on the marked increase of attendance at the College, with its consequent addition to the work of the physician.

You are aware that during the early part of the year the weather was exceptionally severe, and that in this section of the Province at least an unusual proportion of the population suffered from sickness, and that this condition of the public health applied to the College. In addition to the minor accidents and the many forms of slight ailments with which we had to deal, I regret to say that there occurred among the students a number of cases of rather grave illness, requiring treatment in the hospitals of this city, where under the excellent nursing of these worthy institutions all recovered : I might mention among such cases, one of pneumonia, on of severe septicaemia, one of appendicitis, and one of fracture of lower jaw.

On the occasion of my annual inspection of the College premises I noted with pleasure the improvement in the heating of the more exposed bed rooms which are further protected from cold by outside or storm windows with an aperture in the bottom of the sash for purpose of ventilation. In these rooms the warmth is now all that can be desired, but I am not sure that the ventilation is adequate.

Another matter concerning the health of the students came under my notice at that time. I refer to the condition of the swimming bath—to the need that exists there, for renewal of the present flooring or its replacement by something more suitable, for some means of preventing students from coming in contact with the heating pipes and for improved ventilation and admission of more light. In my opinion, swimming as an exercise is not fully appreciated and should be encouraged, and in connection with this matter I respectfully suggest that there be placed in conspicuous places about the bath illustrations of the best means of rescuing the drowning and resuscitating the apparently drowned.

In closing my report I am glad to say that the general sanitary condition of the College is excellent.

Respectfully yours,

W. O. STEWART,

College physician.

GUELPH, Dec. 30, 1899.