TWENTY-THIRD ANNUAL REPORT

OF THE

ONTARIO AGRICULTURAL COLLEGE

AND

EXPERIMENTAL FARM.

1897.

(PUBLISHED BY THE ONTARIO DEPARTMENT OF AGRICULTURE.)

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1898.

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TWENTY-THIRD ANNUAL REPORT

OF THE

ONTARIO AGRICULTURAL COLLEGE

AND EXPERIMENTAL FARM,

FOR THE YEAR 1897.

GUELPH, January 1st, 1898.

To the Honorable JOHN DRYDEN,
Minister of Agriculture:

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

In this report, the work of the year 1897 has been briefly reviewed under the following heads:

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

JAMES MILLS,
President.

THE ONTARIO AGRICULTURAL COLLEGE

AND

EXPERIMENTAL FARM, GUELPH, ONT.

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

JAMES MILLS, M.A., LL.D.	President
J. H. PANTON, M.A., F.G.S. (*died Feb. 2, 1898*)	Professor of Biology and Geology
A. E. SHUTTLEWORTH, B.A.Sc.	Professor of Chemistry
J. H. REED, V.S.	Professor of Veterinary Science
H. H. DEAN, B.S.A.	Professor of Dairy Husbandry
WM. RENNIE,	Farm Superintendent
C. A. ZAVITZ, B.S.A.	Experimentalist
G. E. DAY, B.S.A.	Agriculturist
H. L. HUTT, B.S.A.	Horticulturist
F. C. HARRISON, B.S.A., (who has charge of Library)	Bacteriologist
J. B. REYNOLDS, B.A.	Lecturer in English and Physics
J. F. CLARK, B.S.A.	Resident Master
R. HARCOURT, B.S.A.	Assistant Chemist
L. G. JARVIS	Manager and Lecturer in Poultry Department
R. F. HOLTERMANN	Lecturer in Apiculture
CAPTAIN WALTER CLARKE	Instructor in Drill and Gymnastics
W. MCCALLUM, B.S.A.	Fellow in Bacteriology
T. F. PATERSON, B.S.A.	Fellow in Biology
P. W. HODGETTS, B.S.A.	Assistant Librarian
W. O. STEWART, M.D.	Physician
G. A. PUTNAM	Stenographer
A. MCCALLUM	Bursar

ADVISORY BOARD.

JOHN I. HOBSON, *Chairman*	Guelph, County of Wellington
JOHN MCMILLAN, M.P.	Seaforth, County of Huron
EDWARD JEFFS	Bradford, County of Simcoe
G. B. BOYCE	Warkworth, County of Northumberland
D. A. DOWLING	Appleton, County of Carleton
WM. DONALDSON	South Zorra, County of Oxford
C. C. JAMES, *Secretary*	Deputy Minister of Agriculture, Toronto

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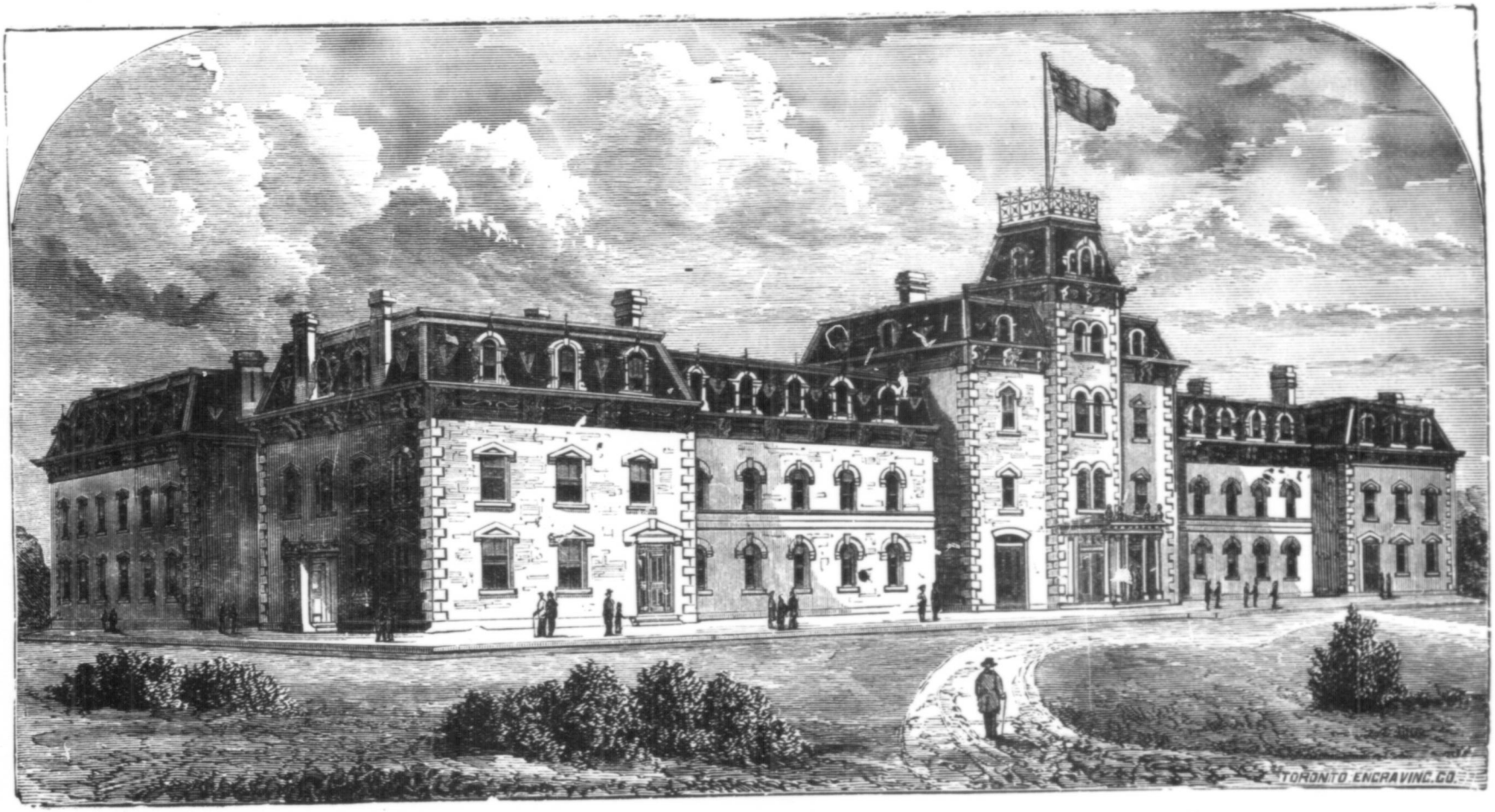


MAIN BUILDING—ONTARIO AGRICULTURAL COLLEGE, GUELPH.

MAIN BUILDING—ONTARIO AGRICULTURAL COLLEGE, GUELPH.

PART I.

REPORT OF THE PRESIDENT.

The steady progress of a nation in times of peace and prosperity is not so clearly marked from year to year as is the condition of things when there is domestic disturbance or foreign complications. It is so with an institution; and the Ontario Agricultural College is no exception to the rule. For some time past its history has been characterized by uninterrupted peace and prosperity, and for that very reason its condition has not been so definitely and adequately set forth as in the earlier days. For the last four years especially it has moved steadily forward without a solitary jar of disturbance or agitation; in fact the machinery has worked so smoothly, quietly and effectively, that people have scarcely been aware of its movement. It is, of course, true that we are well watched now as at other times; we are severely criticized once a year; and we are often misrepresented; but these things do not seem to influence the body politic very much so long as the officers of the College are united among themselves, mind their own business, and keep pushing ahead.

The past year has been one of honest work, perfect harmony, and satisfactory progress throughout the departments of the institution, separately and in their relation to one another; and, in justice to the officers under me, it may be said that they are earnestly endeavoring to educate thoroughly the young men who come to the College, and as zealously striving to serve in every way possible the farmers of the Province at large.

Some who have gone forth from our halls, like a considerable number of "old boys" from other schools and colleges, are not doing so well as they should; but the great majority of those who have been with us long enough to get a fairly thorough knowledge of our course of study and apprenticeship, are giving a good account of themselves at home and abroad. They have gone back to work with an increased liking for farm life; they are pushing to the front as practical, progressive men; and, wherever you find them, they are warm friends of the College at Guelph. Of the students now in attendance, over ninety-five per cent. came on the express recommendation of ex students.

Students in Attendance.

The attendance of students during the fall term of the year just closed—1st October to 22nd December—was 27 more than during any previous term since the College was opened, 23½ years ago. At the present time every bed in the Residence is occupied and 27 students are lodging outside, most of them in the immediate neighborhood of the College. The total number on the roll in 1897 was 275—212 in the regular course, and 63 in the special dairy course, the great majority being Ontario farmers' sons of the very best class.

County Students.

By Act of Parliament, each county council in the Province has power to send one student free of tuition. Of those on the roll in 1897, 60 were nominated by county councils, and as a consequence were exempted from the payment of tuition fees. The counties which exercised the power of nomination last year (42 in number) were the following: Algoma, Brant, Bruce, Carleton, Dufferin, Dundas, Durham, Elgin, Essex, Frontenac, Glengarry, Grenville, Grey, Haldimand, Halton, Hastings, Huron, Kent, Lambton, Leeds, Lennox, Lincoln, Middlesex, Norfolk, Northumberland, Ontario, Oxford, Parry Sound, Peterboro', Peel, Perth, Prescott, Prince Edward, Renfrew, Simcoe, Stormont, Victoria, Waterloo, Welland, Wellington, Wentworth, and York.

Analysis of College Roll.

1. *General Course.*

(1) From Ontario.

Counties, etc.	Students.	Counties, etc.	Students.
Algoma	2	Middlesex	7
Brant	6	Norfolk	3
Bruce	3	Northumberland	7
Carleton	2	Ontario	5
Dufferin	1	Oxford	3
Dundas	1	Parry Sound	4
Durham	3	Peel	2
Elgin	2	Perth	4
Essex	2	Peterborough	2
Frontenac	4	Prescott	3
Glengarry	3	Prince Edward	2
Grenville	2	Renfrew	1
Grey	6	Russell	4
Haldimand	2	Simcoe	8
Halton	1	Stormont	1
Hastings	4	Victoria	5
Huron	5	Waterloo	4
Kent	2	Welland	3
Lambton	4	Wellington	12
Lanark	2	Wentworth	6
Leeds	6	York	6
Lennox	2	Toronto	15
Lincoln	5		179
Manitoulin Island	2		

(2) From Other Provinces of the Dominion.

Provinces.	Students.	Provinces.	Students.
Manitoba	2	Prince Edward Island	2
North-West Territory	1	Quebec	8
Nova Scotia	3		16

(3) From Other Countries.

Countries.	Students.	Countries.	Students.
Bermuda	2	United States	1
England	12		17
Scotland	2		

Total in General Course 212

2. *Dairy Course.*

Counties, etc.	Students.	Counties, etc.	Students.
Bruce	2	Oxford	8
Carleton	1	Perth	3
Dufferin	1	Prince Edward	1
Durham	1	Russell	1
Dundas	2	Simcoe	1
Elgin	2	Stormont	1
Grey	2	Victoria	2
Grenville	7	Wellington	7
Huron	3	Wentworth	1
Leeds	3	England	1
Lincoln	2	Ireland	1
Middlesex	2	North-West Territory	1
Norfolk	1	United States	1
Northumberland	2		63
Ontario	3		

Age of Students in General Course.

1	14 years of age.	20	23 years of age.
3	15 "	7	24 "
13	16 "	4	25 "
26	17 "	2	26 "
37	18 "	3	27 "
33	19 "	2	28 "
19	20 "	2	29 "
18	21 "	1	30 "
20	22 "	1	31 "

Average age of Students in General Course..... 20
" " Dairy " 23

Religious Denominations.

(1) Students in General Course.

Methodist	67	Brethren	3
Presbyterian	65	Congregationalists	2
Episcopalians	55	Christadelphian	1
Baptists	8	Unitarian	1
Roman Catholics	6		212
Friends	4		

(2) Students in Dairy Course.

Methodists	32	Baptists	4
Presbyterians	12	Catholics	4
Episcopalians	11		63

English.

There is no subject in our course of study which receives more careful attention than English. The early education of many of our best students has been very much neglected; and it is only by the most persistent and painstaking drill in grammar, composition, and literature that we succeed in making such students fairly correct and proficient in the use of their mother tongue, without which they cannot hope to hold their own in the fierce struggle and intenseley keen competition of these times.

We continue the study of English from the beginning to the end of our course.

Physics.

During the last few years, we have made a distinct advance in the subject of physics. The work done in this department—including mechanics, hydrostatics, hydrodynamics, thermodynamics, electricity, and agricultural physics—is much broader and more practical

than formerly. Owing to the enterprise and liberality of the Minister of Agriculture, we now have a separate physical laboratory, which is fairly well equipped for practical demonstration and instruction in the various branches under this head, especially in the study of soil moisture and the functions of the different constituents which enter into the composition of soil; and, with an able and energetic physicist, we hope before long to obtain valuable information regarding the physical characteristics of Canadian soils.

Biology.

Our work in biology, especially in zoology, is much more thorough and practical than it was a few years ago. A great deal more is required of students in this department than formerly. The whole field of botany, in all its branches, is now covered; and the laboratory practice in zoology has become an important part of the course prescribed for third year students. The work in biology is quite enough for one man. The United States agricultural colleges, almost without exception, have a man for biology and another for entomology; but hitherto we have had only one man for biology, entomology, and geology. Our Professor Panton, who is now very ill, has done the work for some time; but of late years the correspondence about noxious weeds and insects has been so large and has called for so much careful observation and research, that he has frequently complained of being unable to do justice to all that has been allotted to him: lectures in botany, zoology, entomology, and geology; laboratory work with students in botany and zoology; and an extensive correspondence on weeds and insects—work similar to that done by Dr. Fletcher of the Dominion Experimental Farms.

In consequence of the increased number of students and the extension of the practical work in botany, we found it necessary to enlarge our botanical laboratory, which we did last summer by putting a second storey on the boiler house attached to the building. By this alteration, we secured an additional room, 18 by 20 feet, for microscopic and seminary work.

Chemistry.

Early in May, our chemist, Prof. A. E. Shuttleworth, went to Gottingen, Germany, to do some work in organic chemistry, and to familiarize himself with the methods of investigation in the German agricultural Experiment Stations. In his absence, R. Harcourt, B.S.A., his assistant, delivered the lectures required in the department and took charge of the students in the qualitative and quantitative laboratories; and W. A. Kennedy, B.S.A., was employed to do Mr. Harcourt's analytic work in the laboratory.

Some valuable work was done in the laboratory during the year. A number of digestion experiments were made, to determine the feeding value of clover, timothy, and lucerne, cut at different stages of their growth; the analysis of ashes was continued from last year; and forty odd samples of sugar beets from the neighborhood of Owen Sound were analysed, to assist the people along the Georgian Bay in reaching a conclusion as to whether sugar can be profitably manufactured from beets grown in that locality.

Veterinary Science.

Nothing worthy of special notice has occurred in this department during the past year. Generally speaking, our stock has been healthy; and the work of instruction has gone on as usual.

Dairying.

Our Dairy School opened on the 14th January and continued in session till the end of March, a period of two and a half months. In 1898, the session will be three months —from the 4th January to the 31st March. Hitherto the attendance at the school has

been satisfactory ; but it would, no doubt, have been larger if the session had been shorter. Young men are anxious to get certificates and diplomas in as short a time as possible, and are not disposed to spend ten to twelve weeks at Guelph if they can get certificates elsewhere in less than half the time.

From the close of the school to the end of the year—during nine months—two of our men are engaged in experimental work, Mr. T. C. Rogers in the home dairy and Mr. R. W. Stratton in the cheese room, both working under the head of the department and endeavoring to solve some of the many problems which confront those who are anxious to make first-class butter and cheese. Much valuable work along these lines has been done during the past year. Difficulties have been removed and obscure points made plain.

Agriculture.

Very few agricultural colleges have given as much prominence as the Ontario Agricultural College has given to the department of agriculture proper, including live stock. From the first, we have laid special emphasis on the work of this department, requiring all our students to take three lectures a week, with a large amount of practical work, throughout the first two years of the course, and specialists who choose the agricultural option to devote three or four hours a week to that subject in the third year. We have done so because we think the first duty of an agricultural college, and perhaps the chief one, is to make first-class practical farmers.

During the past year, the work of instruction and management in this department was done by two men. Mr. G. E. Day, our agriculturist, delivered the lectures on field agriculture and live stock, conducted the class-room drill in examining and judging cattle and sheep, did similar work with swine in the pens, looked after pedigrees and stock registers, and took charge of experiments in feeding cattle, sheep, and hogs. Mr. William Rennie, farm superintendent, devoted his time to the management of the farm and live stock, giving close attention to the minutest details and pushing the work ahead with as much zeal and persistency as if he were in charge of his own farm. I feel that I cannot speak too strongly in praise of Mr. Rennie's devotion to his work as Farm Superintendent ; and I must not forget to state that, during the year, he has given the students a number of very valuable lectures on his methods of cultivating and preparing the soil for different crops. I am now warranted in saying that our farm is in good condition, well tilled and economically managed.

Horticulture.

The work in our horticultural department is extending from year to year. Mr. Hutt, our horticulturist, set out a large new orchard last spring, to test certain varieties of apples, pears, plums, and cherries in this cold and trying locality ; and he continued his strawberry experiments on a very extensive scale. He has had 150 varieties under test, and has given the results in a concise and interesting form.

Bacteriology.

Of late years, a great deal of attention has been given to bacteriology. People are just beginning to realize how vast and important the subject is—important, because of the relation of bacteria to the growth of plants, the health of animals, and the food of man and beast. They abound in earth, air, and water, causing fermentation, putrefaction, and disease. A number of the worst species are found in sewers ; and various disease-producing types are usually present in foul air and impure water.

As an outcome of this tuberculosis agitation, the Minister of Agriculture decided about a year ago to provide for the manufacture of tuberculin in our laboratory. The necessary apparatus was ordered at once, and our bacteriologist soon got things in shape

to commence work. The first fourteen doses were sent out about the end of May ; and since that time the demand has increased so rapidly that we have found it necessary to order an additional incubator and add a room to the laboratory. With these additions, we hope to be able to supply what is required in the province.

Some original work has also been done during the year. A considerable amount of time has been devoted to foul brood in bees and to the bacteriological examination of milk, cheese, etc.

Field Experiments.

The work in this department is growing in importance from year to year. The experiments with varieties of wheat, oats, barley, peas, corn, turnips, mangels, potatoes, carrots, green fodders, grasses, clovers, mixtures of grain, etc., have been carried on systematically and persistently on well defined lines for seven or eight years, on plots in different parts of our fifty-acre field, and under climatic conditions which have varied with the years. Hence the results now begin to indicate very clearly which varieties are best adapted to the soil and climate of the College farm ; and the co-operative experiments throughout the Province, carried on simultaneously by the College Experimental Union (largely under the direction of our experimentalist) go to show that the varieties which have done best at the College, give the best results all over the Province.

In this way some excellent foreign varieties have been introduced, tested, and distributed throughout the Province—varieties which yield from six to eight bushels per acre more than any varieties previously grown. *In oats and barley alone, the varieties introduced and distributed by our experiment station have, within the past four or five years, paid to the Province a good deal more than the entire cost of the College for the last ten years.*

Bird and Bee Departments.

We have a course of lectures, with suitable illustrations, by R. F. Holtermann, of Brantford, for first and second year students in the spring term. The most important practical points in bee-keeping are set forth and emphasized in these lectures ; samples of hives, foundation, comb, etc., are exhibited ; and some of the best breeds of bees are examined and studied while at work in a few hives which we keep for the purpose. The experimental work of this department is done by Mr. Holtermann in Brantford.

Further use has shown our poultry buildings to be satisfactory in their structure and arrangement ; but the yard room allowed in our first plan has been found insufficient. Hence we have fenced in a considerable addition immediately behind the yards first enclosed. The more room fowl have for outside runs, the better.

The work in the poultry department has gone on as usual. The stock is in good condition and looks well. A fair number of chickens was raised during the year ; but the results from our incubators were by no means satisfactory ; and the regulation forbidding us to sell by private sale made the financial showing of the department much less satisfactory than it would have been. Persons wishing to select and prepare fancy birds for shows, will not wait and run their chance of getting them by auction. When buyers find what they want, they will pay a good price for it, if they can get it at once. If not, they will go elsewhere. We have had to refuse some excellent offers for birds which were afterwards sold at very low prices by auction.

Some experimental work was done in testing the keeping qualities of fertile and infertile eggs, and in crossing certain breeds and varieties of fowl.

Other Departments.

The usual routine of work throughout the year has been faithfully done by the College physician, the bursar, the instructor in drill and gymnastics, and the foremen in the different departments of the institution.

Water Works.

Our water works are now in very good shape. By a great deal of labor and at considerable expense, we have at length succeeded in getting all the water we require for the daily use of the different departments of the institution and for fire protection, with engine, supply pumps, fire pump, a reservoir 100x63x10 feet in front of the chemical laboratory, pipe connections, hose, reels, and ladders—all complete.

Other Permanent Improvements.

Several other additions to our permanent equipment have also been made during the year—a new sixty-foot brick chimney at the dairy department, to take the place of two iron smoke stacks which fell from the effects of rust and storm; a small house to protect the milking machine; a rope drive from the dairy engine to the dairy cattle barn, with shafting, etc., to drive the milking machine and cut feed for cattle in the dairy and experimental feeding stables: a cement floor in the dairy piggery; a six-foot close mesh wire fence around a large addition to the poultry yards; an 18x20 foot addition to the biological laboratory; the moving of a partition with the addition of a space 4x36 feet to our bacteriological laboratory, and expensive tables for the students' section thereof; iron staging about 3x180 feet and 8x60 feet, to take the place of decayed wooden staging in the tropical section of our greenhouses; and a cheap house to protect our fire hose, reels, etc., until a building suitable for the purpose can be erected.

Visitors.

We have been favored with a very large number of visitors during the past year—the usual quota from day to day, between 18,000 and 19,000 excursionists in the month of June, and the teachers and students of the Toronto Normal School in the latter part of September. These visitors, especially those who come on farmers' excursions, examine very closely our buildings, laboratories, apparatus, farm, garden, stock, etc.,; and the great majority, irrespective of political leanings, express themselves as well pleased with what they see.

Eastern and Western Dairy Schools.

These schools have done good work during the past year. The Eastern School being in a fine dairy section of the Province, and giving a good course of instruction, the attendance in 1896 was more than could be properly accommodated, especially in the milk testing and butter departments. Hence, in the summer of 1897, a contract was let for the enlargement of the building. The additions and alterations, which were completed about the first of October, furnished the necessary accommodation and left things in a good shape for the session commencing in November, 1897. As a result of these changes and other causes, the number of applications for admission to the courses of the present session is much larger than at any time in the past.

The Western School, at Strathroy, was run as a creamery during the summer, in order that both instructors and students might have experience of actual factory conditions and the difficulties which arise in handling large quantities of milk in warm weather. The results were, I believe, quite satisfactory to the patrons; but the attendance of students was not such as to indicate any general demand for dairy instruction in that part of the Province.

Class-Room Work.

The class-room work in the different departments has gone on as usual. Nine candidates wrote for the B. S. A. degree in the University of Toronto. Six received diplomas and one was starred in chemistry. A fair proportion of first and second year students gained a respectable standing in our College examinations; but the percentage of failures is still very large, resulting in some cases from idleness, but in most instances from a lack of proper training in the elementary branches of an English education.

Examiners.

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

Bachelors of the Science of Agriculture.

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

*Cass, L. H	L'Orignal, Prescott, Ont.
Gamble, W P	Cumberland, Russell, Ont.
Hodgetts, P. C	St. Catharines, Lincoln, Ont.
Macdonald, J. C	Lucknow, Huron, Ont.
Oastler, J. R	Featherston, Parry Sound District, Ont.
Parker, F. A	Bowmanville, Durham, Ont.
Rogers, C. H	Grafton, Northumberland, Ont.

*Starred in Chemistry of the general course.

Recipients of Associate Diplomas.

Twenty-four having completed our regular course of two years, were examined for associate diplomas. Twenty-one passed in all the subjects and three were starred in certain branches. The diplomas were presented by the Hon. John Dryden, Minister or Agriculture, at the annual closing exercises on the 30th June. The names and addresses of the recipients are as follows:

Beam, E	Black Creek, Welland, Ont.
Clark, G. H	Cainsville, Brant, Ont.
Craig, R. D	O. A. C., Guelph, Ont.
Davis, A. N	Cayuga, Haldimand, Ont.
Elliott, W. J	Seaforth, Huron, Ont.
Fairweather, F. H	Alma, Wellington, Ont.
Heartz, W. B. G	Spring Hill, Nova Scotia.
Lloyd-Jones, T	Burford, Brant, Ont.
Lucas, W. T	Bailieboro, Northumberland, Ont
Mooney, J. A	Inverness, Megantic Co., P. Q.
Morgan, G. W	Kerwood, Middlesex, Ont.
McCalla, G. B	St. Catharines, Lincoln, Ont.
McKinley, W. W	Seeley's Bay, Leeds, Ont.
*McMillan, M J	Newmarket, York, Ont.
Reade, J. M	Toronto, Ont.
Richardson, E L	Toronto, Ont.
Robertson, T. H	Kingston, Frontenac, Ont.
Ross, H. R	Gilead, Hastings, Ont.
Ross, M. N	Warrington, England.
Ross, N. M	Warrington, England.
Squirrell, W. J	O. A. C., Guelph, Ont.
Summerby, W. L	Russell, Russell, Ont.
*West, A. W	Shelly Bay, Bermuda.
*Winchester, G	Toronto, Ont.

*To take supplemental examinations:—McMillan, in Literature; West in Literature and Electricity; Winchester in Literature.

First-Class Men.

The work of the College is divided into five departments; and all candidates who get an aggregate of seventy-five per cent. of the marks allotted to the subjects in any department, are ranked as first-class men in that department. The following list contains the names of those who gained a first-class rank in the different departments at the examinations in 1897, arranged alphabetically:

First Year.

1. *Anderson, J. B.*, St. Marys, Ont., in one department: Mathematics.

2. *Jarvis, C. D.*, Guelph, Ont., in two departments: Agriculture and Veterinary Science.

3. *Kennedy, W. J.*, Vernon, Ont., in three departments: Agriculture, Natural Science and Mathematics.

4. *Marshall, F. R.*, Westbrook, Ont., in two departments: Natural Science and Mathematics.

5. *Price, W. J.*, Marsville, Ont., in five departments: Agriculture, Natural Science, Veterinary Science, English and Mathematics.

6. *Raynor, M.*, Rose Hall, Ont., in two departments: Agriculture and English.

7. *Zavitz, H. V.*, Coldstream, Ont, in one department: Mathematics.

Second Year.

1. *Clark, G. H.*, Cainsville, Ont., in one department: Veterinary Science.

2. *Craig, R. D.*, Guelph, Ont., in five departments: Agriculture, Natural Science, Veterinary Science, English and Mathematics.

3. *McCalla, G. B.*, St. Catharines, Ont., in two departments: Natural Science and English.

4. *Reade, J. M.*, Toronto, Ont., in one department: Natural Science.

5. *Ross, H. R.*, Gilead, Ont., in two departments: Agriculture and English.

6, *Summerby, W. L.*, Russell, Ont., in three departments: Natural Science, English and Mathematics.

Medals.

Gold Medal.—George Bruce McCalla, St. Catharines, Lincoln, Ont.

Governor-General's Silver Medal.—H. R. Ross, Gilead, Hastings Co., Ont.

Second Silver Medal, Equal.—E. Beam, Black Creek, Welland Co., Ont.; J. M. Reade, Toronto, Ont.

Roland Craig, O. A. C., Guelph, Ont., 1st in Competition for Medals; W. L. Summerby, Russell, Russell Co., Ont., 3rd in Competition for Medals.—Both ruled out by special regulations.

The George A. Cox Scholarships.

First Year.

1. *Agriculture, Live Stock, Dairying, Poultry, and Apiculture.*—W. J. Kennedy, Vernon, Dundas Co., Ont.

2. *Natural Science.*—W. J. Price, Marsville, Dufferin Co., Ont.

3. *Veterinary Science.*—C. D. Jarvis, O. A. C., Guelph, Ont.

4. *English.*—M. Raynor, Rose Hall, Prince Edward Co., Ont.

5. *Mathematics.*—J. B. Anderson, St. Marys, Perth, Ont.; F. R. Marshall, Westbrook, Frontenac, Ont,—Equal.

Second Year.

1. *Agriculture, &c.*—Not awarded.
2. *Natural Science.*—G. B. McCalla, St. Catharines, Lincoln, Ont.
3. *Veterinary Science.*—W. G. B. Heartz, Halifax, Nova Scotia.
4. *English.*—H. R. Ross, Gilead, Hastings, Ont.
5. *Mathematics.*—R. D. Craig, O. A. C., Guelph, Ont.

PRIZE MEN.

First Year.

Agriculture, Live Stock, Dairying, Poultry, and Apiculture—1st, W. J. Kennedy; 2nd, M. Raynor.

Natural Science.—1st, W. J. Price; 2nd, W. J. Kennedy.

Veterinary Science.—1st, W. J. Price; 2nd, C. D. Jarvis.

English Literature, Grammar, and Composition.—1st, W. J. Price; 2nd, M. Raynor.

Mathematics, Book-keeping, and Drawing.—1st, W. J. Price; 2nd, W. J. Kennedy.

General Proficiency.—1st, W. J. Price; 2nd, W. J. Kennedy; 3rd, M. Raynor; 4th, F. R. Marshall; 5th, J. B. Anderson, St. Marys, Perth, Ont.

Second Year.

Agriculture, Live Stock, Dairying, Poultry, and Apiculture.—1st, H. R. Ross; 2nd, R. D. Craig.

Natural Science.—1st, R. D. Craig; 2nd, J. M. Reade.

Veterinary Science.—1st, G. H. Clark, Cainsville, Brant, Ont.; 2nd, R. D. Craig.

English Literature, Theses, and Political Economy.—1st, R. D. Craig; 2nd, G. B. McCalla.

Mathematics, Physics, and Electricity.—1st, W. L. Summerby; 2nd, R. D. Craig.

General Proficiency.—1st, R. D. Craig; 2nd, G. B. McCalla; 3rd, W. L. Summerby; 4th, H. R. Ross; 5th, E. Beam and J. M. Reade, equal; 7th, W. B. G. Heartz, Spring Hill, Nova Scotia.

VALEDICTORY PRIZE.

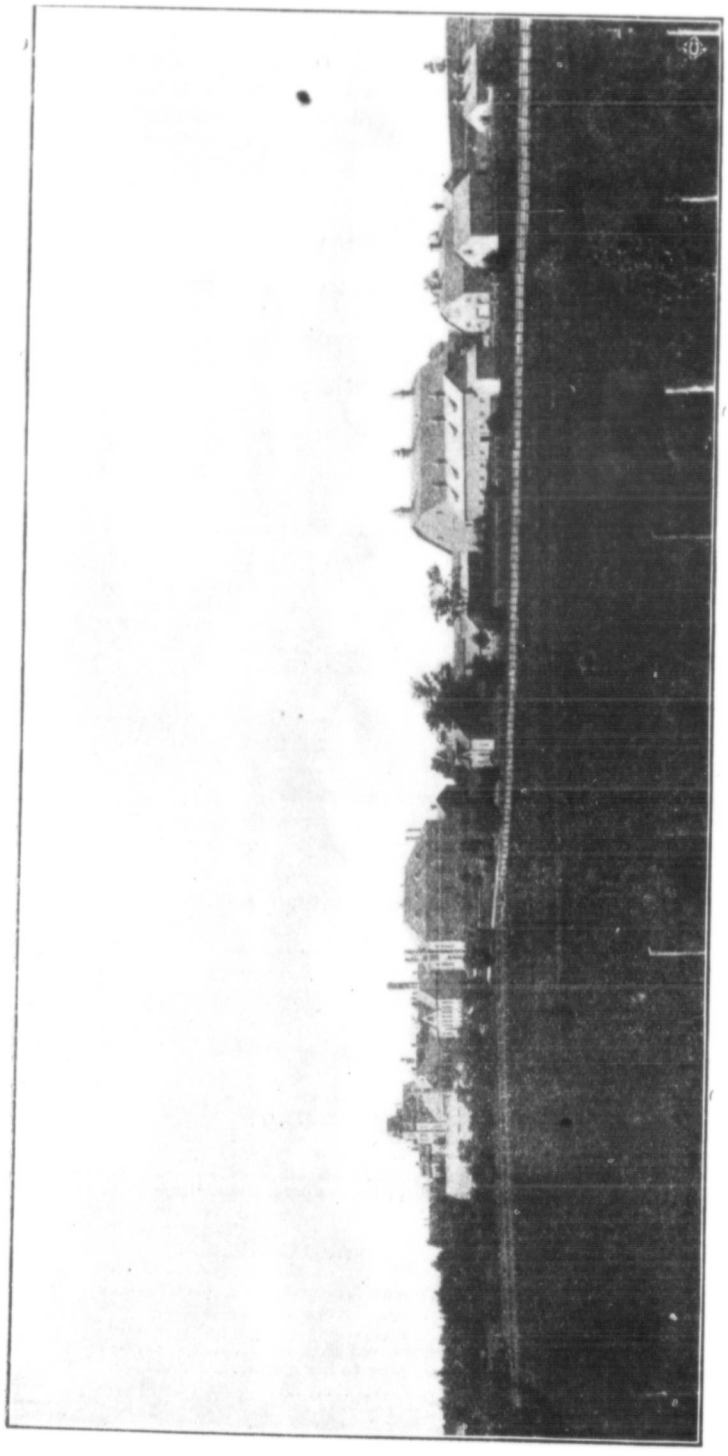
A prize of $10 in books is offered annually to the second year students for a valedictory address. The subject last year was "The Live Stock Industry in Ontario," and the prize was awarded to H. R. Ross, Gilead, Hastings Co., Ont.

CLOSING EXERCISES.

Our closing exercises for the year took place on the 30th June. The weather was fine and the attendance of visitors large. The Hon. John Dryden presented the diplomas and spoke briefly on the work of the College. Rev. Dr. Potts also favored us with his presence, and delivered an address suitable to the occasion.

NEEDS.

Institutions which keep abreast of the times in scientific research are constantly reaching out and pressing forward; and the wants of such institutions are numerous. This is specially true of an agricultural college, because it has to do with the whole field of physical science.



Ontario Agricultural College and Experimental Farm, General View.

Within the last few years, large additions have been made to our equipment and, as a consequence, our work is broader and more thorough than at any time in the past; but our request is still for more. The attendance of students having increased beyond our residential accommodation, it becomes necessary for us to consider the question of enlarging our buildings. Something should be done at an early date; and my own judgment is, that it would be best to change the present library and museum into domitories; build an addition behind the present physical laboratory—ground floor for practical work in agricultural physics, and first and second flats for student's dormitories; and erect a new building for library and museum.

FINANCIAL STATEMENT FOR 1897.

I.—College Expenditure.

(a) College Maintenance.

1. *Salaries and Wages*		$ 20,257 03
2. *Food*—		
Meat, fish, and fowl		4,593 47
Bread and biscuit		932 60
Groceries, butter, and fruit		4,864 27
4. *Household Expenses*—		
Laundry, soap, and cleaning		201 63
Women servants' wages		1,914 40
4. *Business Department*—		
Advertising, printing, postage, and stationery		1,148 01
5. *Miscellaneous*—		
Maintenance of chemical laboratory		710 53
" botanical laboratory		208 63
" bacteriological laboratory		174 55
" physical laboratory		82 01
Library and reading room—books, papers, and periodicals		717 61
Medals		87 75
Unenumerated		727 68
		$36,620 17

(b) Maintenance and Repairs of Government Buildings.

Furniture and furnishings	865 50	
Repairs and alterations	1,222 05	
Fuel	3,292 10	
Light	841 27	
Water	95 80	
Sewage disposal	433 28	
		6,750 00
		$43,370 17

College Revenue.

Fees	1,976 20	
Balance for board, after deducting allowances for work in outside departments	6,494 75	
Chemicals	30 00	
Gas in laboratories	95 00	
Laboratory fees	10 00	
Supplemental examinations	34 00	
Oil bought by college and sold to other departments	25 00	
Gas cylinders sold by biological department	25 00	
Sale of tuberculin	5 22	
Sale of sundry articles—bones, second-hand stove, old iron, etc	32 33	
Balance paid by Harrison for connecting water pipe to his house	92	
Contingencies—breakage, fines, etc	258 15	
		8,986 57
Net expenditure of the College in 1897		$34,383 60

Unexpended balance for the year, $422.40. (See Estimates for 1897, pp. 36 and 42.)

II.—Farm Expenditure.

(a) *Farm Proper.*

1. *Permanent improvements*—			
Fencing, underdraining, etc			422 12
2. *Farm maintenance*—			
Salary of superintendent		1,200 00	
Wages—herdsmen, teamsters, engineer, etc		2,948 52	
Live stock—steers, cows, etc		1,842 33	
Maintenance of stock		600 80	
Seed		173 01	
Binding twine		25 20	
Repairs and alterations (including blacksmithing)		441 68	
Furniture and furnishings		128 39	
Tools and implements		190 67	
Advertising, printing, postage and stationery		119 06	
Fuel and light		75	
Contingencies		63 70	
			7,734 11
			$8,156 23
Cash revenue of farm proper—			
Sales of cattle—24 head, mostly young animals		859 07	
" —11 steers, 15,210 lbs. at 5c	760 50		
" —7 steers, 8,930 lbs. at 4c	357 20		
	1,117 70		
Less allowance in deal	7 25		
		1,110 45	
Sales of pigs by auction—52, mostly young		611 36	
" " for slaughter—12,220 lbs. at average price of 4½c		549 90	
" sheep by auction—27, mostly lambs, average price $8.18½		220 98	
" wheat—264½ bush. at $1.00		264 50	
" oats—199 1-20 bush. at 40c		79 62	
" barley—183 38-48 bush. at 60c		110 28	
" peas—46⅔ bush. at 75c		35 00	
" potatoes—164 5-6 bushels at 30c		49 45	
" wool—541 lbs. unwashed at 13c		70 33	
" hides and skins—1 hide and 3 skins		5 65	
" milk—2,761½ quarts at 4c		110 45	
" hay and ensilage		13 81	
" old fence rails and boards		36 95	
" service of animals—cows and pigs		157 00	
Paid by Harrison for use of man and team		11 25	
			4,295 55
Net expenditure of farm proper			$3,860 68

Unexpended balance for the year, $1,114.32. For full returns from the farm proper, see Mr. Rennie's figures in Part XI.

(b) *Experimental Plots and Feeding.*

1. *Permanent improvements*—			
Alterations in buildings, furnishings, etc		$178 01	
2. *Maintenance*—			
Experimentalist, salary		1,500 00	
Foreman, salary part of year		222 00	
Feeder, wages		360 00	
Teamsters		558 00	
Laborers		2,217 93	
Seed		355 15	
Manure and special fertilizers		229 92	
Stock—cattle and pigs for feeding		1,021 90	
Furnishings and repairs, including blacksmithing		272 65	
Printing, postage, and stationery		142 88	
Implements		213 78	
Feed and fodder		450 19	
Contingencies		107 48	
		7,829 89	
Revenue,—			
Sales of cattle—9 head	509 97		
" pigs—86 head	621 95		
		1,131 92	
			$6,697 97

Over-expenditure for the year, $299.97. (See Estimates, p. 37.)

III.—Dairy Department.

(a) *Experimental Dairying.*

Salary of foreman—instructor, butter-maker, and experimenter, 9½ months		$514 58	
Experimental cheese-maker, 9½ months		500 00	
Man to assist in experimental work, attend boilers, etc., 9½ months		278 93	
Assistant in chemical laboratory, employed in analyzing milk, etc.		75 00	
Cattleman, milkers, etc.		510 25	
Temporary assistance		92 30	
Purchase of milk for experimental work		2,083 78	
Purchase of cows and pigs		615 48	
Feed and fodder		380 74	
Furniture, furnishing, and repairs—new separators and vats, new chimney, etc.		1,052 76	
Advertising, printing, postage, and stationery		124 78	
Fuel and light		332 86	
Contingencies		101 91	
		6,663 37	
Revenue—			
7,904 lbs. butter at 20 1-50	1,582 44		
13,717 lbs. cheese at average of 8⅔c.	1,189 65		
4,245 qts. milk at 4c	169 79		
14,540 lbs. skim and butter milk at 15c per 100	21 81		
8 calves	15 50		
11 cows	325 00		
Pigs—12,298½ lbs. at 5c.	614 93		
3 hides	10 47		
	3,929 59		
			$2,633 78

Unexpended balance for the year, $1,536.22. (See Estimates, p. 38.)

(b) *Dairy School.*

Wages of instructors, 2½ months		1,582 49	
Engineer		105 00	
General helper		75 00	
Services of boy and board of engineer		43 60	
Purchase of milk		3,788 74	
Dairy appliances—pasteurizing apparatus, utensils, etc		609 14	
Expenses of cheese and butter judges		9 00	
		6,212 97	
Revenue—			
Registration fees	63 00		
10,394 lbs. butter at 19 4-5c.	2,015 88		
14,002 lbs. at 8 96-100c.	1,255 11		
20,350 lbs. skim milk at 10c.	20 35		
7,750 lbs. butter milk at 10c.	7 75		
Whey	20 00		
	3,382 09		
			$2,830 88

Unexpended balance for the year, $249.12. (See Estimates p. 38.)

IV.—Poultry Department.

Salary of manager		$ 700 00	
Stock—6 birds		21 50	
Furniture and furnishings, etc.		113 53	
Feed, etc.		131 87	
Fuel and light		41 31	
		1,008 21	
Revenue—			
Eggs for hatching—93 settings	128 50		
" college—188 doz.	35 97		
Stock sold—105 birds at 81 7-10	85 79		
18 dressed chickens	5 00		
	255 26		
			752 95

Unexpended balance for the year, $247.05. (See Estimates, p. 38.)

V.—Horticultural Department..

Garden, green houses, lawn, arboretum, orchard, forest tree plantations, etc.

1. *Permanent improvements*—new greenhouse, staging, painting, etc.	159 47	
2. *Maintenance*—		
Head gardener and foreman	649 92	
Assistant gardener and florist	528 00	
Assistant in greenhouses	375 00	
Teamster and laborers	1,702 91	
Manure	90 50	
Trees, plants, bulbs, seeds, etc	254 24	
Furniture, furnishings, and repairs, including implements and flower pots	453 84	
Fuel and light	636 02	
Contingencies	28 02	
		4,868 92
Revenue—		
1,196 boxes of strawberries at 4c	47 85	
Team hauling stones for Harrison, 6 hours	1 80	
Unexpended balance for the year, $248 73. (See Estimates, p. 38)		49 65
		$4,819 27

VI.—Mechanical Department.

Salary of foreman	$700 00	
Extra carpenter for erection of buildings	700 00	
Tools, etc	60 19	
Fuel and light	23 92	
		$1,484 11
Over-expenditure for the year, $9.11. (see Estimates, p. 39.)		

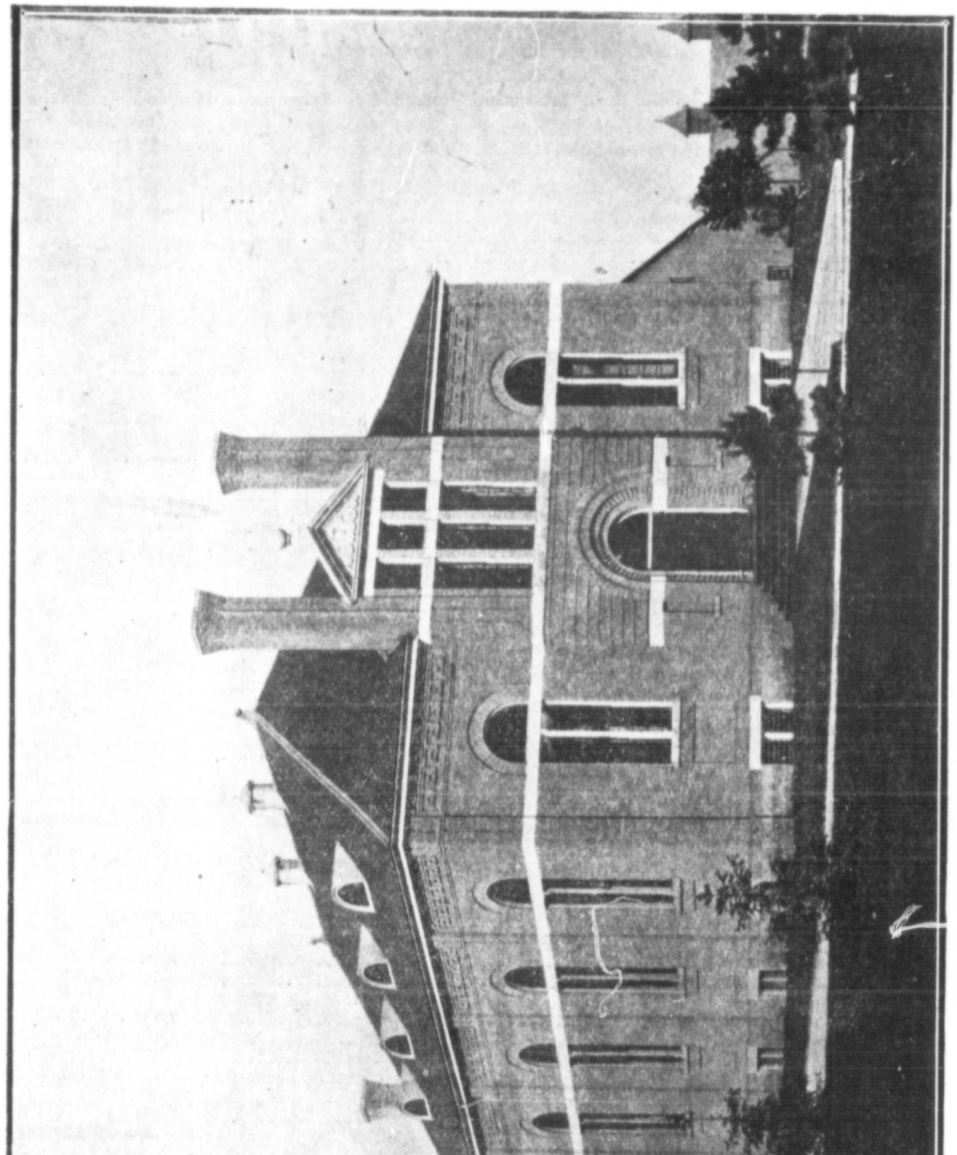
Summary.

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

I. College and Government buildings	$34,383 60	
II. Farm—		
1. Farm proper	3,860 68	
2. Experimental plots and feeding	6,697 97	
III. Dairy Department—		
1. Experimental Dairy	2,633 78	
2. Dairy School	2,830 88	
IV. Poultry Department	752 95	
V. Horticultural Department—garden, greenhouses, lawn, arboretum, orchard, forest-tree plantations, etc	4,819 27	
VI. Mechanical Department	1,484 11	
		$57,463 24

The unexpended balance on the year's operations in all departments was $3,508.76.

JAMES MILLS,
President.



CONVOCATION HALL AND GYMNASIUM, O. A. C., GUELPH.

PART II.

REPORT OF THE LECTURER

IN ENGLISH LITERATURE AND PHYSICS.

To the President of the Ontario Agricultural College:

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

English Literature.

Last year I gave rather a full report on the work in this department, and as no special changes have been introduced since last year, a very brief reference is all that is necessary. I am pleased to be able to state, or rather repeat, that the interest in the study of literature here is continuous, and especially is this true of Shakespeare studies. Essay writing is being more and more emphasized. Your assistant in the residence, Mr. Clark, reads the essays for the First Year, and he reports a steady progress in carefulness, neatness and accuracy. The same is true of the other years. Questions of the day are discussed in these essays, relating either to practical matters of the farm, or to live issues in the larger world outside of the farm. Following are some of the subjects given to the different years: Preparation of ground for fall wheat, the Klondyke, college sports, principal world events of 1897.

I am exceedingly grateful to you and to the librarian, Mr. F. C. Harrison, for the large number of books of English authors and commentaries thereon, that have been added to the library in the past year. A very generous and judicious selection has been made. I am now able to give each class a good list of reference works, which makes the study and the teaching of English more easy and more interesting. We have now the beginnings of a good English library.

Physics.

I am pleased to be able to state that the work in the department of Physics is gradually extending. This present term, for the first time, a course of lectures has been outlined for the First Year, consisting mainly of Soil Physics practically considered in its relation to cultivation, drainage, soil fertility, and soil moisture. One lecture a week is being given to cover this work, with the expectation of finishing with the close of the fall term. It may be necessary to continue the lectures through a part or all of the winter term, if the whole of the course outlined is to be covered.

The Second Year work remains much the same as last year Three lectures a week are given, principally on Mechanics. A very important part of the instruction in this branch of Physics is practical, being an investigation of the principles of machines, and is carried on during the afternoons, in addition to the forenoon lectures. I have also included in the fall term's work practical instruction in measuring land areas, chaining, levelling for drains, and allied subjects. I am doing my best to give the class a complete course in practical instruction, but find it rather difficult to give them sufficient personal attention, since part of the class is in the field chaining while part is in the laboratory employed on mechanical appliances there. However, I have succeeded in keeping them employed for two afternoons a week since the opening of the term and expect to continue until near the close. During the winter term, hydrostatics, thermodynamics, and hydrodynamics will be discussed and specially applied to Soil Physics. In the spring term, electricity as usual. The Third Year course is an extension of that of the Second Year.

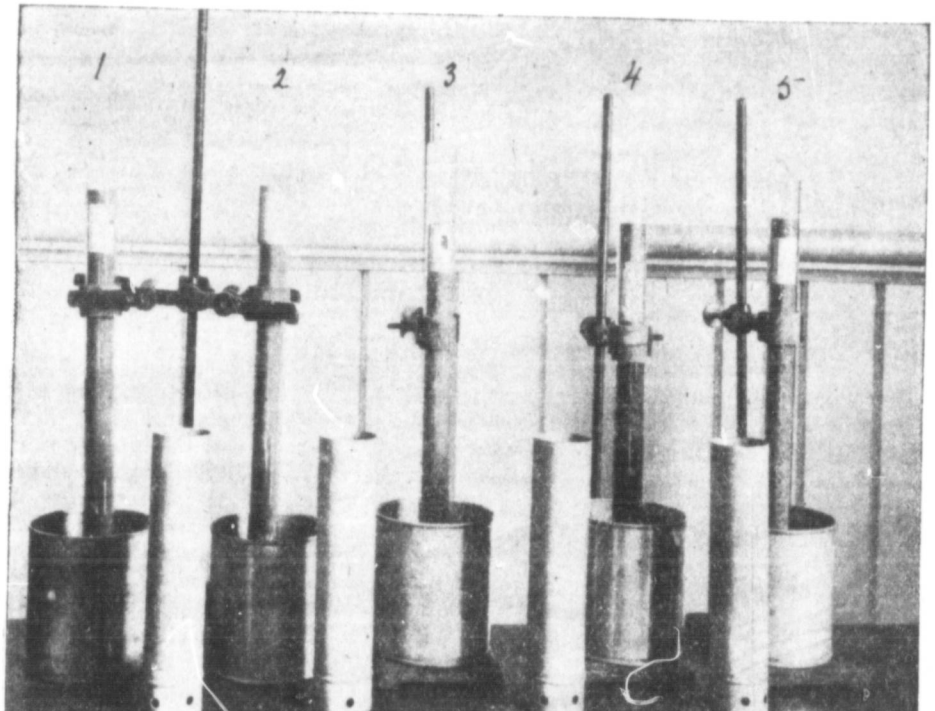


Fig. 1.

In addition to lectures and laboratory instruction, a little independent investigation has been done, as time has allowed. Following are some of the results obtained :

The Physical Effects of Lime on Soils.

To determine these, zinc cylinders, as in the figure above, were nearly filled with the soils prepared according to the description found in the following tables No 1, 2 and 3. The soil rested on wire gauze at the rim just above the holes. The cylinders, when filled with the dry soil, were placed in water just deep enough to cover the rims ; and the water rose to the surface by capillary action. The water-coefficient is

$$\frac{\text{The volume of water taken up by the soil}}{\text{The volume of the soil}} \times 100.$$

The numerical results are given in the tables. Two kinds of clay were used, both sent for examination by Mr. J. J. Devitt of Freeman, Ont.

Table 1.

Sample.	Clay.	Clay 80%, Humus 20%.	Clay 80%, Lime 20%.
Time in reaching surface	9 hours.	12 hours.	3½ hours.
Water-content	50.4%.	58.8%.	51.7%.
Condition after drying	Hard.	Friable.	Very friable.

Table 2.

Sample.	Clay.	Clay 80%, Humus 20%.	Clay 90%, Lime 10%.
Time in reaching surface	24 hours.	26 hours.	5 hours.
Water-content	50.9%.	56.6%.	51.1%.
Condition after drying	Very hard.	Medium.	Friable.

Table 3.

Sample.	Lime .5%, Sand 99.5%.	Lime 1%, Sand 99%.	Lime 2%, Sand 98%.	Lime 6%, Sand 94%.	Lime 10%, Sand 90%.
Time in reaching surface	10 minutes.	11 minutes.	13 minutes.	23 minutes.	30 minutes.
Water-content	35%.	35.9%.	36.7%.	40.5%.	42.8%.
Condition after drying	Friable.				Quite adhesive

The greater the amount of lime used, the greater the effect; and a small percentage of lime has only a proportionately small effect. *To lime one acre* to a depth of 3 inches with ½ per cent of lime by weight, that is, one pound of lime for every 200 pounds of soil, *would require 2 tons.* That quantity would have a very considerable effect on any soil. In our experiments we used larger percentages in order to obtain measurable effects on small lots of soil. The conclusions may be stated thus:

1. Lime increases the water capacity of all soils.
2. Lime makes *clay more friable* and *sand more adhesive.*
3. Lime makes *clay more pervious* and *sand more close.*

It must be remembered that while the physical action of lime is thus beneficial, it has also a chemical action in setting free the plant food in the soil. Since heat is a most active agent in the decomposition of manures and vegetable matter generally, in a cold, close, heavy clay soil this decomposition may not proceed fast enough for the use of crops, and hence a little lime is very beneficial both physically and chemically. But in a well drained and warm sandy soil, this decomposition generally goes on fast enough; and here lime may be an injury, since it may decompose the plant food faster than the crops require it, and the result may be an impoverishing of the soil. Lime, therefore, is most beneficial in close, clay soils, since it is to be regarded not so much as a food, but as a stimulant.

Experiments in Capillarity with Long Tubes.

Figure 2 and table 4 contain nearly all the information needed regarding this experiment. It illustrates chiefly the movements of soil-water in different strata of the soil. The only difference in the three samples is the amount of humus contained, 0-6 inches

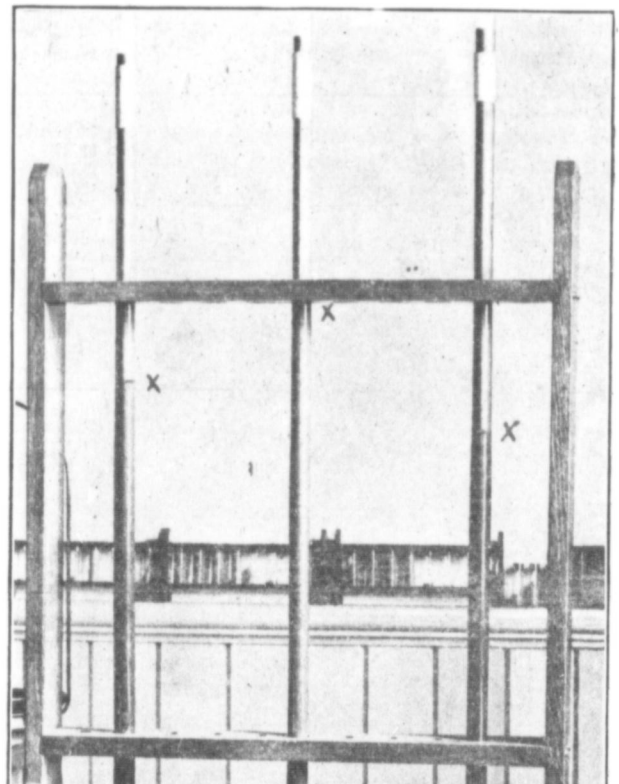


Fig. 2.

being well supplied, as it is surface soil, 6-12 containing a little, and 12-18 none at all. I wish to draw attention to (1) the rate of movement of the water, and (2) the amount of water retained by the soil in each tube.

Table 4.

Sample.		Loam.	Loam.	Loam.
Location		Expl. Field.	Expl. Field.	Expl. Field.
Depth from surface		0-6 inches.	6-12 inches.	12-18 inches.
Height of water reached in tube in	1 day	9 inches.	11 inches.	14 inches.
	4 days	15.5 inches.	17 inches.	25 inches.
	11 days	20.5 inches.	21 5 inches.	35 inches.
Water content in	1 day	46%	43%	39.4%
	4 days	49%	42 9%	39.7%
	11 days	45%	42 7%	39 5%

Table 5.

Sample.	Height of water reached in tube.			Sample.	Water content per cent.		
	Pure sand.	Sandy soil.	Clay loam.		Pure sand.	Sandy soil.	Clay loam.
2 days	25.08 in.	18.88 in.	20 in.		26.96	27.88	37.88
3 days	25 52 in.	19.6 in.	21.33 in.		27.36	28 38	37.61
4 days	26 in.	20 in.	22.4 in.		27.01	27.16	36.77
5 days	26 6 in.	20.6 in.	23 6 in.		26.4	27.44	36.71
6 days	26.6 in.	21 in.	24 2 in.		26 4	27.24	37.11
7 days	26.6 in.	21.3 in.	25 in.		26.4	27.5	36.3
				Average.	26.75	27.6	37

Table No. 5 gives the result of an experiment very similar to the preceding, the difference being a comparison of entirely different soils, instead of soils from different depths of the same field. The following conclusions may be drawn :

1. The capillary action was at first more rapid in the pure sand.

2. The pure sand could not raise the water more than 26.6 inches from the level of the standing water below. The limit was reached in 5 days, while the other soils continued their action.

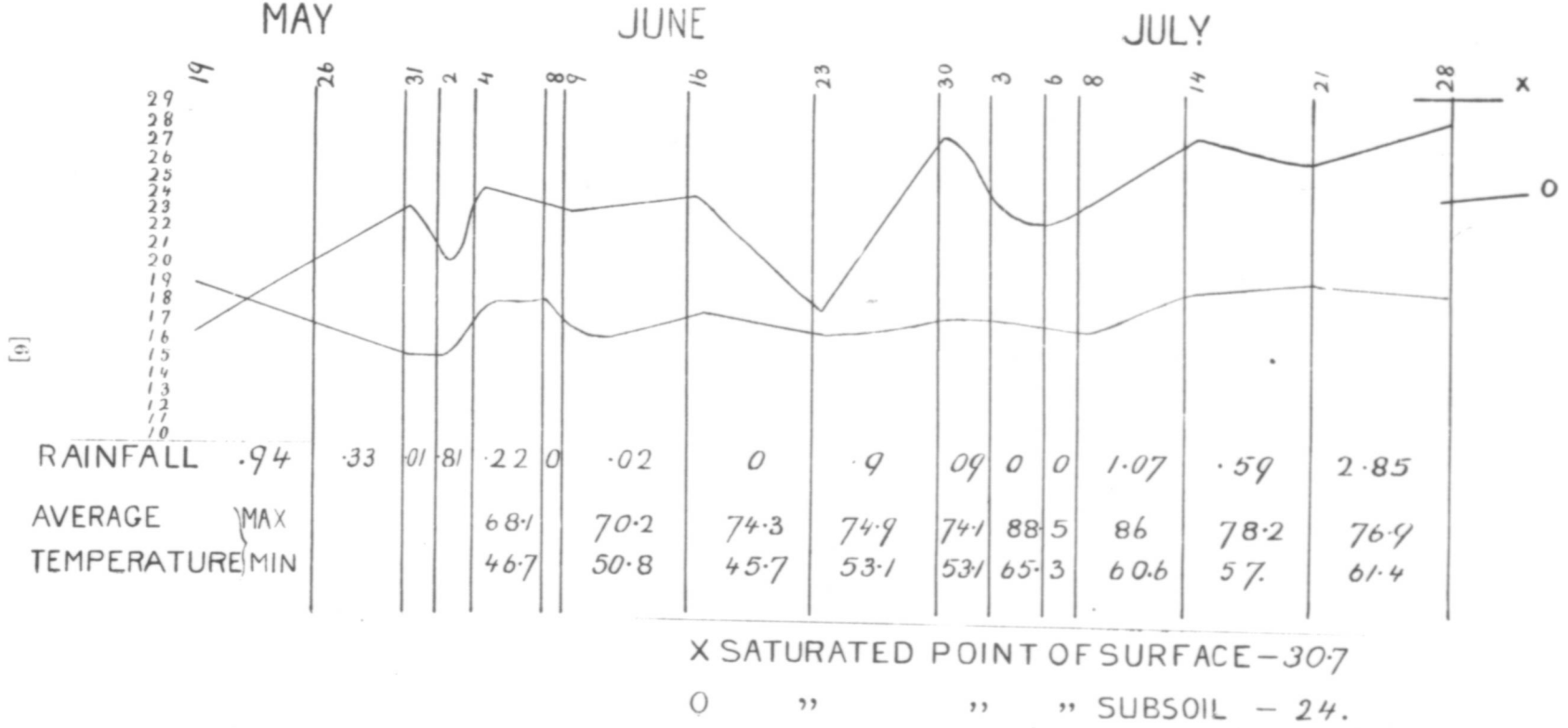
3. The farther from the level of free water, the slower is the capillary movement of water.

4. The fine clay soil absorbs about 35 per cent. more water than either of the other samples.

Variations of Soil Moisture through May, June and July.

During the months May, June and July, I conducted, with the assistance of Mr. A. C. Wilson, a series of experiments with a view to determining the variations of the soil-water throughout the season. The samples of soil were taken from the College corn field. Two lots were taken at each test, one lot being to the depth of 9 inches, and the second lot below the first to the depth of 18 inches from the surface. The samples were dried and the percentage of water determined. This was done at stated intervals, generally once a week, with occasionally an extra test when a heavy rainfall occurred. The amounts of rainfall and the temperature readings were obtained from the Experimental Department. The subjoined map indicates graphically the moisture variations. The figures at the top refer to the dates at which the tests were made and those at the left indicate the percentage by weight of water in the soil as it came from the field. For instance, on June 30th, in 100 pounds of surface soil there was 27.4 pounds of water, and in 100 pounds of subsoil, on the same date, there was 17 pounds of water. The upper curve refers to the surface, and the lower curve to the subsoil.

Our determinations date from May 19th. On May 17th, 18th and 19th, the corn was sown. The cultivation during these three days and previously had effected a rapid drying of the surface, and on May 19th the surface soil contained only 16.3 per cent. of water, while the subsoil contained 19 per cent. This inequality could not last long, however, since, in a state of equilibrium the surface soil contains more water than the subsoil in proportion to the amount of humus contained. Hence, as the diagram shows, the moisture content of the surface rose, due to percolation of rain from above and to capillary action from below, while the subsoil lost. Each rainfall is clearly indicated by an upward shoot of the curve belonging to the surface, and a dry, hot spell is as clearly indicated by a drooping. The surface is of course subject to greater daily variations, while the subsoil pursues a more even tenor. Between June 2nd and June 4th. quite a heavy rainfall occurred (.81 inch), and we see by the diagram that



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EXAMINATIO

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the subsoil felt the effect considerably. Elsewhere, the subsoil was but little responsive to changes in the weather, and the rain that fell was mostly retained by the surface nine inches. This would not be the case in a poor soil, since such a soil would allow the rain to percolate rapidly through it, and the subsoil curve would present almost as great variations as that of the surface. The quality of the soil is indicated by the yield of corn—20 tons per acre.

The high moisture content from June 4th to June 8th, accompanied by a comparatively low temperature, made the soil both wet and cold. Corn while germinating, and even after, is quite susceptible to cold, and on this occasion the corn did not sprout. On consulting Mr. Rennie's record of the season's work, I learn that the corn was re-sown on June 7th, 8th and 9th. From June 9th to 16th, with only a slight rainfall, the curve rises in both the surface and the subsoil. They were both, in all probability, drawing from the reserve fund of water below. After the 16th, the continued dry weather, added to a high temperature, succeeded in reducing the moisture-content of the surface considerably, and the subsoil curve droops sympathetically. At no point after about May 22nd does the surface curve fall below that of the subsoil. This is due to the higher capacity for moisture of the surface. Surface soil may contain more water per pound of soil than the subsoil, and yet be no wetter, just as a pound of water at 60 degrees contains much more heat than a pound of iron at the same temperature, as is evidenced by the more rapid cooling of the iron.

On July 26th, the big rain began, which did such damage to crops throughout the country. Our experiments concluded on July 28th, and at that time the surface soil contained more water than at any other time of the season since May 19th, as the curve indicates.

It cannot be claimed that these results are of any great immediate importance, since there is a total lack of comparison between different conditions. There is, however, in these results a clear indication of what might be accomplished in this direction. I intend, with your approval, to suggest a series of experiments to the Experimental Union, wherein the question of soil moisture may be studied under different conditions, viz., different *soil* conditions, different *weather* conditions, different *methods of cultivation*, and different *crops*. The last two conditions can be investigated locally, without co-operative assistance, and I hope to be able to institute a research along these lines next season from experiments to be made at the College. To introduce different weather and soil conditions, samples of soil may be sent from representative districts in Ontario, and the amounts of moisture determined here. I am positive that results of great practical importance may be reached by such a series of experiments, especially if conducted through a term of years. The work is quite new. Kansas Experiment Station has sent in a bulletin showing the determinations for one month, July 1897, under various methods of cultivation. Washington has done some work very similar for the seasons 1895 and 1896, but in none of those places has anything been done until quite recently.

Last May quite a number of gentlemen from the neighborhood of Stouffville visited the district of Lake Temiscaming, with a view to purchasing claims if they found favorable conditions there. Following is a report on some samples of soil sent in by them for analysis and examination :

Examination of Soil from Lake Temiscaming sent by Mr. Joseph Steele, of Stouffville.

The samples sent were three, namely :

1. Surface soil from which one crop had been taken.
2. Soil from the root of an upturned tree.
3. Soil from a depth of five feet.

Sample 1 and 2 are practically the same in composition, with the exception that the surface soil contains more vegetable matter. A machanical analysis of the surface soil was made, with the following result, side by side with a similar analysis of a sample of sandy loam taken from a cornfield at the College farm.

	Lake Temiscaming.		College.	
Gravel	.29	per cent.	.32	per cent.
Coarse sand	2 63	"	1.50	"
Fine sand	3 70	"	29.06	"
Coarse silt	5 71	"	24.67	"
Fine silt	8 03	"	21.35	"
Clay	79 64	"	23.10	"

It is evident from these figures that the sample in question is a very fine clay soil. In the College sample, the first four subdivisions—gravel—coarse silt—are almost entirely composed of quartz, looking like small bits of granite, while in the Temiscaming sample there is scarcely a trace of quartz or rock. The coarser parts of this soil may be resolved into two, some woody matter being undecomposed humus, and some yellowish grains, which when rubbed slightly, pulverized quite easily. After the first analysis, these coarser parts were pulverized, and the finer particles washed away. The coarse residue consisted almost entirely of woody matter. So that, while the Lake Temiscaming soil contains a small percentage of coarse parts, these are not rock or quartz, but clay formed into lumps containing a trace of iron oxide. The soil is then a fine, white clay, practically free from rock or quartz.

Another conclusion drawn from a comparison of the two soils is the relative quantities and the condition of the humus, or vegetable matter, contained in them.

If drainage conditions are favorable, there is nothing wrong with soil that has a good supply of humus in proper condition. Now, in the coarser parts of the College sample, there was only a trace of black specks, or humus. In the finer parts, however, the dark color indicated an abundance of well decomposed humus. In the Temiscaming sample, the finer subdivision, clay and silt, was almost white in color, indicating a lack of humus. The coarser parts, as stated above, were mostly composed of woody matter. As to the total humus content, a comparison of the colors of the two samples clearly indicated that the Temiscaming sample is not so well supplied with humus as the College sample. I was unable to understand this at first, as the Temiscaming soil is practically a virgin soil, and should be rich in vegetable mold. I have learned, however, that the surface was burned over no very long time since, and possibly the humus was burned out then. It is not meant by these remarks to convey the impression that the soil in question is at all impoverished, but simply that there is no very large reserve fund of fertility which can be drawn upon by crops for years to come. A good system of farming, such as is necessary in this part of Ontario, had better be applied at Lake Temiscaming from the beginning Then the soil will be in a better condition in ten years than it is now. It should give very good results from the start, judging from the physical analysis given above and the chemical analysis given below. Only the principal ingredients required by crops—phosphoric acid, potash and nitrogen—are given, and side by side are given the proportions required to constitute a fertile soil.

	Lake Temiscaming.	Req'd for fertility.
Phosphoric acid	.292	.20
Potash	1.98	1.
Nitrogen	.16	.15

It will be seen that the sample in question exceeds the requisites for fertility in phosphoric acid by 46 per cent., in potash by 98 per cent, and in nitrogen by only 6 per cent. The nitrogen is furnished principally by decomposed vegetable matter, especially clover and peas. A crop of clover would improve the condition of the soil, both in fertility and texture.

It should be explained that the chemical analysis given above was made two years ago at the Chemical Department, from a sample of soil sent from the same district. It may be found in the College report for 1894.

Water Capacity.

The amount of water that soil can hold in suspension is another important physical property. In ordinary seasons a high water capacity will secure a plentiful supply of water and plant-food for growing crops. The figures given below represent the volume of water retained in a known volume of soil, say a cubic foot, under natural conditions, such as a rain fall. The soil is saturated to determine these results; while the water is free to drain away below. If the volume of soil used be represented by 100, these figures will represent the maximum volume of water retained by it.

Lake Temiscaming (surface soil) 60% water capacity.

College 56.5% water capacity.

L. T. (from root of upturned tree) 53.7% water capacity.

College (9 inches below surface) 50.4% water capacity.

In this respect, then, the sample is considerably above the average, which may be taken for surface soils at 51 and for subsoils at 44.

Texture.

By texture may be understood the mechanical condition of the soil while under cultivation. It may be viewed from two points: First, whether or not it is friable and easy to work; secondly, whether or not it is impervious to the water. As to the first, judging from the firmness of its composition, it might be supposed to be a stiff and stubborn clay. To test this some of the soil was formed into a mould, then thoroughly saturated and dried while in that form. Many clays, especially the red clays, when thus treated, would require a hammer to pulverize them. This soil, however, pulverized with an easy pressure of the thumb and finger. So that for clay soil, it is exceedingly friable; and if drainage conditions are favorable, as I understand they are naturally, and if a sufficient quantity of humus be preserved in this soil, there will be no difficulty with regard to baking or becoming difficult to work.

Further, through all soils of fine composition the water moves slowly, and this soil is no exception to the rule. The subsoil from five feet below the surface is especially close. But it does not present any greater difficulties than the average clay soil, so far as can be judged by laboratory examination. It is only a question of sufficient drainage to make it tractable. The alternate wetting and drying that takes place under a good system of drainage, either natural or artificial, will keep even a clay soil porous, since clay expands when wet and shrinks on drying, thus leaving pores or openings throughout the soil. This applies both to the surface and to the subsoil. Reports from that district state that natural drainage is all that can be desired. If so, the soil will present but little difficulty, either in working or draining it.

Another sample of soil was sent later by Mr. Steele, taken from a spot six miles back from the lake where the previous sample was selected. This last sample, while the same in foundation as the first, contains much more humus, and the humus is much more decomposed. The sample is better adapted for immediate cropping, and is much more friable and porous, and altogether approaches more nearly to the condition of the ideal virgin soil. It presents the appearance that the lake sample should present after some years of liberal manuring and judicious cultivation and cropping.

Needs of the Department.

The quarters allotted to the department of physics two years ago seemed ample at that time. Since then, however, large additions have been made to the course, especially

in practical instruction. This fact, added to the increased attendance, both in the second and third years, has made the physical laboratory too small. What we need now is (1) the present room fitted up for laboratory instruction alone; (2) a new class-room; (3) a new room for experiments and station work.

If any station work is to be carried on, such as I have suggested, in connection with the soil-moisture determinations, an allowance for a fellowship in physics or other assistance is needed. Without assistance I cannot carry on this work, nor can I give sufficient attention to the students in their practical work throughout the year. Mr. A. C. Wilson rendered valuable help last year, while he was concluding his third year course and afterward during the summer. If provision can be made for permanent assistance in this young and growing department, I hope to render full value to the College and to the Province for the expenditure.

My thanks are due to you for the liberal grant made last year toward the purchasing of new appliances, and also for the electrical outfit provided. I have been enabled thereby to present the subject of electricity with much greater clearness and effect, and to make the whole subject of physics more valuable and practical as a part of the course in agricultural science.

Respectfully submitted,

J. B. REYNOLDS.

ONTARIO AGRICULTURAL COLLEGE,
GUELPH, November 30th, 1897.

PART III.

REPORT OF THE

PROFESSOR OF BIOLOGY AND GEOLOGY.

To the President of the Ontario Agricultural College :

SIR,—The time at which I should write the report of my department finds me prostrated upon a bed of illness, utterly unable to give a statement of the work of a busy year with that fulness it demands. From the 5th to the 26th of January, my time was completely taken up attending Farmers' Institutes. I was at seventeen, and delivered forty-five lectures upon topics relating to agricultural science. When spring opened, the work of answering inquiries began, and I may say that more information has been sought during this year by farmers, fruit-growers, and others than during any previous year of my connection with the College. Hitherto it has been customary to give a list of the names of insects, weeds and fungi identified, with the object of educating, as far as possible, the farming community with regard to the common and scientific names of the foes which prey upon the crops of garden, orchard and field. This year we have deemed it expedient to omit this list.

On June 9th, I was requested by the Honorable Minister of Agriculture to proceed to the Niagara district, where it was reported that the San José scale had appeared. The infested orchard was that of Mr. Thonger, near Niagara-on-the-Lake. Delegates from Ottawa and from the Fruit Growers' Association met at this place on June 19th, 1897, and examination of the trees soon revealed the fact that they were undoubtedly infested with this serious insect pest. I had scarcely returned to the College when I was again requested to go, in company with Mr. Orr, to the same district and examine, as far as possible, to ascertain if the scale had attacked other orchards. After travelling from place to place for several days, we returned and submitted our report to the Department of Agriculture. It was now seen that this work would be sufficient to occupy much time, and Mr. Orr, who had charge of the experiments in spraying under the Agricultural Department, was appointed to look into the matter thoroughly and to ascertain, if possible, to what extent the insect had appeared in the Province, and also to find out whence it came.

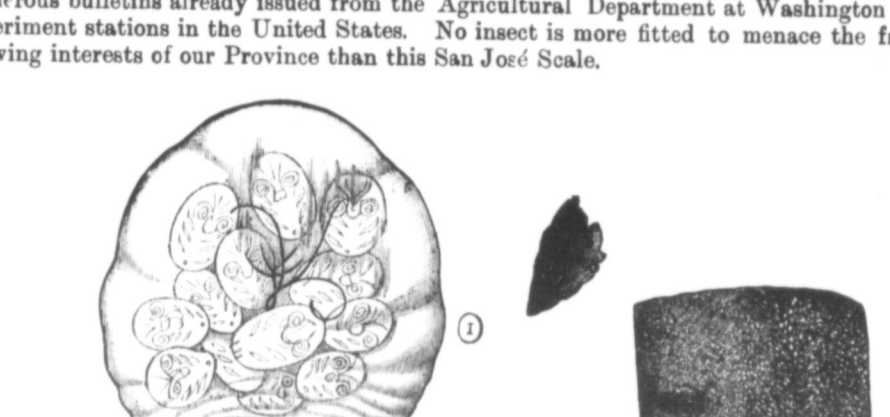
I prepared at that time the following bulletin, with the object of giving as clear, simple and concise a description as possible of the life history of the insect :

THE SAN JOSE SCALE.

(*Aspidiotus perniciosus*)

The discovery of the fact that the San José Scale has appeared in one of the most important fruit growing districts in Ontario demands that we furnish, at as early a date as possible, information regarding its habits, etc. For the past four years it has excited

much alarm among fruit growers in the Eastern States, and a wealth of literature has been published concerning it, so that all information needed is readily obtained from the numerous bulletins already issued from the Agricultural Department at Washington and experiment stations in the United States. No insect is more fitted to menace the fruit-growing interests of our Province than this San José Scale.



San José Scale, female enlarged, and part of infested branch (life size).

1. It possesses marvellous powers of reproduction. A single female that has wintered over may be the progenitor of millions in a single season ; some have computed that her progeny may reach the incredible number of 3,000,000,000. There may be four generations in a season, the adult females of each giving birth to living young for five or six weeks, the progeny of these bearing young when about thirty days old. Each female brings into existence 100,500 insects during her lifetime. Thus it will be seen that a great confusion of generations will soon exist, as there may be upon a plant at one time the young of several generations.

2. Infested young trees perish in two or three years.

3 The range of food plants is extensive, and all parts of the plant may be attacked—leaf, stem, twig and fruit. The scale has been found upon the peach, pear, plum, apple, cherry, apricot, quince, currant, gooseberry, raspberry, rose, hawthorn and even elm.

4. The insect and scale are exceedingly minute. The scale is often much the same color as the bark of the infested trees. Most are less than one-sixteenth of an inch in diameter, and are thus almost invisible to the naked eye.

5. It is readily introduced by nursery stock and fruit from infested trees.

Although first observed in 1893, it has now been located in Alabama, Florida, Georgia, Louisiana, Virginia, Delaware, Idaho, Indiana, Massachusetts, Maryland, New York, Ohio, New Jersey and Pennsylvania ; in 1894 it was reported in British Columbia ; and now, unfortunately, in June of 1897 we have to announce it as present in Southern Ontario. Some specimens are reported to have been found last winter near Chatham.

The general consensus of opinion, after much investigation, is, that it came originally from California, where it was noticed as a pest in the San José Valley as far back as

1873. In 1880 Prof. Comstock described it, and named the insect *Aspidiotus perniciosus*, on account of its serious character as a scale. It is believed to have been introduced into the East in 1886-7 by two New Jersey nurseries—one at Burlington, the other at Little Silver. These firms imported from the San José Valley a variety of Japanese plum, the Kelsey, which was claimed to be curculio proof. In 1889 or 1890 the first scaly stock from this importation began to be distributed, and in August of 1893 the San José Scale was first observed on the eastern side of the Rocky Mountains. It was located in an orchard of Charlottesville, Virginia, and since then each season has extended the list of infested districts.

In the work of distribution the insect itself can do but little, as it is quite helpless to move from place to place. Its life of active movement is very brief—a few hours, at the most a day or two. It moves only a few inches from its birth-place, then settles, becomes covered with a scale, and in the case of the female, remains fixed for life, and begins producing young in about thirty days. After becoming fixed, it lives by sucking the sap of the plant upon which it is located. The males have wings and may fly about at maturity, but the females are always wingless. During the few hours or days the tiny lice are moving about, they may get upon birds, such insects as ants and small beetles, and by them be carried to other trees. One observer has noticed that in infested districts, the scale is often more common near a bird's nest. As trees in a nursery grow close together, they present favorable conditions for being infested. Fruit from infested trees may have the scale upon it ; even wind may assist in spreading these insects that appear at first so comparatively helpless to travel by their own efforts. Thus *birds, insects, fruit, scions* from infested trees, infested *trees*, and *wind* may all be important factors in the distribution of the scale.

The nearly fully grown insect passes the winter beneath its wax-like scale. About June the young begin to appear, as exceedingly minute, six-legged insects, like yellowish specks moving about. They creep about only for a few hours, at most a day or two, then settle but a few inches from their birthplace, and become attached to the spot, from which the females never move. During their sedentary life the females lose their feelers and legs, and have neither eyes nor wings. The males, however, have legs, feelers (antennæ) eyes and wings in the adult condition. The scale of the female is circular, with a small nipple in the centre. This scale is from a twelfth to one-twentieth of an inch in diameter, and may be of a light or dark gray color, and usually is much the same color as the bark ; the nipple in the centre may be a pale yellow or blackish color. The scale of the male is oblong, with the nipple near one end, and is thus readily distinguished from that of the female. The female brings forth living young, and does not lay eggs, as is usually the case with scale insects, such as the oyster shell and scurfy scales. She may bring into existence from 100 to 500 young during the six weeks of her existence after reaching the adult stage.

The males develop about a week sooner than females, the latter taking about five weeks, and emerge from their scales as exceedingly minute two-winged fly-like insects. From June, when the young appear, a constant succession of generations is observed.

The scale of these insects is formed from a waxy secretion which commences soon after they come into existence, and forms a protective covering as development proceeds. In the earlier stages of growth the scale presents a somewhat grayish-yellow color, and gradually becomes darker.

The general appearance upon affected twigs is that of a grayish, slightly roughened scurfy deposit. This hides the natural reddish color of the young limbs of the peach, pear and apple. They sometimes even look as if sprinkled with ashes. If the scales are crushed, a yellowish oily liquid will appear from the crushed soft yellow insects beneath the scales. Examined in summer, many show orange-colored larvæ, snowy-white young scales, mingled with old brown or blackened matured scales. This insect produces a peculiar reddening effect upon the skin of the fruit and of tender twigs. An encircling band of reddish discoloration around the margin of each female scale is very marked on the fruit of pears. The cambium layer of young twigs, where scales are massed, is usually

stained deep red or purplish. Where the scales are few the purplish ring surrounding each is quite distinguishable.

REMEDIES. The remedies for this scale present three forms: *Corrosive washes*, such as whale oil soap; *penetrating substances*, such as gases or kerosene emulsion; and *varnishes* or *resin washes* which cover the scale so as to prevent the escape of the young.

1. The use of hydrocyanic acids, or the gas treatment, is very effectual, but it is only practicable in certain cases, especially in the treatment of imported nursery stock. The following method is given in Bulletin 87, of the New York Experiment Station, Geneva: "This gas is lighter than air, hence will work better if the generator is placed below the pile of trees to be treated. A convenient way would be to make a rack a little less than six feet long, five feet wide, four feet high. The bottom of the rack could be made of loose slats raised a few inches above the ground to allow room to place the gas generator under the rack. When the rack is filled with trees, a piece of gas-tight canvas thrown over the whole and fastened down at the sides by throwing dirt on the margins would complete the apparatus. One side could be left open till the water and chemicals are placed in the dish and the dish slipped beneath the rack. This gas is a deadly poison, and great care should be used not to breathe it while placing the dish under the rack.

"To generate the gas pour three fluid ounces of water in a glazed earthenware vessel, to this add one fluid ounce of sulphuric acid; place under the trees and then add one ounce by weight of fused cyanide of potassium. This will make gas enough to fill a space of 150 cubic feet." An hour's exposure will likely kill all the scale insects.

2. One of the most effectual remedies, and one readily applied, is the use of whale-oil soap, two pounds in one gallon of water. Apply this in the fall just as the leaves drop off, before the scales harden, and again in spring just before the trees bloom. Some recommend a weaker solution in the fall, one pound to one gallon of water, then just before the buds swell in spring, the stronger solution, two pounds to one gallon of water. Even the use of common soap has been followed by good results, but whale-oil or fish oil soap is preferable. Kerosene emulsion diluted with nine parts water, or whale-oil soap, one pound to four gallons of water, is good for summer treatment, as soon as the lice are moving. Three or four applications of this, at intervals of ten days, will destroy many insects, but as the females are continually producing young throughout the summer, the spraying should be kept up to be effectual. Fall or winter treatment with strong solutions is decidedly the most successful.

3. Pure kerosene is destructive to the scales, but will kill the trees unless great care is observed in its application.

The use of resin washes, though successful in California, has not given very decided results in the east.

There are two enemies to the scale among insects, both of which are reported to aid very materially in keeping the scale in check. One, the "Twice-stabbed Ladybird" (*Chilocorus bivulnerus*,) is very common on infested trees, apparently feeding upon the scale; the other is a chalcid parasite (*Aphelinus fuscipenius*).

SUGGESTIONS.

1. Examine carefully sickly trees and trees or scions brought from nurseries in infested districts.

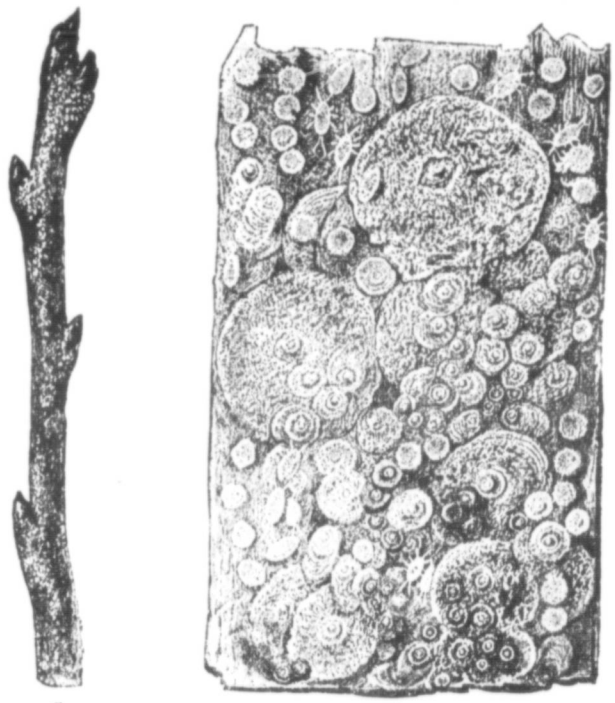
2. If only a few trees are infested, destroy them.

3. Trees infested, if well cut back and treated with whale-oil soap, as directed, may be largely saved.

4. Orchards set out within the last six years with trees from infested States, may be suspected. They should be carefully examined.

5. Examine fruit from infested localities

This most excellent cut, taken from Bulletin 3, U. S. Department of Agriculture, represents exactly what the writer of this bulletin has seen in the Niagara District.



a. *b.*

Appearance of scale on bark; *a*, infested twig—natural size; *b*, bark as it appears under hand lens, showing scales in various stages of development and young larvae.

I also prepared last spring a bulletin on spraying. It is as follows:

INSTRUCTIONS IN SPRAYING.

Solutions Recommended.

Bordeaux Mixture.	Copper sulphate	4 pounds.
	Lime (fresh)	4 "
	Water	40 gallons.

Suspend the copper sulphate in five gallons of water. This may be done by putting it in a bag of coarse material, and hanging it so as to be covered by the water. Slake the lime in about the same quantity of water. Then mix the two and add the remainder of the 40 gallons of water.

Warm water will dissolve the copper sulphate more readily than cold water. If the lime is at all dirty strain the lime solution.

If the lime is good the above amount is likely to be sufficient. It is an easy matter to know how much lime is required by using what is termed the ferrocyanide of potassium test. This substance can be got at any druggist's, and very little is required. Take a small bottle (2 oz.) and get it filled with a saturated solution of this compound. If there is not plenty of lime in your mixture, a drop of the test added to it, turns brown. Add

more lime and stir. As soon as the test fails to color in coming in contact with your mixture, it indicates there is sufficient lime present to neutralize the effects of the copper sulphate. Use wooden vessels in preparing the Bordeaux mixture.

Ammoniacal Copper Carbonate Solution.	Copper carbonate	1 ounce.
	Ammonia sufficient to dissolve the copper carbonate.	
	Water	10 gallons.

This solution is not much used, and is recommended only in cases where the fruit is so far advanced that it would be disfigured by using the Bordeaux mixture.

Paris Green Mixture.	Paris green	1 pound.
	Water	200 to 300 gallons.

Use 200 gallons of water in a mixture for apple trees, 250 for plum trees, and 300 for peach trees. When Paris green is added to Bordeaux mixture, so as to form a combined insecticide and fungicide, add four ounces to every 40 gallons of the Bordeaux mixture.

Hellebore.	White hellebore (fresh)	1 ounce.
	Water	3 gallons.
Pyrethrum.	Pyrethrum powder (fresh)	1 ounce.
	Water	4 gallons.
Kerosene Emulsion.	Hard soap	½ pound, or soft soap, 1 quart.
	Boiling water (soft)	1 gallon.
	Coal oil	2 gallons.

After dissolving the soap in the water, add the coal oil and stir well for 5 to 10 minutes. When properly mixed, it will adhere to glass without oiliness. A syringe or pump will aid much in this work. In using, dilute with from 9 to 15 parts of water. Kerosene emulsion may be prepared with sour milk (1 gallon), and coal oil (2 gallons), no soap being required. This will not keep long.

Notes.

1. When there is danger of disfiguring fruit with the Bordeaux mixture, use the ammoniacal copper carbonate solution.

2. Experience in spraying during the past two years indicates that it is best to use the combined insecticide and fungicide, commencing as soon as the buds begin to swell, again when the leaves appear, and continue it at intervals of 10 to 15 days, until the trees have been sprayed 3 to 5 times, which will depend upon the weather. In the case of a rainy season, it may be necessary to spray at least five times, while if dry, and the mixtures have been allowed to remain on the foliage, then three or four times may be sufficient.

In no case spray while the trees are in bloom, but immediately after.

3. The combined insecticide and fungicide, containing Paris green and Bordeaux mixture, is to be used for insects that chew, and injurious fungi, but kerosene emulsion alone for those insects that suck the juices of plants, such as aphis, thrip, red spider, etc.

4. A stock solution for the preparation of Bordeaux mixture may be prepared as follows: Dissolve 25 pounds of copper sulphate in 25 gallons of water. One gallon of this contains one pound of the copper sulphate. In another barrel slake 25 pounds of good lime, and add 12½ gallons of water. One gallon of this contains two pounds of lime. To make the mixture, take four gallons of the copper sulphate solution and two of the lime. If there is any doubt about there not being sufficient lime try the test already referred to under Bordeaux mixture. Now fill up the amount to 40 gallons with water.

5. Prepare the mixtures well, apply them at the proper time, and be as thorough as possible in the work.

TREATMENT.

APPLE. Treatment for destroying *codling moth, bud moth, tent caterpillar, canker worm, apple spot* and *leaf blight* :

First spraying : Bordeaux mixture and Paris green (4 oz. to the barrel of the mixture) when the buds are swelling.

Second spraying : Bordeaux mixture and Paris green before the blossoms open.

Third spraying : Bordeaux mixture and Paris green when the blossoms have fallen.

Fourth and fifth spraying : Bordeaux mixture and Paris green at intervals of ten to fifteen days, if necessary.

PEAR. *Leaf blight, scab* and *codling moth*, the same treatment as for the apple.

PLUM. *Curculio, brown rot*, and *leaf blight.*

First spraying : Bordeaux mixture before the flower buds open.

Second spraying : Bordeaux mixture and Paris green as soon as the petals have fallen.

Third spraying : Bordeaux and Paris green in seven to ten day after.

Fourth spraying : Bordeaux mixture in ten to fifteen days after.

PEACH. *Brown fruit rot, leaf blight*, and *plum curculio.*

First and second sprayings : Same as for the treatment of the plum.

Third spraying : Bordeaux mixture in two to three weeks.

Fourth spraying : Ammoniacal copper carbonate, if any danger of disfiguring the fruit with Bordeaux mixture.

CHERRY. *Aphis, slug, brown rot*, and *leaf blight.*

First spraying : Bordeaux mixture as the buds are breaking ; if the *aphis* appears use kerosene emulsion alone.

Second spraying : Bordeaux mixture and Paris green, as soon as the blossoms fall.

Third spraying : Bordeaux mixture and Paris green ten to fifteen days after.

GRAPES. *Mildew, black rot*, and *flea beetle.*

First spraying : Bordeaux mixture and Paris green when leaves one inch in diameter.

Second spraying : Bordeaux mixture and Paris green when flowers have fallen.

Third and fourth sprayings : Bordeaux mixture at intervals of ten to fifteen days.

Paris green alone when the beetle is attacking the buds in the spring.

RASPBERRY —*Anthracnose* and *leaf blight.*

First spraying : Bordeaux mixture just before growth begins.

Second spraying : Bordeaux mixture about when first blossoms open.

Third spraying: Bordeaux mixture when the fruit is gathered.

CURRANT AND GOOSEBERRY.—*Worms* and *mildew.*

First spraying : Bordeaux mixture and Paris green as soon as the leaves expand.

Second spraying : The same, ten to fifteen days later.

For worms alone, hellebore or Paris green will be effective.

TOMATO.—*Rot* and *blight.*

Spray with Bordeaux mixture, as soon as rot or blight appears, for three times, if necessary, at intervals of ten to fifteen days.

POTATO.—*Blight* and *beetles.*

First spraying: Paris green as soon as the beetles appear (one pound to 100 gallons of water).

Second spraying: Bordeaux mixture and Paris green, when plants six inches high.

Third and fourth sprayings: Bordeaux mixture at intervals of ten to fifteen days, if necessary.

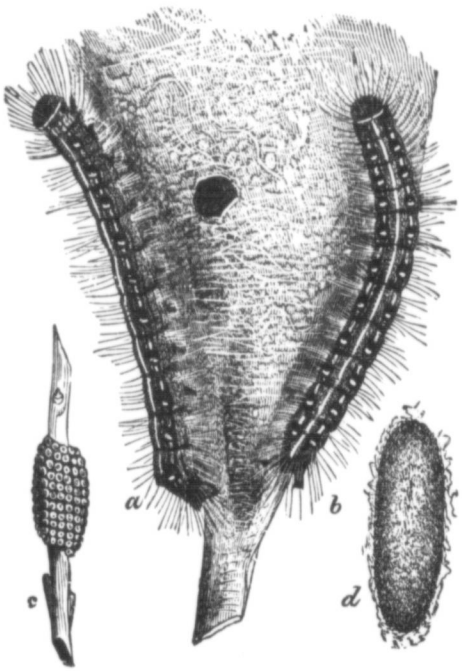
CABBAGE.—Pyrethrum applied in solution (one ounce to four gallons of water) or dusted on (one part pyrethrum to seven parts flour) for the cabbage worm.

STRAWBERRY.—The *rust* or *leaf-blight.*

Bordeaux mixture, when it can be applied without disfiguring the fruit, will control this disease. Apply at intervals of two or three weeks on new beds after they begin to make runners.

INJURIOUS INSECTS.

The following are some of the most common injurious insects that are troublesome in the garden and orchard. To destroy these, spraying as directed will be effective. To destroy insects only use an insecticide, but if treating for a fungoid pest at the same time use a combined fungicide and insecticide.



Tent Caterpillar: *a* and *b*, caterpillars; *c* egg cluster; *d* cocoon.

Tent Caterpillar moth.

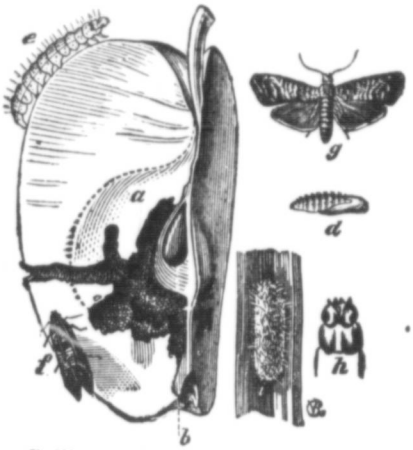
TENT CATERPILLARS.—*Clisiocampa Americana*, and *C. Sylvatica.*—These insects weave large webs in the branches of the apple tree, and do much damage feeding upon the foliage of the trees. It also attacks the plum and cherry. The eggs—200 to 300—are laid in rings upon the twigs of the trees and can be readily seen, so that many of them might easily be destroyed during the winter. The caterpillars grow rapidly. *Americana* has a white strip down the back, and *Sylvatica* a series of white spots, and thus they are readily distinguished from each other. Both develop into brown moths. The accompanying cut represents the different stages of the insects. *C. Americana.*

Remedy—1. Collect the egg clusters in winter. 2. Crush the "tents" when full of caterpillars. 3. Apply Paris green alone or with Bordeaux mixture.

CODLING MOTH.— *Carpocapsa pomonella* The eggs of this tiny moth are laid on the calyx of the young apple, while it is turned up. As soon as hatched the larva burrows into the apple, where it feeds until fully developed. Affected apples fall to the ground, and often contain the worms in them. The cocoons are frequently under the bark and in other sheltered spots.

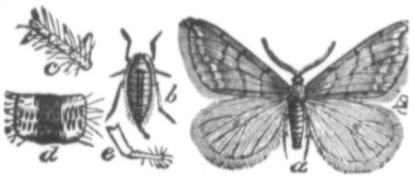
The moth appears about the time the trees are in bloom, and is one of the worst pests that attacks the apple.

Remedy —1. Feed to hogs the fallen apples which may contain larva. 2. Spray with Paris green, as directed for the treatment of the apple.

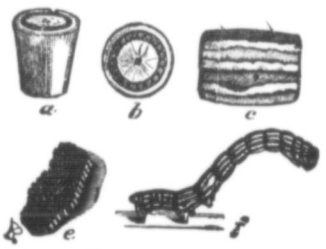


Codling moth : *a*, burrow ; *b*, entrance hole ; *d*, pupa ; *e*, larva ; *f*, moth.

CANKER WORMS.—*Anisopteryx vernata* and *A. pometaria.* The spring canker worm was very common in 1896. Both worms are much alike, about an inch long, of a



Canker Moths : *a*, male ; *b*, female.



Canker Worm (*f*), and eggs (*a*, *b*, *c*.)

darkish brown color, slender, and move with a loop-like motion ; hence, sometimes called "measuring worms." They can drop from a tree by a silken thread.

A. vernata, the imago, appears in spring, the female is wingless, the male is ash-colored and has wings. *A. pometaria* is much the same, but the imago appears in the fall. The wingless females in both species crawl up the trunks to lay their eggs upon the twigs.

These insects attack the plum, cherry and apple. The accompanying cuts illustrate *A. vernata.*

Remedy.—The females may be trapped by putting a band of some adhesive material around the tree.

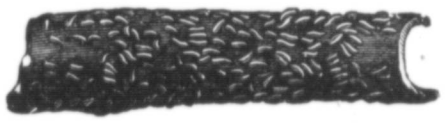
2. Paris green is an effective remedy, as directed in the treatment of the apple.

OYSTER-SHELL BARK-LOUSE —*Mytilaspis pomorum.* The insect appears in the form of a minute brown scale upon the bark of the apple tree, and, being much the same color, it is difficult to distinguish. The eggs are beneath the scales. They hatch about the end of May or the beginning of June. The young lice are almost invisible. They suck the ends of the young twigs, where they become fixed and continue to suck the juice from the twigs. Soon a scale forms over them. All under the scales, the shape of an oyster-shell, are females that lay their eggs under the scale. The scale of the male is more oblong, and is rarely seen.

Remedy —1. In winter, or early spring, scrape off the rough bark from the trunk and large limbs, and rub in with a scrubbing-brush the following solution : One quart soft

soap, or one-quarter pound hard, in two quarts boiling water; take seven parts of this and add one part carbolic acid; then, when the young lice are moving (May or June) spray with kerosene emulsion, diluted with ten parts water.

Pear-tree slug, various sizes.

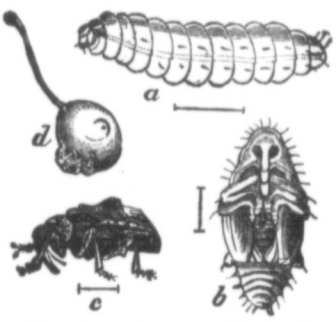


Oyster-shell Bark-Louse.

PEAR-TREE SLUG.—*Eriocampa cerasi.* This insect may be found attacking the pear, plum and cherry. The eggs are laid about June; the larva is about one-half inch in length and is thicker towards the head; of a somewhat greenish-black color, and slimy. It has many legs. The pupa stage is spent in the ground and lasts two weeks. The imago is a small four-winged black fly. The slug feeds on the upper surface of the leaf. It was quite common during 1896.

Remedy.—Spraying with Paris green, hellebore or pyrethrum, in the common proportions.

PLUM CURCULIO.—*Conotrachelus nenuphar.* There is no insect better known than this little beetle. The egg is deposited in the plum, where it hatches. The affected fruit soon falls to the ground, and the larvæ leave the plums and pass into the ground, where they remain for about six weeks. The imago is a small grayish beetle, one-fifth of an inch long, with a black lump on the middle of each wing-case. It has a curved snout and a stout body. The beetles hide themselves during the winter, in sheltered spots, and appear in spring about the time the trees are in bloom. This insect is also found upon the cherry, peach, and even apple.



Plum Curculio; *a*, grub; *b* and *c*, beetle; *d*, egg laying on plum.

Remedy.—1. Jarring the tree morning and evening. At this time many beetles will drop and may be collected upon a sheet placed below.

2. Gather and destroy the affected plums, as they fall.

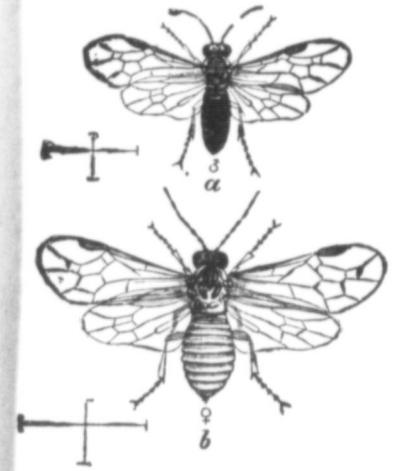
3 Spray Paris green as directed for the treatment of the plum, or Paris green may be applied alone (1 pound to 250 gallons of water, if the foliage is tender add 2 pound of lime) Spray once before the trees bloom, as soon as the foliage is well started, again as soon as the petals fall, and repeat about a week after.

CURRANT WORM.—*Nematus ribesii.* This insect is very troublesome upon currant and gooseberry bushes. It lays its eggs early in the spring, on the under side of the leaves, in rows along the veins. These hatch in about ten days, and the young worms appear. The larvæ, when full grown, is about three-quarters of an inch in length, of a greenish color, with dark spots, and has many legs. It spins a brown cocoon, of paper-like texture, which is found sometimes on the ground among the dried leaves, or on the bush attached to the stems or leaves. This represents the pupa condition.

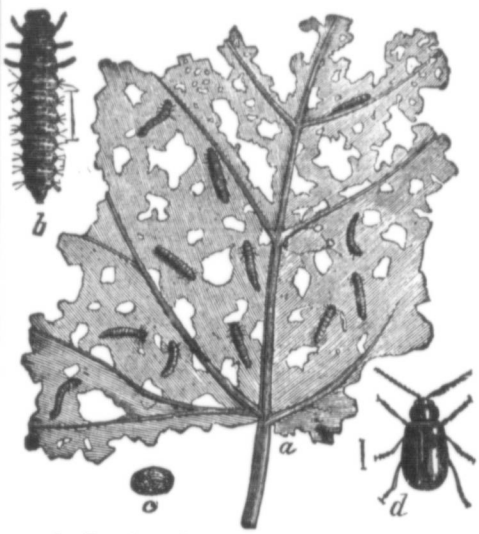
The imago appears in about two weeks after the pupa stage has been entered. The male is much smaller than the female, the body black, with some yellow spots above, while in the female the body is mostly yellow. Both have four membraneous wings. A second brood is of common occurrence.

Remedies.—1. Hellebore, one ounce in three gallons of water. It may also be applied as a dry powder, mixing it with three or four parts flour.

2. Paris green for the first brood ; but care must be taken not to continne this if the fruit is likely to be affected.



Currant Worms and the Saw Flies to which they change.



GRAPE-VINE BEETLE.—*Haltica chalybea.* The eggs are deposited on the under side of the leaves. The larva is about one-third of an inch long, brownish, with several black dots on the body. The pupa condition is passed in the ground, and continues for about three weeks.

The imago is a small polished beetle, about one-fifth of an inch long. It passes the winter in sheltered spots, under leaves or around the roots, and is very destructive in the spring to the young buds, and afterwards, in the larval condition, to the leaves.

Remedies.—1. Paris green, three ounces to fifty gallons of water, or combined with Bordeaux mixture, as directed under treatment of the grape.

2. Dust pyrethrum powder upon the vines attacked.

3. Jarring the vines in the morning and collecting the beetles.

ROUND HEADED BORER (*Saperda candida.*) The *eggs* are deposited about June, near the base of the trunk of the apple tree. The *larva* eats its way

Round-headed Apple Tree Borer, *Saperda candida* : *a*, larva ; *b*, pupa ; *c*, beetle.

through the outer bark to the inner, and takes about three years to develop. It works in the sapwood, where it forms flat, shallow cavities, filled with saw-dust like castings. These are often seen on the bark, and indicate where the "borer" is at work. As it reaches maturity it cuts a passage upwards into the solid wood, and then curves towards the bark. In this channel it enters the *pupa* stage, about spring. When fully developed, it is an inch long, with a round head that distinguishes it from the flat-headed borer, which also affects the apple tree.

The *imago* is a slender beetle, one inch long, with two broad, whitish stripes on the wing-covers, and long, jointed antennæ. It appears about June.

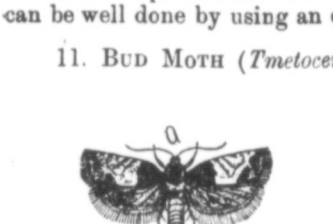
Flat-Headed Borer (*Chrysobothris femorata*). This insect also attacks the trunk of the apple tree, but lays its *eggs* higher up the tree than the preceding one. The *larva* is pale yellow, an inch long, and has a well-marked flat head, much wider than the body. It is sometimes found even in the limbs, and is not so long in developing as the round headed borer. It cuts flat channels in the sap-wood, and sometimes girdles the tree. Castings and discolored bark indicate its presence. It finally bores into the solid wood, and becomes a *pupa* for about two weeks, and then emerges as an *imago* about half an inch long, somewhat flat, and of a greenish black color, with three raised lines on each wing cover. The legs and under side of the body present a coppery lustre.

Flat-Headed Apple Tree Borer, *Chrysobothris femorata*, Fabr: *a*, larva; *b*, beetle.

Remedies.—1. Examine the trees in autumn, and where the saw-dust-like castings indicate the presence of the "borer," a stiff wire may be pushed in and the larva killed, or sometimes the larva can be cut out with a knife.

2. About the beginning of June apply the following mixture to the trunk of the tree: One pound of hard soap, or one quart of soft, in two gallons water; heat to boiling, and add one pint crude carbolic acid; make a second application in three weeks. This can be well done by using an old scrubbing-brush to rub it in.

11. Bud Moth (*Tmetocera ocellana*).—This insect is found attacking the buds upon the apple, and sometimes proves very injurious. The half-grown *larva* winters over, and appears in spring as a small brown caterpillar, just about the time the buds begin to open, and feeds upon them. It measures about half an inch when full grown. By rolling up one side of a leaf, and securely fastening it with silken threads, it forms a tube in which it enters the *pupa* stage, having lined the little chamber with a closely woven layer of silk. This condition lasts ten days. The *imago* is a small moth, resembling the codling moth in size and form. It is of an ash gray color. The front wings have a whitish gray band across the middle; the hind wings are a dusty brown. The expanded wings measure half an inch across.



Apple Tree Bud Moth, *Tmetocera ocellana*: *a*, moth; *b*, larva; *c*, pupa.

Remedy.—Paris green added to Bordeaux mixture, as directed for the treatment of the apple.

The Grape-leaf Hopper or Thrip (*Erythroneura vitis*). This small insect, about an eighth of an inch long, of a white color, marked by three dark bands, is sometimes troublesome on grape vines. They feed upon the juices of the plant, and are usually upon the underside of the leaves, where they are difficult to reach in spraying.

Remedy.—1. Remove fallen foliage at the close of the season, so that the insects cannot find shelter during the winter.

2. Spray with kerosene emulsion diluted with ten parts water, on the under side of the leaves, in the cooler part of the day.

RED SPIDER (*Tetranychus telarius*). The red spider is a very small insect—a true mite—and in some places is very destructive. It sucks the juices of the plants attacked, and causes the color of the leaf to change from green to a grayish-white. It flourishes in a dry atmosphere and in sunny places; shade and moisture are not favorable to its development.

Remedy.—Spray with clear water and keep the atmosphere about the plants moist.

2. Spraying with kerosene emulsion should also be followed by good results.

PLANT LICE (*Aphidæ*). These minute, greenish insects affect the foliage of many plants by sucking the juice, and thus injure the leaves. They can be controlled by spraying with kerosene emulsion.

INJURIOUS FUNGI.

The following are among the most injurious fungi that affect the product of the garden and orchard. They can be readily controlled by the proper application of Bordeaux mixture, as directed.

The usual life history of a parasitic fungus is, that it arises from a spore which is microscopic; this germinates and gives rise to thread-like structures which penetrate the plant upon which the fungus grows and derives its nourishment. Upon these structures in time spores are produced, as new sources from which the fungus may develop and continue to be injurious to the vitality of the plants attacked.

APPLE SPOT OR "SCAB" (*Fusicladium dendriticum*). This fungus attacks the leaves and fruit of the apple, causing the "spots" on the fruit. The vegetative portion of the fungus is chiefly around the edge of the spots, where the spores are produced in great numbers.

LEAF SPOT (*Entomosporium maculatum*). This disease attacks the pear, causing the leaves to show reddish spots with small pimples in the centre. When the fruit is attacked it cracks and appears stunted.

"BROWN ROT" (*Monilia fructigena*). Attacks plums, cherries and peaches. The fruit affected becomes brownish at first, then shrivels and appears dried. In this condition it is termed "mummified," and is often seen upon the trees in that form. All "mummified" fruit should be gathered and burned, as they contain spores that will perpetuate the disease.

"ANTHRACNOSE" (*Gloeosporium venetum*). This fungus appears on the canes of raspberries as small round or oval patches, with a purple border, and sometimes upon the leaves as small yellowish spots with dark border. The affected canes should be cut out and destroyed by burning.

"LEAF-BLIGHT," "SUNBURN" (*Sphœrella fragariæ*). This disease produces very conspicuous spots on the upper surface of the leaves of the strawberry. The spots are reddish at first, then the centre becomes somewhat grayish.

"POWDERY MILDEW" (*Sphærotheca mors uvæ*). This mildew is the well-known blight on the gooseberry. It thrives in a warm, dry atmosphere, and sometimes is very destructive. At first the berries are covered with a grayish substance, and later assume a brown color.

"POTATO BLIGHT" (*Phytophthora infestans*). This fungus attacks the potato, commencing with the leaves and finally affecting the tubers.

VITALITY OF THE COMMON BINDWEED (*Convolvulus arvensis*).

The series of experiments with this weed, begun in 1896, was continued this season, but with indifferent results, no satisfactory method of dealing with the pest having been found. The plot, which had been covered with salt in May, 1896, was observed on May 11th, 1897, to have some plants springing through, especially near the edges. Weekly hoeings of the other plots and digging around to the depth of one foot failed to overcome the trouble.

On May 12th a test was made of the vitality of small sections of the root. A plot of ground two feet square, infested with the weed, was dug and the soil removed and carefully sifted. There were obtained 142 feet of main root one-seventh to three eights of an inch in thickness and 120 rootlets of an average length of three inches. The total weight of roots was 13¼ ounces. The main root was cut into half-inch, one inch and two-inch pieces and these were sown in pots. There were ten half inch pieces, five one-inch pieces, and five two-inch pieces of the root, also five two-inch pieces of the stem; but none of them grew. On July 2nd, a similar experiment was tried, when it was found that out of five pieces of root, each five inches in length, two grew.

A piece of root ten inches in length was exposed to the sun for a short time and then planted, and it did not grow. From this it would appear that exposure to the sun destroys the vitality of the root.

BORDEAUX MIXTURE AS AN INSECTICIDE.

The experiments with Bordeaux mixture as an insecticide were a continuation of those reported upon in 1896. Twenty-five gooseberry bushes were selected for the work. Every fifth one was left unsprayed while the others were sprayed with Bordeaux mixture, made from four pounds of copper sulphate, four pound of lime and forty gallons of water.

First application, May 6th.

Second application, May 13th. No worms were found. On May 19th, a few worms were seen on the lower side of some of the leaves. They had eaten from the under surface and interior of the leaf, avoiding the poison, and had thus skeletonized a number of leaves.

Third application, May 21st. On May 28th only a few worms were found on the sprayed bushes; on the unsprayed the worms had done considerable damage. On May 31st, these appearances were more marked, but on the sprayed bushes a few worms were observed on the young shoots which had lately come into leaf.

Further experiments with the application of lime water gave results similar to those with the Bordeaux mixture.

Tent caterpillars were sprayed with Bordeaux mixture and with Bordeaux mixture and Paris green combined. In both cases a blackening of the larvæ and death resulted.

These last experiments, though incomplete, seem to indicate that lime water is as efficacious as Bordeaux mixture, and that there is, perhaps, a slight advantage to be gained from the addition of Paris green.

I wish to bear testimony here to the great assistance rendered me by the Fellow in Biology, Mr. T. F. Paterson, who, unfortunately, resigned his position in September to accept one which in his opinion offered a better field for the exercise of his energies. Mr. J. C. Macdonald, B.S.A., of '97, has been appointed in his place, and already his work has proved him worthy of the appointment.

All of which is respectfully submitted,

J. HOYES PANTON,

Professor of Biology and Geology.

Guelph, November 24th, 1897.

PART IV.

REPORT OF

THE CHEMISTRY DEPARTMENT.

To the President of the Ontario Agricultural College :

SIR,—Owing to Prof. Shuttleworth's absence in Germany, it devolves upon me to write the report of the Chemical Department for this year.

During Prof. Shuttleworth's absence Mr. W. A. Kennedy, a graduate of the college, has been assisting with both the teaching and analytical work of the department ; and much of the matter herein reported is due to the valuable services he has rendered since his appointment.

A year's work in the new laboratory has shown it to be admirably adapted to the requirements of our work. The class-room and preparation room adjoining are far superior to those in the old building, and afford greatly increased facilities for the demonstration of the principles of chemistry. The qualitative and quantitative laboratories are now fully equipped, making it possible to do much more efficient work. A separate room for station analyses has greatly facilitated the investigation work of the department.

Some slight changes have been made in the work of this department. Owing to a change in the options of the Third Year, the Agricultural and Horticultural specialists have now to take a course in the chemistry of Insecticides and Fungicides, and a course in the chemistry of Dairying has been added to the work of the Dairy specialists. In addition to this, the agricultural specialists have now to take honours in Agricultural and Animal Chemistry, and the dairy specialists in Animal Chemistry ; and the increased laboratory accommodation makes it possible to give the Second Year students more practical work than heretofore.

WORK FOR OTHER DEPARTMENTS.

Agricultural Department : In conjunction with Mr. Day's experiments to ascertain the comparative feeding value of sweet and sour whey, we determined the protein and sugar in a number of samples of whey. The results of this work will be found in the report of the Agriculturist.

Dairy Department : At Prof. Dean's request we analyzed a number of samples of whey with a view to determining at what stage in the process of the manufacture of cheese the casein is lost ; also, if more casein is found in the whey from rich milk than in that from poor milk, and at what stage, or stages, it is lost. For this purpose, the casein was determined in a number of samples of rich and poor milk taken at four different stages in the process of manufacture, viz., before dipping, after dipping, after milling, and after salting.

We also determined the moisture of forty samples of butter. The results of this work will appear in the report of the Professor of Dairying.

Five samples of water and one sample of clay were analyzed during the year, but the results are not of sufficient importance to publish here.

Analyses of Sugar Beets.

At the request of the Minister of Agriculture and the Directors of the Owen Sound Sugar Manufacturing Co., we analyzed, during the latter part of October, forty samples of sugar beets. The results of which are here given.

The Owen Sound Sugar Manufacturing Co. had, during the last season, about 400 farmers growing sugar beets. The plots varied from one-tenth to one and one-half acres in area, and were all sown with seed imported from Germany. To determine the quality of the beets grown, representative samples were selected, a number of which were sent to Thomas Macfarlane, Analyst of the Dominion Inland Revenue Department, Ottawa, and part to our laboratory. The beets arrived here in a good fresh condition and were at once analyzed. The results of the analyses are given in the table below.

No.	Name.	No. of roots	Average weight in pounds.	Analysis of juice.			Remarks.
				Solids.	Sugar.	Purity.	
1	Anderson, D.	5	1.50	18.96	14.6	77.01	Long, pointed and medium.
2	Tomsett, Wm.	5	1.35	17.71	14.1	79.61	Stout, short, medium.
3	Cann, Jno.	6	.67	18.40	16.4	88.04	Short, stout and small.
4	Millard, A.	6	1.61	17.70	14.5	81.35	Large and rather short.
5	Sprag, L.	6	1.06	19.47	15.7	80.63	Slender and of medium length.
6	Simms, W. W.	6	1.01	19.40	15.7	80.92	Long and of medium thickness.
7	Power, Jas.	6	1.50	19.07	14.9	78.12	Short and rather stout.
8	McLain, D.	5	1.34	19.36	15.9	81.91	Of medium length.
9	McGregor, Wm.	6	1.31	18.92	15.31	80.86	Medium to large.
10	Forrest, D.	6	1.12	19.00	15.9	83.68	Slender and of medium length.
11	M'f'g Co., O.S.S.	6	1.19	17.97	13.5	75.12	Small, short and stout.
12	Michael, G.	5	1.07	18.20	15.5	85.16	Slender and small.
13	Bailey, Wm.	6	1.37	19.40	15.4	79.38	Long and of medium thickness.
14	Frost, T.	4	1.41	19.32	15.3	79.19	Long, slender roots.
15	Walters, J.	6	1.26	18.60	15.6	83.87	Of medium length, slender.
16	Tory, Arthur.	6	1.51	20.00	17.0	85.00	Short and of medium thickness.
18	McIntosh, R. J.	5	1.12	17.70	14.6	82.49	Small and of medium length.
20	Cook, Moses.	4	1.44	18.56	15.00	80.81	Large and short.
20	Cook, Moses.	4	1.88	17.60	14.1	80.11	Short and quite stout.
21	McGregor, I.	5	.86	18.70	15.9	85.02	Very small.
22	Morrison, —	6	1.95	18.69	15.1	80.79	Large, stout and long.
23	Lang, H. C.	6	2.31	19.90	15.9	79.89	Very large and long.
24	McNabb, Geo.	8	1.06	16.81	13.6	80.90	Of medium length.
25	Vail R.	6	1.56	15.81	10.8	68.31	Quite large, long and slender.
27	Nesbit, Wm.	6	.88	19.80	16.0	80.80	Small and short.
28	Ried, N.	6	.76	19.97	16.5	82.62	Very small and lengthy.
29	Duff, T.	7	1.59	18.60	14.5	77.90	Thick and of medium length.
30	Kennedy, H. C.	6	1.00	19.30	16.2	83.93	Long and slender.
31	Dinsmore, J.	6	2.51	19.20	15.4	80.20	Large, very thick.
32	Emry, J.	6	1.52	18.10	15.7	86.74	Lengthy, medium and stout.
33	Herman, A. A.	5	2.51	18.80	14.8	78.72	Very stout, of medium length.
34	McKay, —.	6	1.67	18.76	15.4	82.08	Of medium length and stout.
35	Quinn, Jas.	6	1.54	17.20	10.7	62.20	Thick and of medium length.
36	Martindale, G.	5	1.87	19.60	16.0	81.63	Short and stout.
37	Pacey, E.	2	4.51	16.91	12.0	70.90	Very large.
38	Davidson, D.	6	1.64	18.70	15.0	80.21	Of medium length and stout.
39	McKenzie, J.	6	1.47	17.70	13.2	74.57	Thick and short.
40	Whinfield, J.	5	1.92	18.00	10.7	59.44	Thick and of medium length.
41	M'f'g Co., O.S.S.	5	1.34	17.90	14.0	78.21	Thick and of medium length.
42	Magwood, —.	6	1.61	18.70	14.8	79.14	Of medium length and stout.
	Average.	.....	1.52	18.81	14.8	79.66	

The results of the analyses show the beets to be of a very good quality. The percentage of sugar in samples No. 25, 35 and 40 is low, and the co-efficient of purity is very low. These three samples have naturally reduced the average per cent of sugar and the co-efficient of purity in the forty samples analyzed. The average, however, still compares very favorably with the standard proposed by Dr. Wiley, in Bulletin No. 30, Division of Chemistry, United States Department of Agriculture. Dr. Wiley gives the following as a standard of comparison:

"I would say that a typical sugar beet for sugar-making purposes should weigh 600 grammes, (1⅓ lbs.), contain fourteen per cent. sugar, and have a purity of at least eighty." Continuing, Dr. Wiley says, "With such raw material at his disposal in sufficient quantity, the manufacturer cannot fail of success, provided he be supplied with the latest and most improved forms of machinery."

During the year 1890, C. C. James, Deputy Minister of Agriculture for Ontario, then Professor of Chemistry in this institution, and Mr. Wilfred Skaife, B.A., Sc., analyzed a large number of samples of sugar beets gathered from different parts of the Province. The results of their work were published in the College Report of that year. Later, sugar beets were sent here from the Leamington, Niagara and Owen Sound districts. The analyses of these, with some varieties grown by Mr. Zavitz on the experimental plots of the College Farm, are given in the report of this institution for 1895. In most cases the beets were grown by inexperienced beet growers and, as a result, were very large, with a considerable portion grown above ground. Notwithstanding this fact, it is evident from the average of these analyses, which are given in the table below, that beets containing a fairly high percentage of sugar and high co-efficient of purity can be grown in Ontario.

Average of the analyses made in 1890, 1895 and 1897.

Year.	Average weight of beet.	Analysis of juice.		
		Solids.	Sugar.	Purity.
	lbs.			
1890	1.40	17.12	13.58	79.32
1895	3.75	15.90	14.34	90.20
1897	1.52	18.81	14.80	79.66

With the present degree of perfection in the production of beet seed rich in sugar, and with the knowledge of the scientific principles of agriculture which should guide the beet growers, it is undoubtedly possible to increase the percentage of sugar and improve the co-efficient of purity.

Composition of the Ashes of Different Woods.

The value of wood ashes lies in the fact that they are the mineral remains of the plant. The growing plant gathers all its mineral constituents from the soil in which it grows, and these, not being combustible, are left as an ash when the plant is burned. Consequently it must contain all the mineral constituents that are necessary for growth. Of these essential constituents, potash and phosphoric acid are the most important, not only because they are taken up in comparatively large quantities by the growing plant and then sold and taken from the parm in the form of grain and beef, but also because of the fact that average Ontario soils do not contain them any too abundantly. Our soils, particularly for the growth of certain crops, are beginning to require potash and phosphoric acid, and these are contained in an available form in wood ashes. Ashes also con-

tain large quantities of lime, which acts physically in making sands firmer and clays more friable, and chemically in rendering available for plant growth the potash and phosphoric acid held in certain comparatively insoluble constituents of the soil. Wood ashes therefore supply both directly and indirectly these two valuable constituents, potash and phosphoric acid.

The fact that the soil in many sections of the Province is decreasing in fertility, combined with low prices for produce, has made many farmers and orchardists look about for some cheap form of fertilizer. Many letters have been received by the Department asking for the composition of the ash from various woods, and to supply this growing demand for information regarding the amount of potash and phosphoric acid contained in ashes, we have, during the last two years, made a considerable number of analyses of the ashes from different kinds of wood. The report from this department for last year contains an account of the work done, and the work of collecting and analyzing the ashes was continued throughout this last year; so that we now have the analyses of a fairly complete list of the ashes of the common Ontario forest trees; and in addition, some work has been done on the ashes from fruit trees and small fruits.

The method of preparing a sample of ashes for analysis was the same as that reported last year. "The samples of ash of the different woods and small fruits were obtained by carefully reducing the whole or portions of the tree or bush to a comparatively white, anhydrous ash which was tightly bottled and labelled for analysis. Each sample, therefore, was true to representation."

As commercial ashes are usually obtained from the burning of cordwood, samples for analyses were, in most cases, taken from the trunks and older boughs of trees. From fruit trees, samples were obtained in the same way, while in the case of the small fruits, only the canes were burned.

The figures given in table below express the percentage of the various constituents contained in the dry ash. The nitrogen was, of course, dissipated in burning.

Varieties.	Potash.	Soda.	Phosphoric acid.	Lime.	Magnesia.	Oxide of iron.	Sulphuric acid.
Iron wood	8.15	4.95	1.71	42.61	5.63	.50	.79
Maple (hard)	9.31	.....	2.03	45.24	.....	.....	1.24
Hickory	9.17	4.35	2.12	44.43	6.49	.24	.56
Beech	7.58	4.09	1.39	41.21	6.16	.30	traces
Maple (soft)	9.52	.....	1.29	41.97	5.38	.12	1.39
Rock Elm	6.66	2.690	.71	49.52	2.64	.25	.59
Swamp Elm	35.37	traces	.45	23.64	6.48	.19	traces
Birch	8.58	1.47	1.81	37.10	5.65	.39	1.90
Oak, red	5.75	1.00	.92	48.97	2.45	.37	traces
Ork, white	9.39	2.88	1.69	43.54	4.39	.25	.91
Hemlock	8.73	3.88	2.76	45.83	4.78	.36	.98
Ash, black	25.30	4.22	1.20	49.04	7.42	.22	.71
Ash, white	16.88	12.90	.93	37.14	3.98	.32	.67
Pine	11.22	8.44	4.03	20.28	6.53	1.52	5.85
Cedar	3.30	3.08	.98	49.06	2.49	.70	.77
Spruce	8.98	.15	4.00	25.82	4.04	1.52	2.61
Willow	9.59	1.51	2.16	35.55	3.21	.55	2.38
Balsam	17.53	1.54	2.39	22.63	4.04	1.08	.88
Basswood	9.39	.10	5.28	33.42	4.28	.44	traces
Poplar	10.42	.....	1.18	28.73	3.64	1.43	1.67
Butternut	3.99	2.27	1.76	44.95	5.22	.45	.42
Walnut	4.62	.....	.70	35.93	5.35	3.42	1.51
Mixed wood ashes.							
No. 1	5.53	.....	1.34	.....	.....	.....	.....
" 2	4.55	.....	3.57	.....	.....	.....	.....
" 3	5.14	.....	1.32	36.45	.....	.....	.....
" 4	4.98	.....	1.45	33.39	.....	.....	.....
" 5	13.40	.....	1.18	28.73	3.64	1.43	1.67

Percentage of various constituents.—*Concluded.*

Varieties.	Potash.	Soda.	Phosphoric acid.	Lime.	Magnesia.	Ox'de of iron.	Sulphuric acid.
Ashes from fruit trees.							
Apple	4.84	4.02	1.81	44.93	3.28	.70	.41
Cherry	5.28	.92	1.90	46.93	3.00	1.29	.79
Pear	9.73	traces	.81	42.07	3.10	.39	.93
Plumb	4.81	traces	2.49	48.39	1.89	.22	.63
Peach	6.98	.27	3.43	41.49	3.18	.30	.73
Quince	6.32	1.76	2.29	48.22	3.17	.33	1.07
Ashes from small fruits.							
Blackberry	10.34	.....	7.26	35.14	.....	.....	1.24
Strawberry (whole plant)	15.90	.....	9.17	17.44	.....	.....	4.85
Gooseberry	13.07	.49	6.99	20.64	2.61	1.08	2.01
Raspberry	7.90	.81	6.54	23.03	8.54	1.19	2.60
Grape vine (whole vine)	8.33	.....	3.37	26.74	.....	.....	1.39
Grape vine, cuttings	12.21	7.67	6.31	21.39	9.96	.44	2.64
Hard coal, No. 1	traces	traces	.159	traces	traces	5.329	.415
Hard coal, No. 1	traces	traces	1.12	1.49	traces	2.60	.304
Garbage ash	1.27	2.31	1.66	8.13	1.17	5.307	1.400

The fact that these ashes were pure and prepared from the wood only explains why the percentages of mineral constituents are so much higher than those found in the average ashes in the market, which are as follows for unleached ashes: Moisture, 12.50; potash, 5.25; phosphoric acid, 1.70; lime, 34, and magnesia, 3.40 per cent. These averages correspond very closely with those of the mixed ashes given in the table above. Ashes which have been subjected to leaching show a reduced percentage of potash and an increased percentage of moisture, but otherwise remain the same. The average percentage composition of leached ashes, as compiled from analyses by the Massachusetts and Connecticut stations, is as follows: Moisture, 30.22; potash, 1.27; phosphoric acid, 1.51; lime, 28.08, and magnesia, 2.66 per cent. Limekiln ashes differ in composition from the leached ashes, principally in their lower percentage of moisture and higher percentage of lime. The average composition, as compiled from a large number of analyses, is as follows: Moisture, 15.45; potash, 1.20; phosphoric acid, 1.14; lime, 48.50, and magnesia, 2.60 per cent.

Reference to potash column in table of analyses shows clearly why ash buyers are anxious to get black ash and swamp elm ashes. At the same time, it must not be forgotten that these ashes are very light and bulky; therefore, although they are so high in percentage composition, there may be as much potash in one measure bushel of maple as there is in the same bulk of swamp elm ash. Basswood and pine contain very large amounts of phosphoric acid. Cedar is the poorest ash in the list. The ash of the fruit trees is very similar in composition to that of the forest trees. In that of the small fruits the percentages of potash and phosphoric acid are noticeably high, particularly that of the phosphoric acid. While this alone cannot be taken as a definite guide as to the proportion of the fertilizing constituents necessary for these plants, it certainly indicates that they will be benefited by a liberal supply of phosphoric acid. The figures bear out the idea that hard coal ashes do not contain much that has a fertilizing value. The garbage ash was from the Toronto crematory. Remembering the many sources of these ashes, it is evident that their composition will be very variable, and for that reason buyers should not draw hasty conclusions from any single analysis.

It is a well known fact that the ash from different parts of the same plant differs in composition, that from the young and growing parts being richest in potash. It is also true that the same kinds of plants grown upon different soils vary widely in the amount

of potash and phosphoric acid which they contain. For these reasons we do not claim that the figures given in the table represent a constant composition ; that is, that maple ashes always contain exactly 9.3 per cent. of potash and 2.03 per cent. of phosphoric acid, but that they are a general guide to the amount of the fertilizing constituents contained in an ash. For instance, a person may have a quantity of maple ashes on hand, or may wish to buy a pile that has been made largely from maple wood, and he will be safe in assuming that if they have been obtained from body wood, are dry, and free from dirt, 100 lbs. of the ash will contain about nine lbs. of potash and two lbs. of phosphoric acid.

But, as ordinarily obtained, ashes contain impurities, such as charcoal, sand, and more or less moisture. This usually amounts to fifteen per cent., and will of necessity reduce the percentage composition correspondingly.

A comparison between the value of wood ashes, based on the prices paid for artificial fertilizers, and what the producer actually receives for them, brings out some interesting figures. In commercial fertilizers, potash and phosphoric acid cost, on an average, about five cents per pound. We have seen that the ordinary ashes in the market contain 5 25 per cent. of potash, and 1.70 per cent. of phosphoric acid, or 105 lbs. potash and 34 lbs. of phosphoric acid per ton, which at five cents a pound would amount to $6.95, or allowing fifty bushels to the ton, 13.9 cents per bushel. At the same time, it is a well-known fact that in many parts of the Province ashes can be bought from the producer at from three to five cents per bushel. These figures show a difference of ten cents a bushel between the value of ashes and the price at which they are often sold.

It has been stated by those interested in the sale of potash fertilizers, that the potash in wood ashes is not all in an available form for plant use. To ascertain what truth there is in the statement, a nnmber of ashes were treated according to Dr. Dyer's method for determining the availability of plant food Plants exude an acid from their roots which has a solvent action on the constituents of the soil, and by carefully conducted experiments Dr. Dyer has determined that this acid root sap corresponds, so far as its solvent action is concerned, to a one per cent. solution of crystallized citric acid. If, then, the ash be treated with this solution, potash—corresponding to the amount that would be dissolved by the acid sap—will be brought into solution Nine ashes were treated in this way, and the amounts of potash, phosphoric acid and lime in solution determined. The results are given in the table below.

Table showing the availability of potash, phosphoric acid and lime, in a number of of samples of wood ashes :

Ash.	Potash.			Phosphoric acid.			Lime.		
	Pounds in 100 lbs. of ash.	Pounds soluble in a 1 per cent. solution of citric acid.	Per cent. of potash available.	Pounds in 100 lbs. ash.	Pounds soluble in a 1 per cent. solution of citric acid.	Per cent of phosphoric acid available.	Pounds in 100 lbs. ash.	Pounds soluble in a 1 per cent. solution of citric acid.	Per cent. of lime available.
White Oak	9.39	7 64	82.33	1.69	Traces	.....	43.54	3.60	8.27
Birch	8.58	6.82	79.48	1.81	Traces	.....	37.10	3.67	9.89
No. 5, mixed ash	13.40	12.72	94.92	1.18	.120	10.169	28.73	3.27	11.38
Walnut	4.62	4.61	99.87	.70	.109	15.57	35.93	2 57	7.15
Red Oak	5.75	4.72	82 09	.92	Traces	.....	48 97	2.24	4.57
Poplar	10.42	8.78	84.26	1.18	.034	2.88	28 73	3.90	13.50
White Ash	16.88	15.24	90.20	.93	.096	10.32	37.14	4.47	12 03
Butternut	3.99	3.56	89.22	1.76	Traces	.....	44.95	3.52	7.82
Willow	9.59	9.19	85.40	2.16	.144	6.66	35.55	2.99	8.41

Nearly 80 per cent. of the total potash of the birch ash was found in the solution and practically the whole of that of the walnut ash. An average of the nine samples experimented with shows that 87.5 per cent. of the total potash of the different ashes was soluble in the citric acid solution. According to this method of determining availability of plant food, all but 12.5 per cent. of the potash would be in a form in which growing plants could make use of it at once. Smaller amounts of the phosphoric acid and lime appeared to be soluble. In some cases, the amount of phosphoric acid was so small that it was not determined but simply entered as "traces."

It is evident from the above:

1. That wood ashes contain varying, but comparatively large, amounts of potash.
2. That the potash is very nearly all in a form immediately available for plant use.
3. That the price received for ashes by the producer does not nearly represent their value as a fertilizer.

The composition of Hay as affected by maturity.

Under the above heading, the report of this Department of last year contains the following: "To obtain something definite regarding the time when the most profitable degree of maturity is reached, six plots, one rod square, were set apart in our experimental grounds in 1895. Three were seeded down with common red clover and three with timothy. All the circumstances were favorable for the production of even and uniform crops. Each of the three plots of clover and of the three plots of timothy was cut on a different date, so that each cutting of clover and of timothy represents a distinct stage in the maturity of the respective crops. The produce of every plot immediately after being cut was weighed and cured as hay in the usual way, but without exposing to rain or dew. This cured hay was then again weighed, and a sample taken for chemical analysis." The above outlined experiment was repeated this year, the cuttings of clover and timothy being taken from the same plots as last year.

Pounds of dry matter per acre at the time of cutting:

Hay.	Dates of cutting.		Pounds of dry matter per acre.	
	1896.	1897.	1896.	1897.
Clover.				
1st cutting	June 1st	June 14th	2,948.34	2,682.21
2nd cutting	" 14th	" 28th	4,440.67	4,281.49
3rd cutting	July 7th	July 15th	6,439.36	4,462.80
Timothy.				
1st cutting	June 15th	June 25th	5,460.76	6,369.78
2nd cutting	July 7th	July 9th	9,114.91	7,751.42
3rd cutting	" 23rd	" 25th	8,537.96	7,537.55

As nearly as possible the different cuttings were made when the plant had reached the same stage of maturity as when the cuttings were made last year. This, for the first cutting of clover, was when the first blossom was just appearing; the second was made when one-third of the total number of blossoms had turned brown; and the third cutting when the heads were all browned or dead. The three cuttings of timothy were made when the heads were beginning to appear; when the first blossom had just fallen; and when the second blossom had fallen and the seeds were well formed. This year, on account of the cold wet weather in the month of May, the first cuttings were made two weeks later than the corresponding cuttings of last year.

The figures in the above table show a continual growth in the clover after the first cutting in both 1896 and 1897, while with the timothy in both years there is an increase to the second cutting, but a decrease between the second and third.

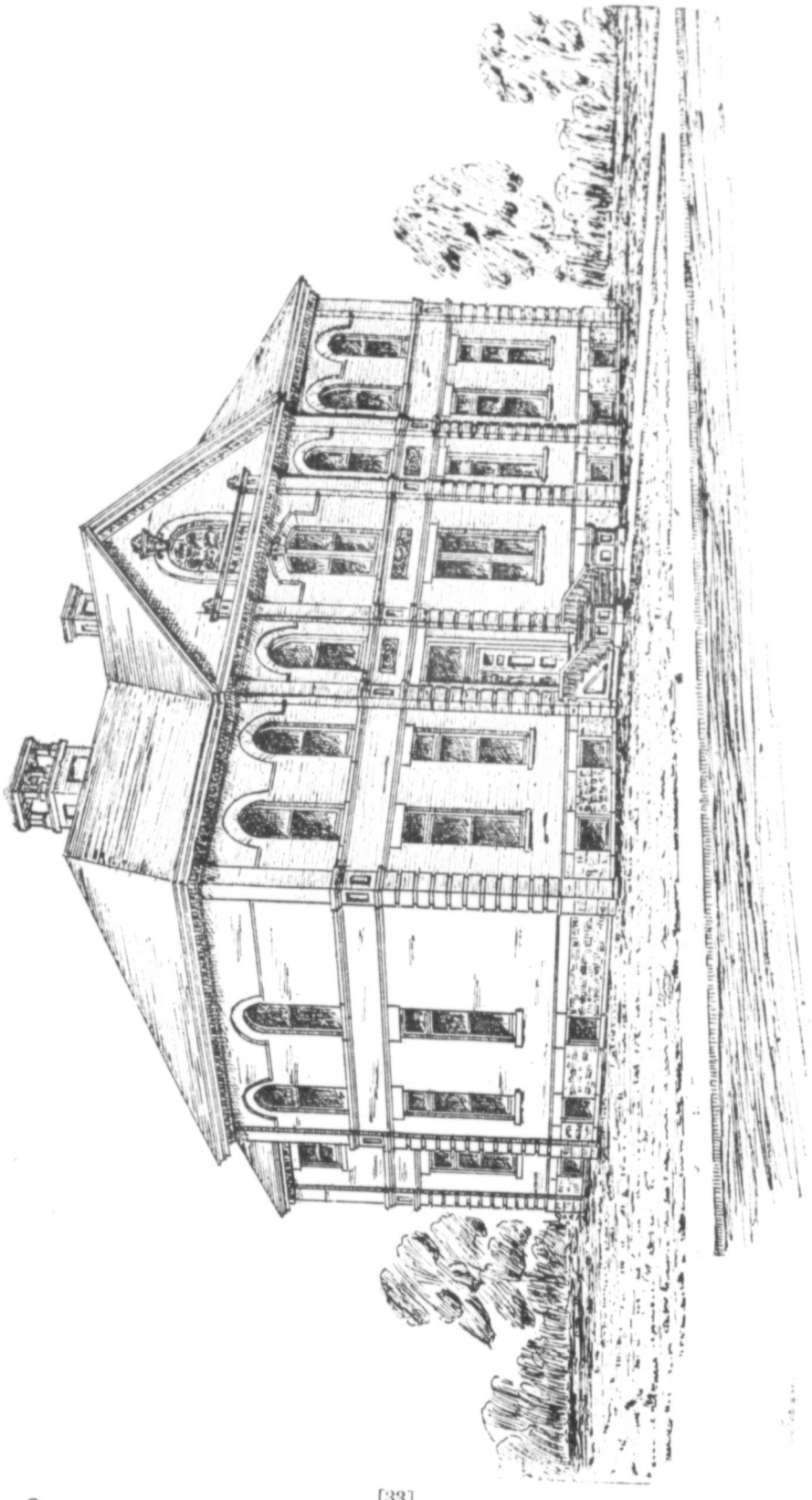
Although after a certain stage in the maturity of the crop, growth continues, the deterioration in composition is very rapid. The table below gives the percentage composition of clover and timothy cut at different stages of maturity in 1897, an average of the analyses of 1896 and 1897, and an average of the American analyses of cuttings made at a stage of maturity corresponding very closely with our own. It is interesting to note the close resemblance in composition of the different cuttings as given in the American analyses and in our own.

Composition of hay harvested at different dates.

Dates of cutting.	In fresh material.							Calculated to water-free substance.					
	Water.	Ash.	Crude protein.	Crude fibre.	Nitrogen-free extract.	Crude fat.	Amides.	Ash.	Crude protein.	Crude fibre.	Nitrogen-free extract.	Crude fat.	Amides.
					Clover.								
1897—													
June 14th	87.01	1.08	2.29	3.13	5.81	0.68	0 42	8.31	17.64	24.12	44.69	5.24	3.22
" 28th	77.45	1.87	3.46	5.85	10.08	1.29	0.61	8.60	15.92	26.92	42 65	5.92	2.82
July 15th	77.23	1.59	2.70	7.37	9 67	1.44	0.50	6.98	11 86	32.37	42.46	6.33	2.18
Averages of 1896-97	82.66	1.59	3.08	3.80	7.63	0.94	0.50	8.99	17.76	22.35	44.16	5.41	2.94
	77 00	1.95	3.30	5.93	10.03	1.30	0.78	8.15	14.68	26.29	42.60	5.75	3.45
	75.28	2.01	2.67	7.84	10.39	1.46	0.48	8.50	10.90	31.80	42.25	5.93	2.16
Averages of available American analyses	61.21	3.24	5.54	10 76	18.59	0.66	....	8.30	14.30	27.80	47.90	1.70	....
	47.13	4.04	7.13	14.69	25.75	1 26	....	7.70	13.50	27.80	48.60	2.40	....
	61.05	2.54	4.03	12.36	19.08	0.94	....	6.50	10.40	31 80	48.90	2.40	....
					Timothy.								
1897 —													
June 25th	70.73	1.98	2.73	9 79	13.59	1.18	0.79	6.76	9.32	33.46	46.43	4.03	2.70
July 9th	62.31	2.38	2.22	14.13	19.97	1.33	0.05	5.95	5.54	35.30	49.88	3.33	0.13
" 25th	61.71	1.97	1.70	13.15	20.11	1.36	0.01	5.15	4.44	34 35	52.52	3.55	0.03
Averages of 1896-97	73.00	1.95	1.87	8.77	12.55	1.17	0.56	7.28	8.65	32.41	46.50	4.38	2.02
	63 46	2.33	2.01	12.90	19.03	1.37	0.09	6.19	5.31	34.15	50.50	3.67	0.24
	59.68	2.57	1.91	13.70	20.77	1.25	0 08	6.82	4.72	33.99	51.55	3.24	0.20
Averages of American analyses	61.72	1.80	3.66	12.65	19.42	0.75	....	4.70	9.60	33.00	50 80	1.90	....
	66 83	1.44	2.36	11.04	17.68	0.65	....	4.40	7.10	33 30	53.20	2 00	...
	55.29	1.63	3 04	15.84	23.32	0.88	....	3.70	6.80	35.40	52.10	2.00	....

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

The above table of composition shows a decrease in percentage of water, and therefore in the succulency of the material as maturity approaches. Crude protein decreases considerably with maturity, while the woody portion or crude fibre increases very rapidly. The crude protein is the most valuable part of the food, and the crude fibre that part which is of the least value. It must follow therefore that both clover and timothy decrease in food value as they approach maturity.



CHEMICAL LABORATORY—ONTARIO AGRICULTURAL COLLEGE, GUELPH.

Chemical analysis alone does not tell the nutritive value of a food, but the chemical composition, taken in connection with actual digestion tests, indicates quite accurately what portion of the food may be available for the nutrition of the animal, for it is only the part of the food which is digested that has any nutritive value. A digestion experiment is usually made as follows: Selected animals are fed with the kind or kinds of feeding stuffs to be tested. The feeding stuffs are carefully analyzed. A weighed portion is fed, care being taken to see that none is wasted. In this way the exact weights of protein, fat, fibre, nitrogen free extract and ash eaten, are ascertained. The solid excrement of the animal contains the undigested residues. This is carefully collected, dried, weighed and analyzed, and the amounts of undigested protein, fat, fibre, nitrogen free extract and ash contained in it are found. The difference between the amounts found in the undigested residues and the amounts contained in the food eaten is taken as a measure of the amounts of the various nutrients which have been digested and assimilated by the animal.

While such an experiment seems comparatively simple, it is surrounded by a number of difficulties which make the work laborious and tends to make the results somewhat uncertain.

The results of digestion experiments in Germany and elsewhere warrant the following general conclusions upon the influence of species, breed, etc., upon digestibility of feeding stuffs.

Influence of Kind of Animals. All ruminants, such as cows, oxen, sheep, and goats, seem to digest practically the same amount of protein, fat, nitrogen free extract, and fibre from the same kind of food. In general, horses digest less of the food constituents than do ruminants. This is especially true of the fibre and fat in the hays and grasses.

Influence of Breed. The influence of breed upon digestibility has been studied with sheep, but no difference due to breed has been found. In general, it is probably true that different breeds of animals of the same species digest practically the same amounts of nutrients of the same foods.

Influence of Individual. Individual differences have always been observed. The variation is quite wide, and on this account the results with the influence of kinds and breeds of animals are somewhat obscured, variations in amounts digested by different individual animals of the same species and breed being wider than most variations in different species.

Influence of Age. The few experiments conducted (principally with sheep) indicate very little difference, if any, due to age.

From the above it will be seen that differences due to age, breed and species of ruminants are slight. The digestibility of a fodder by a sheep can be taken as a tolerably correct measure of its digestibility by a cow or steer.

During the last summer we conducted one digestion experiment with each of the different cuttings of clover and timothy; and as sheep are much easier experimented with than larger animals, they were used in this test.

The pen for each animal was about five feet square. The mangers were arranged on the outside of the pen, with stanchions on the inside in which the animal's head was placed while feeding, thus effectually preventing any loss of food by scattering. A rubber lined bag for collecting the fœces was attached to the animal by means of a suitable harness.

Each experiment lasted twelve days. The first seven days were given to preliminary feeding, during which the fœces were not collected. The whole of the fœces was collected during the last five days, and was removed twice daily from the bags and placed on the drying apparatus.

To give full particulars of each experiment would be adding an immense amount of data which would be of very little value to the general reader. We, therefore, come at once to the results of the experiments. The following table gives the number of pounds

of each constituent digested, for every 100 pounds fed. There was not sufficient hay from the first cutting of clover to feed the sheep the full number of days of the experiment, consequently, although it was worked out, it is not reported.

Pounds of each constituent digested per 100 pounds fed.

	Dry matter.	Protein.	Fat.	Fibre.	Nitrogen-free extract.
Clover—					
2nd cutting	57.35	61.48	72.03	44.30	71.10
3rd "	55.76	54.18	74.23	44.30	68.67
American determinations—					
Just before blossoming		73.00	62 00	55.00	76.00
In full blossom		67.00	63.00	48.00	70.00
Just out of blossom		59.00	45.00	39.00	71.00
Timothy—					
1st cutting	57.21	53.58	65.08	59.03	59.29
2nd "	54.13	40.36	47.50	54.20	58.43
3rd "	45.13	22.63	65.07	38.99	53.11
American determinations—					
Full bloom		57.00	56.00	59.00	64.00
Late cut		45.00	51.00	48.00	61.00

It has been stated that individual animals vary in the amount they will digest of a given fodder. For this reason and for the fact that but one experiment was conducted in each case, we do not wish to place too much emphasis on the digestion coefficients given above. The results of some American digestion experiments of clover and timothy cut at different dates are placed in the tables. Both these and our own work show clearly a decrease in digestibility as the plant approaches maturity. The clover and timothy, therefore, not only deteriorate in composition with maturity but also in digestibility. Apparently the younger the plant, the richer it is in valuable constituents and the more digestible are these constituents. But as the plant matures the absolute amount of these constituents increase. Therefore the object in hay-making should be to cut at such a stage of maturity that the largest possible amount of the valuable constituents can be got without too great a decrease in digestibility. It will be seen in both our own work and the American determinations that there is a very rapid decrease in digestibility after full bloom is reached. Hence it would appear that this is about the time when there is the largest amount of digestible nutrients present. This is borne out by the tables given below.

Pounds of Dry Matter Digested per Acre

Dates of cutting.	Pounds of dry matter digested per acre.
Clover.	
2nd cutting, June 28th	2,455.43
3rd do July 15th	2,488.45
Timothy.	
1st cutting, June 25th	3,644.15
2nd do July 9th	4,195.84
3rd do " 25th	3,401.69

Practical Results:

1. Grasses deteriorate as they mature.

2. Their digestibility decreases with maturity.

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

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

Composition of Lucerne as Affected by Maturity.

A considerable amount of lucerne, or alfalfa, is grown in different parts of the Province. The plant seems to prefer a light, sandy or loamy soil, with a subsoil through which its long roots can penetrate. It has, however, been successfully grown on a clay soil. On such a soil greater pains must be taken to secure a good stand; but, once the plant is established, the character of the subsoil is of more importance than that of the surface soil. On account of the large amount of food it will produce during the season, and the rapid growth it makes in the spring, lucerne has been used very largely as a supplementary food. It is usually grown where it is convenient for cutting and feeding to the farm animals in the green state. The idea seems to prevail that though this plant will produce an immense amount of rich food, yet when it is cut and cured as hay, the result is a harsh, stalky, indigestible fodder. To ascertain what truth there may be in this idea, and to learn, if possible, at what stage in its growth the plant should be cut to get the maximum amount of digestible constituents, we have commenced a study of its composition and digestibility as affected by maturity. For this purpose we cut the the second growth of lucerne for this season at three different stages of ripeness. The first cutting was made when the blossom was just appearing; the second, eleven days later, when the plants were in full bloom; the third, thirteen days later, when most of the blossom had fallen. The treatment of these different cuttings was exactly similar to that given the clover and timothy which is outlined in the previous experiment. It is our intention to repeat the work another season with an increased number of digestion experiments. For, while the work here reported has been very carefully done, it requires repeating and confirming before definite conclusions can be drawn.

The following table gives the calculated amounts of dry matter of the several cuttings per acre:

Pounds of Dry Matter per Acre.

Dates of cutting.	Pounds of dry matter per acre.
July 6th	3,197.17
" 17th	3,819.35
" 30th	3,317.71

It will be seen from the above figures that there was an increase of dry weight until full bloom was reached. After that period there was a decrease, which can be at least partially accounted for by the large number of leaves which had fallen previous to the third cutting. Not only was the dry matter less in the third cutting, but the percentages of the most valuable food constituents had also decreased. This is shown in the following table:

Composition of Lucerne Hay Harvested at Different Dates.

Dates of cutting.	In fresh material.							Calculated to water-free substance.					
	Water.	Ash.	Crude protein.	Crude fibre.	Nitrogen-free extract.	Crude fat.	Amides.	Ash.	Crude protein.	Crude fibre.	Nitrogen-free extract.	Crude fat.	Amides.
July 6th	81.31	1.60	3.76	5.32	7.08	0.93	0.70	8.54	20.12	28.47	37.88	4.99	3.73
" 17th	75.20	1.75	3.86	7.83	10.64	0.72	1.12	7.09	15.54	31.57	42.90	2.89	4.52
" 30th	71.17	1.79	3.97	11.67	10.83	0.57	0.83	6.23	13.79	40.46	37.54	1.99	2.88
American analyses	.....	.....	.....	.....	.....	.....	.....	11.10	16.30	30.53	39.23	2.92	3.53
	.....	.....	.....	.....	.....	.....	.....	8.04	12.99	36.77	38.84	2.07	1.42
	.....	.....	.....	.....	.....	.....	.....	7.31	10.37	41.36	39.25	1.76	0.98

Like clover and timothy, as shown in the last experiment, lucerne shows a decrease in percentage of water as maturity advances Referring to the portion of the table in which the composition is calculated to water-free substance, it will be noticed that the crude protein also decreases, and that the crude fibre increases very rapidly. It must follow that lucerne, like clover and timothy, decreases in food value as it approaches maturity; but the deterioration is much more rapid in lucerne, for there is a greater decrease in protein and increase in fibre in the 24 days covered by this experiment than in the 30 days of the clover and timothy experiment.

For the sake of comparison, the average of some American analyses of cuttings made at similar stages of maturity to our own, have been placed in the above table.

It is a matter of everyday experience that only a part of the food eaten is actually used by the animal. It is, therefore, of importance to have a knowledge, not only of the chemical composition of lucerne, but of the amounts of the nutrients which are capable of being assimilated. The digestibility of the lucerne was, in this case, determined with a shearling wether. As only one digestion experiment was made with each cutting, we do not wish to give them undue prominence. The results are given in the table below:

LUCERNE DIGESTION CO-EFFICIENT.

Pounds of each constituent digested per 100 pounds fed.

Cuttings.	Dry matter.	Protein.	Fat.	Nitrogen-Free Extract.	Fibre.
1st Cutting	60.62	78.97	71.49	70.63	37.11
2nd "	59.47	70.78	41.69	70.50	50.39
3rd "	49.88	67.68	48.92	61.73	36.45

We were unable to find a record anywhere of digestion experiments having been conducted with lucerne clover at stages of maturity similar to our own, and consequently have nothing with which to compare our results. The table shows clearly that there is a decrease in the digestibility as the plant matures. Using these figures and those in the table giving the pounds of dry matter per acre, we are able to calculate the pounds of dry matter digested per acre. They are given in the table below:

Pounds of dry matter digested per acre.

Dates of cutting.	Pounds of dry matter digested per acre.
July 6th	1,938.12
" 17th	2,271.36
" 30th	1,654.87

We do not feel that there has been sufficient work done to warrant us in drawing any definite conclusions, but the work certainly indicates the following:

1. That lucerne deteriorates with maturity.
2. That its digestibility decreases with maturity.
3. That from early to full bloom it contains the largest amount of digestible matter.
4. That from this stage on it deteriorates faster than clover or timothy.

It is interesting to compare the composition of common red clover, timothy, and lucerne clover, cut at the time when they apparently yield the maximum amount of digestible matter. In each case the hay was cured without rain or dew. The table shows the composition as the hay was taken from the field :

Hay.	Water.	Total dry matter.	Protein.	Fat.	Nitrogen-free extract.	Fibre.	Ash.
Red clover.....	24.98	75.02	11.51	4.28	33.55	19.46	6.22
Timothy	24.31	75.69	4.19	2.52	37.76	26.72	4.50
Lucerne clover	23.62	76.38	11.87	2.21	32.77	24.12	5.41

In conclusion, I beg gratefully to acknowledge the co-operation and assistance of the experimental department in carrying on our experimental work.

Respectfully submitted,

R. HARCOURT,
Assistant Chemist.

November 27th, 1897.

PART V.

REPORT OF THE

PROFESSOR OF VETERINARY SCIENCE.

To the President of the Ontario Agricultural College:

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

WORK IN THE CLASS-ROOM.

The work in the class room has been much the same as in previous years, but with an effort to make it still more practical. We always find that the work for first year students in my subjects, viz., Veterinary Anatomy and Veterinary Materia Medica, are very dry and hard to understand, and I endeavor to make them as simple as possible. The fall and winter terms with this class are taken up with the study of the bones, ligaments, muscles, tendons and joints; the anatomy of the digestive, respiratory, urinary, generative, circulatory, and nervous systems; and the organs of special sense. We have in the class-room a skeleton of a horse; I usually have also a living horse, and the several bones, and when studying a bone or joint, etc., we notice it in the skeleton and also its position in the living animal, thereby impressing more thoroughly its form and situation upon the students' minds. Where any particular difference exists between the anatomy of the horse and the ox, we notice the same. I have also delivered a course of lectures, or rather talks, to the students on what may be called "Practical Stable." In these talks I take the students to the horse stables on the farm and talk about the most approved methods of building stables as regards site, size, size of single and box stalls, mangers, racks, floors, ventilation, drainage, etc.; speak of the proper times and manner of watering stock, the kinds and quantity of food, when and how often to feed, etc.; also the care of harness, saddles, etc, etc. During the spring term, I delivered a course of lectures on the different medicines generally used in veterinary practice. When lecturing on a medicine, we have a sample of it in the class-room, in order that the students may become familiar with its appearance, odor, etc. When practicable, I hold a post mortem in the presence of the class, but I am pleased to state that very few opportunities have occurred during the past year.

The class-room work of the second year, for the fall and winter terms, consists of the consideration of the causes, symptoms and treatment of the ordinary diseases to which farm stock is subject. During this course I usually have one of my own horses in the class room, and explain the different appearances of a diseased and a healthy animal. When speaking of the diseases of bone, I show the class the condition the disease causes, explaining its nature and comparing the parts with a healthy part (I have specimens of mostly all diseases of bone in the class-room); point out and explain the alterations these diseases cause in the living animal and the manner of treatment. In this course of lectures, as in all others, I endeavor to make the points as simple as possible. During the winter term, I give to this class a course of practical horse lessons, or illustrations, in

which I point out and explain the desirable and undesirable points of the different classes of horses, sometimes having one of my own horses and sometimes one of the farm horses in the class-room. For this purpose we have not got pure-bred animals ; but we have fair representatives of the different classes, and I endeavor to point out the characteristics of each class, in order that the students may be able to distinguish between them, a point, I may say, in which many so-called horsemen are very deficient. I illustrate and explain the manner of securing horses for minor operations, illustrate the different methods of dressing and stitching wounds, paring feet, trimming manes and tails, docking, firing for bone diseases, blistering, bandaging, throwing by side lines and hobbles, placing in slings, the different methods of administering medicines, with the advantages and disadvantages of each method; the way to dress and pull teeth, how to pass a probang in a cow, operate on a teat, etc., etc. This course of lectures is very interesting and instructive to the students, and will certainly be of great value to all who will have much to do with live stock in after life.

During the spring term, I lecture to this class on Veterinary Obstetrics, and illustrate my lectures, as far as possible, by charts.

THIRD YEAR.—To this class I deliver a short course of lectures upon the points and characteristics of the different breeds and classes of horses.

To the special dairy class I deliver a few lectures, in which I speak of the causes, symptoms, and treatment of the ordinary diseases of the dairy cow.

Besides the work in the class-room, I give professional attention to the farm, experimental, and dairy stock, and I am very pleased to be able to state that during the past year, while we have necessarily had a good deal of sickness, the losses have been slight, especially so when we consider the amount of experimental feeding that has been carried on, as we all know that such feeding is more likely to generate disease than ordinary feeding. Below will be seen the particulars of the diseases which occurred during the year in the different kinds of stock.

Horses.—We had a few serious cases of acute indigestion, and some cases of colic, influenza, lymphangitis, calks, bruises, eczema, and other diseases, all of which made favorable recoveries.

Cattle.—We had a fatal case of inflammation of the lungs in a farm cow, and a fatal case of bronchitis in one of the dairy cows. We also had four critical cases of parturient apoplexy, but they all made perfect recoveries. We had several cases of impaction of the rumen, mammitis, fardel bound, diarrhœa, constipation, sore teats, etc., all of which also made good recoveries.

Swine.—We lost four small pigs in the experimental piggery from constipation, caused by eating saw dust, with which they were bedded. We removed the saw dust, used straw, and had no further trouble. We lost another pig in the same piggery from purulent pneumonia.

In the farm piggery a Poland China sow was found dead one morning, and a post-mortem revealed the cause of death to be rupture of a blood vessel ; and a Berkshire sow, in the same piggery, died from over exertion from fighting, one hot day.

Sheep.—We had two fatal cases of wool balls in the pyloric orifice in lambs ; one fatal case of purulent mammitis in a ewe, and a fatal case of enteritis in a Dorset ewe. Some of the lambs showed signs of tapeworm in June, so we adopted our usual treatment, viz.: a decoction of pumpkin seeds, giving each lamb the product of about two ounces of seeds every ten days, in five doses, and we had no losses.

I have, sir, the honor to be

Your obedient servant,

J. H. REED.

GUELPH, Nov. 24th, 1897.

PART VI.

REPORT OF

PROFESSOR OF DAIRY HUSBANDRY.

To the President of the Ontario Agricultural College :

SIR,—I beg leave to submit my seventh annual report of the Dairy Department.

EXPERIMENTS IN CHEESE-MAKING.

The experiments in the Cheese Department were in charge of Mr. R. W. Stratton.

Some experiments were made with cultures sent to the Dairy by the bacteriologist, which are not ready to be reported upon at this date (November). One culture got from cheese sent by Mr. Publow, of Perth, developed a very bad flavor, and the cheese from the milk in which it was used was also very tough in texture. This cheese was made in August, and was still tough and leathery when scored by Mr. Brill, on Nov. 15th. The results of a few trials of different methods of handling over-ripe milk will be left over until another year, as we have not sufficient data upon which to base conclusions.

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

This is the fourth year that experiments relating to this question have been made in the Dairy Department. Next year we hope to give a summary of five years' work on the points investigated by us. The following is a summary for the past year :

1. The number of experiments made was 27.
2. 600 lbs. milk were used in each vat, or 32,400 pounds altogether.
3. The percentage of fat in the milk ranged from 2.8 to 4.3.
4. Both vats were ripened to the same degree before renneting.
5. About one per cent. of starter was used in each vat when needed.
6. H (rich milk) curds were cooked at 100 ° and the L (poor or medium milk) were cooked at 98 °.
7. Both curds were given about one-eighth of an inch of acid before dipping.
8. The H curds mellowed more quickly than the L curds and were ready to salt in less time.
9. The H curds were salted $\frac{1}{4}$ lb. extra per 100 pounds curds.
10. The temperature for putting to press was about 80 ° for both curds.
11. The curds were pressed about 20 hours.
12. The curing room ranged from 60 ° to 75 ° in temperature.
13. All cheese were weighed and marked when taken from the hoops. They were weighed again at the end of one month.
14. The cheese were scored by Messrs. A. T. Bell and G. J. Brill, when about six weeks old, except those made in October, which were scored Nov. 15th. The scale used was : Flavor, 35 ; closeness, 20 ; even color. 15 ; texture, 20 ; finish, 10.

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

Relation of fat in milk to quantity and quality of cheese.

Date.	Per cent. fat in milk.	Lbs. fat in milk.	Lbs. of cheese.		Lbs. milk for 1 lb. cheese.		Lbs. cheese for 1 lb. fat in milk.		Per cent. fat in whey.
			Green.	Cured.	Green	Cured	Green	Cured	
April 6	4.30	25.80	63.50	61.50	.....	.....	.....	2.38	0.20
	3.40	20 40	55.50	53.75	.....	.....	.....	2.63	0.20
" 13	4.00	24.00	63.50	61.25	.....	.....	.....	2.55	0.20
	3.40	20.40	57.75	55.75	.....	.....	.....	2.73	0.20
" 20	4.30	25 80	66.25	63.75	.....	.....	.....	2.47	0.30
	3.50	21.00	58.50	56.25	.....	.....	.....	2.67	0.20
" 27	3.90	23.40	62.00	60.00	.....	.....	.....	2 56	0 25
	3.40	20.40	56.50	54.50	.....	.....	... ..	2.67	0.25
Average for rich milk	4.12	99.00	255.25	246.50	9.40	9.73	2.57	2 49	.237
Average for poor milk	3.42	82.20	228.25	220 25	10.51	10.89	2.77	2 67	.212
May 4	3.90	23.40	61.25	59.25	.....	.....	.....	2.53	0.40
	3.20	19.20	50.25	48.50	.....	.....	.....	2 52	0.35
" 12	4.20	25.20	62.25	60.00	.....	.....	.....	2.38	0.40
	3 20	19.20	53.50	51.50	.....	.....	.....	2.68	0.30
" 18	3.60	21.60	60.25	58.50	.....	.....	.....	2.70	0.35
	2.80	16 80	53.25	51.50	.....	... .	.....	3.06	0.25
" 26	3.65	21.90	64.00	62.00	.....	.....	.....	2.83	0.35
	2.90	17.40	45.00	52.25	.....	.....	.....	3.00	0.20
Average for rich milk	3.83	92.10	247 75	239.75	9.68	10.01	2.69	2.61	.375
Average for poor milk	3 02	72 60	211.00	203.75	11.37	11.77	2.90	2 81	.275
June 1	3.90	23.40	63.75	62.00	....	...	.....	2.64	0.25
	3 00	18.00	54.75	52.50	...	.....	.....	2.91	0.20
" 8	3.70	22.20	64.50	62 25	....	.....	.....	2.80	0.30
	2.90	17.40	56.00	54.00	.....	.....	....	3.10	0.20
" 15	3.70	22.20	62.25	60.00	.....	.....	.....	2.70	0.40
	3.20	19.20	55 00	53.25	.....	.....	.....	2.77	0.25
" 24	3.50	21.00	59.50	57.75	.....	....	.....	2.74	0.25
	2 90	17.40	53 75	52.00	.....	... ..	.....	2.98	0.20
" 29	3.70	22.20	60 00	58.00	.....	.....	.....	2.61	0.25
	3.20	19.20	54.75	52.75	.....	.....	.....	2.75	0.20
Average for rich milk	3.70	111.00	310 00	300.00	9 67	10.00	2.80	2.69	.290
Average for poor milk	3.06	91.20	274.25	264.50	10.93	11.31	3.00	2.90	.210
July 6	3 60	21.60	58.50	56.75	.....	.....	.....	2.62	0.30
	3.00	18.00	53.25	51.50	.....	.....	....	2.86	0.25
" 15	3.90	23.40	62.25	59.50	.....	... .	...	2.54	0 40
	2.90	17.40	52 75	51.50	.....	.....	...	2.95	0 20
" 20	3.90	23 40	61 00	59 25	.....	.....	.....	2.52	0.35
	3.00	18 00	53.25	51.25	.....	....	..	2.83	0.25
" 28	3.75	22.50	61.25	59.25	.....	.....	.....	2.63	0 40
	2.90	17.40	53.00	51.00	.....	.....	.....	2.93	0 30
Average for rich milk	3.78	90.90	243.00	234.75	9.87	10 22	2 67	2.58	3.62
Average for poor milk	2.95	70 80	212.25	205 25	11.30	11.69	2.99	2 89	.250
August 4	3 80	22.80	59.00	57.25	.....	.....	.....	2.51	0.35
	3.20	19.20	55.25	53.00	.....	.....	.. ..	2 75	0.30
" 10	3.90	23.40	56.00	54.25	.....	.....	.....	2 31	0.25
	3.20	19 20	54.00	52.25	.....	.....	.....	2.72	0.20
" 24	3.80	22.80	62.00	60.25	.....	.....	.....	2.64	0.35
	3.30	19.80	57.50	55.75	.....	... .	.....	2.81	0.20
Average for rich milk	3.83	69.00	177.00	171.75	10.16	10.47	2.56	2.48	3.18
Average for poor milk	3.23	58.20	166.75	161.00	10.79	11.18	2.86	2.76	2.33

Relation of Fat in milk, etc.—*Continued.*

Date.	Per cent. fat in milk.	Lbs. fat in milk.	Lbs of Cheese.		Lbs. milk for 1 lb. cheese.		Lbs. cheese for 1 lb. fat in milk.		Per cent. fat in whey.
			Green.	Cured.	Green	Cured	Green	Cured	
September 14	3.85	23.10	62.00	60.00	.....	.....	.....	2.59	0.35
	3.15	18.90	58.50	56.50	.....	.....	.....	2.98	0.20
" 21	4.00	24.00	65.50	63.50	.....	.....	.....	2.64	0.30
	3.20	19.20	60.50	58.73	.....	.....	.....	3.05	0.25
" 30	3.90	23.40	63.00	61.50	.....	.....	.....	2.65	0.40
	3.20	20.40	59.50	57.50	.....	.....	.....	2.81	0 30
Average for rich milk	3.91	70 50	190.50	185.00	9.44	9.72	2.70	2.62	.350
Average for poor milk	3.25	58.50	178.50	172.75	10.00	10.41	3.05	2.95	.250
October 6	4.00	24.00	64.25	62.25	.....	.....	.....	2.59	0.35
	3.40	20.40	60.25	58.25	.....	.....	.....	2.85	0.30
" 15	3.80	22.80	61.25	59.25	.....	.....	.....	2.59	0.35
	3.30	19.80	59.00	57.00	.....	.....	.....	2.87	0.20
" 22	3.70	22.20	64.00	62.00	.....	.....	.....	2.79	0.35
	3.30	19.80	58.75	56.75	.....	.....	.....	2.86	0 30
" 26	4.20	25.20	64.75	62.75	.....	.....	.....	2.49	0.40
	3.30	19.80	60.50	58.50	.....	.....	.....	2.95	0.30
Average for rich milk	3.92	94.20	254.25	246.25	9.43	9.82	2.69	2.61	.362
Average for poor milk	3.32	79.80	238.50	230.50	10.06	10.41	2.98	2.88	.276

Butter Fat Lost in Whey.

The loss of fat in the whey at dipping, and in the drippings from dipping to milling, from milling to salting, and from salting until the cheese were taken from the hoops, has been very carefully determined during the past year. In addition, the Chemical Department determined the casein in the whey and drippings from seven experiments during June and July; so our data on these points are new and very interesting to the close student of cheesemaking.

Date.	Vat.	Drippings from dipping to milling.			Drippings from milling to salting.			Drippings after salting and pressing.		
		Lbs.	Per cent. fat.	Lbs. fat lost.	Lbs.	Per cent. fat.	Lbs. fat lost.	Lbs.	Per cent. fat.	Lbs. fat lost.
April 6	H.	10.50	.15	.01575	1.75	1.00	.0175	6.50	4.90	0.31850
" 13	"	6.50	.05	.00325	2.25	2.00	.0450	8.25	2.80	0.13100
" 20	"	9.00	.20	.01800	1.50	2.70	.0405	8.00	2.80	0.22400
" 27	"	4.00	.10	.00400	1.00	2.40	.0240	8.00	2.00	0.16000
Total	.....	30.00		.04100	6.50		.1270	30.75		0.83350
Average	.....	7.50	.136	.01025	1.61	1.953	.03175	7.68	2.710	0 20837
April 6	L.	11.25	.10	.01125	2.25	.90	.02025	7.00	1.50	0.11200
" 13	"	8.75	.05	.00437	2.25	1.90	.04275	8.25	1.70	0.14025
" 20	"	9.50	.10	.00950	1.50	1.30	.01950	7.25	1.40	0.10150
" 27	"	9.00	.10	.00600	1.00	2.20	.02200	6.75	3.40	0.22950
Total	.....	35.50		.03112	7.00		.10450	29 25		0.58325
Average	.....	8.87	.087	.00778	1.75	1.492	.02612	7.31	1.994	0.14581

Butter Fat Lost in Whey.—*Continued.*

Date.	Vat.	Drippings from dipping to milling.			Drippings from milling to salting.			Drippings after salting and pressing.		
		Lbs.	Per cent. fat.	Lbs. fat lost.	Lbs.	Per cent. fat.	Lbs. fat lost.	Lbs.	Per cent. fat.	Lbs fat lost.
May 4	H.	5.00	.40	.02000	1.00	2.20	.02200	7.50	1.80	.13500
" 12	"	9.00	.25	.02250	1.50	6.00	.09000	7.50	4.20	.31500
" 18	"	8.75	.25	.02187	1.50	5.60	.08400	7.75	2.20	.17050
" 26	"	8.00	.10	.00800	1.25	2.00	.02500	7.00	1.20	.08400
Total	.....	30.75		.07237	5.25		.22100	29.75		.70450
Average	.....	7.68	.235	.01809	1.31	4.209	.05525	7.43	2.368	.17612
May 4	L.	5.25	.20	.01050	1.00	3.70	.03700	6.25	1.80	.11250
" 12	"	5.50	.10	.00500	2.00	4.20	.08400	6.50	3.30	.21450
" 18	"	8.50	.05	.00425	2.50	1.90	.04750	7.25	.90	.06525
" 26	"	9.00	.10	.00900	1.75	1.60	.02800	6.25	1.20	.07500
Total	.....	28.25		.02875	7.25		.19650	26.25		.46725
Average	.....	7.06	.101	.00718	1.81	2.710	.04912	6.56	1.780	.11681
June 1	H.	6.00	.25	.01500	2.25	4.90	.11025	6.50	2.20	.14300
" 8	"	6.75	.15	.01012	1.75	3.80	.06550	7.75	1.40	.10850
" 15	"	7.00	.20	.01400	1.25	5.40	.06750	7.00	1.70	.11900
" 24	"	5.00	.20	.01000	0.50	3 20	.01600	7.00	1.20	.08400
" 29	"	7.25	.10	.00725	1.25	1.70	.02125	7.50	.90	.06750
Total	.....	32.00		.05637	7.00		.28050	35.75		.52200
Average	.....	6.40	.207	.01127	1.40	4.007	.05610	7.15	1.460	.10440
June 1	L.	6.25	.20	.01250	2.25	3.70	.08325	7.25	1.80	.13050
" 8	"	8.50	.05	.00425	2.50	1.50	.03750	6.50	1.00	.06500
" 15	"	8.00	.05	.00400	2 00	1.40	.02800	6.25	1.00	.06250
" 24	"	6.00	.10	.00600	0.50	1.20	.00600	6.00	1.00	.06000
" 29	"	9.00	.05	.00450	1.75	1.00	.01750	6.50	.50	.03250
Total	.....	37.75		.03125	9.00		.17225	32.50		.35050
Average	.....	7.55	.098	.00625	1.80	1.913	.03445	6.50	1.078	.07007
July 6	H.	4.75	.55	.02612	0.75	2.30	.01725	7.00	1.50	.10500
" 13	"	4.00	.40	.01600	0.50	2.70	.01350	7.25	1.00	.07250
" 20	"	7.00	.60	.04200	1.50	4.50	.06750	7.50	1.50	.11250
" 28	"	8.00	.30	.02400	1.50	2.40	.03600	7.00	1.40	.09800
Total	.....	23.75		.10812	4.25		.13425	28.75		0.45807
Average	.....	5.93	.455	.02703	1.06	3.158	.03356	7.18	1.349	.07900
July 6	L.	5.50	.45	.02475	1.25	2.00	.02500	6.00	1.20	.07200
" 13	"	7.00	.05	.00350	3.00	1.30	.03900	5.50	.80	.04400
" 20	"	6.00	.15	.00900	2.00	2.60	.04200	6.50	1.50	.09750
" 28	"	.....	.....	.....	1.00	1.30	.01300	6.00	1.30	.07800
Total	.....	18.50		.03725	7.25		.11900	24.00		.29150
Average	.....	6.16	.201	.01241	1.81	1.641	.02975	6.00	1.215	.07287
August 4	H.	3.25	.10	.00325	1.00	1.40	.01400	8.00	3.20	.25600
" 10	"	5.50	.25	.01375	3.00	1.70	.05100	8.00	6.80	.54400
" 24	"	.....	.....	.....	.....	.....	.....	8.00	2.20	.17600
Total	.....	8.75		.01700	4.00		.06500	24.00		.97600
Average	.....	4.37	.194	.00850	2.00	1.625	.03250	8.00	4.066	.32533

Butter Fat Lost in Whey, etc.—*Continued.*

Date.	Vat.	Drippings from dipping to milling.			Drippings from milling to salting.			Drippings after salting and pressing.		
		lb.	per cent. fat.	lb. fat.	lb.	per cent. fat.	lb. fat.	lb.	per cent. fat.	lb. fat.
August 4	L.	5.75	.05	.00287	1.00	1.60	.01600	6.25	1.60	.10000
" 10	"	6.50	trace	.00000	4.00	0.40	.01600	7.00	1.30	.09100
" 24	"	.....	.....	.....	.....	.....	.....	5.50	1.20	.06600
Total	.....	12.25		.00287	5.00		.03200	18.75		.25700
Average	.....	6.12	.023	.00143	2.50	.650	.01600	6.25	1.370	.08553
September 14	H.	5.75	.15	.00862	1.80	2.70	.04050	8.50	1.70	.14440
" 21	"	9.00	.15	.01350	1.75	1 00	.01750	7.25	1.50	.10875
" 30	"	.....	....	.....	2.25	1.30	.02925	7.00	3.00	.21000
Total	.....	14.75		.02212	5.50		.08725	22.75		.46325
Average	.....	7.37	.150	.01106	1.83	1.586	.02908	7.58	2.036	.15441
September 14	L.	6.50	.05	.00325	2.50	2.50	.06250	7.50	.800	.06000
" 21	"	5.75	trace	.00000	1.25	1.00	.01250	7.00	.60	.04200
" 30	"	.....		.....	3.50	1.00	.03500	6.50	1.80	.11700
Total	.....	12.25		.00325	7.25		.11000	21.00		.21900
Average	.....	6.12	.026	.00162	2.41	1.517	.05500	7.00	1.042	.07300
October 6	H	5.25	.30	.01575	1.25	1.20	.01500	7.00	2.80	.19600
" 15	"	5.00	.40	.02000	0.75	2.00	.01500	6.75	3.60	.24300
" 22	"	5.25	.30	.01575	0.25	2.20	.00550	6.00	1.00	.06000
" 26	"	6.00	.30	.01800	1.00	4.40	.04400	7.50	1.20	.09000
Total	.....	21.50	.....	.06950	3 25	....	.07950	27.25	.....	.58900
Average	.....	5.37	3.23	.01737	0.81	2.446	.01987	6.81	2.161	.14750
October 6	L	10.00	.10	.01000	2.50	1.00	.02500	6.50	1.60	.10400
" 15	"	7.50	.15	.01125	2.50	1.70	.04250	5.50	2.30	.12650
" 22	"	6.50	.15	.00975	1.00	1.70	.01700	5.50	0.80	.04400
" 26	"	7.50	.30	.02250	2.50	2.50	.06250	7.50	1.20	.09000
Total	....	31.50	....	.05350	8.50	.....	.14700	25.00	.....	.36450
Average	.....	7.87	.169	.01337	2.12	1.741	.03675	6.25	1.458	.09112
Total loss for season.	H	161.50	.....	.38548	35.75	.....	.99450	199.00	.....	4.37625
	L	176.00	.....	.18799	51.25	.....	.88125	176.75	.....	2.53300
Average loss per 600 lb. milk	H	6.46	.....	.01540	1.37	....	.03825	7.37	... ..	.16838
	L	7.33	.. ...	.03783	1.97	.....	.03389	6.54	.....	.09381

The tables show the details of fat lost in the different stages of making. I may add that the fat in the last stage, after salting and pressing, represents all the fat or grease pressed from the green cheese while in the hoops. This fat was carefully gathered from hoops and press, and was mixed with the more liquid part. It was then all melted together and a sample taken for testing with the Babcock tester.

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

Total pounds milk used.	Average per cent. fat in milk.	Total loss of fat in whey.	Loss of fat in whey per 100 lb. cured cheese.
		lb.	lb.
3,600	2.88	7.39	2.36
13,200	3.26	29.63	2.46
13,200	3.81	40.09	3.04
2,400	4.23	6.99	2.82

PERCENTAGE OF FAT IN WHEY BY MONTHS.

	Fat in whole milk.		Fat in whey from—	
	Rich milk.	Poor milk.	Rich milk.	Poor milk.
	%	%	%	%
April	4.12	3.42	.237	.212
May	3.83	3.02	.375	.275
June	3.70	3.06	.290	.210
July	3.78	2.95	.362	.250
August	3.83	3.23	.318	.233
Septemb r	3.91	2.25	.350	.250
October	3.92	3.32	.362	.276
Average for season	3.87	3.18	.327	.243

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

Date.	Before dipping.		Drippings from dipping to milling.		Drippings from milling to salting.		Drippings after salting and pressing.	
	H	L.	H.	L.	H.	L.	H.	L.
	%	%	%	%	%	%	%	%
June 8	.146	.149	.117	.087	.322	.262	.244	.314
" 16	.177	.081	.165	.108	.377	.279	.332	.249
" 24	.222	.135	.225	.156	.663	.444	.382	.334
" 29	.206	.183	.173	.144	.249	.287	.298	.426
July 6	.152	.120	.185	.117	.485	.349	.247	.227
" 13	.131	.123	.127	.114	.345	.208	.287	.198
" 21	.128	.134	.228	.124	.511	.467	.361	.....
Averages	.166	.132	.174	.121	.421	.328	.307	.291

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

Per cent. loss in cheese made from	April.	May.	June.	July.	Aug.	Sept.	Oct.	Average.
Rich milk	3.4	3.2	3.2	3.3	2.9	2.8	3.1	3.1
Poor milk	3.5	3.4	3.5	3.2	3.4	3.2	3.3	3.3

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

The chief points to observe are (1) the increased yield of cheese per 100 lbs. of milk as the per cent. of fat increases; (2) the decreased yield of cheese per lb. of fat in the milk as the percentage of fat increases in the milk; (3) the increased percentage of fat in the whey as the percentage of fat in the milk increases.

Group.	Percentage of fat in milk		Milk required to make 1 lb. of cheese.	Cheese produced per 100 lbs. of milk.	Cheese produced from 1 lb. of fat in milk.	Per cent. of fat in whey.
	Range.	Average				
I	Below 3	2.88	11.529	8.673	3.01	.225
II	3.00 to 3.50	3.26	10.968	9.117	2.79	.247
III	3.55 to 4.00	3.81	10.013	9.986	2.62	3.29
IV	4.05 to 4.50	4.23	9.677	10.333	2.44	3.25
Average			10.512	9.512	2.70	

THE QUALITY OF THE CHEESE.

The tables show the scoring of the cheese by months. Out of a total possible score of 2,700 points the cheese made from milk averaging (by months) 3.70 to 4.12 per cent. of fat scored 2,399.5 points. The cheese made from milk averaging (by months) from 2.95 to 3.94 per cent. of fat scored 2,349.5 points out of a possible 2,700.

Points scored by cheese.	Flavor.	Closeness.	Even color.	Texture.	Finish.	Total.
April (four experiments):						
Possible score	140	80	60	80	40	400
Milk 4.12 % fat	113.5	72.5	50.5	67.5	40.0	344.0
Milk 3.42 % fat	113.0	72.5	53.5	69.5	40.0	348.5
May (four experiments):						
Possible score	140	80	60	80	40	400
Milk 3.83 % fat	113	72	55	67	40	347
Milk 3.02 % fat	101	72	55	62	40	330
June (five experiments):						
Possible score	175	100	75	100	50	500
Milk 3.70 % fat	146	93	65	89	50	442
Milk 3.06 % fat	136	92	69	82	50	429
July (four experiments):						
Possible score	140	80	60	80	40	400
Milk 3.78 % fat	118	73	54	71	40	356
Milk 2.95 % fat	115	72	55	69	40	351
August (three experiments):						
Possible score	105	60	45	60	30	300
Milk 3.83 % fat	94.5	56.0	42.0	49.0	30	271.5
Milk 3.23 % fat	89.5	56.0	43.0	51.5	30	270
September (three experiments):						
Possible score	105	60	45	60	30	300
Milk 3.91 % fat	93	53	42	52	30	270
Milk 3.25 % fat	89	54	42	54	30	269
October (four experiments):						
Possible score	140	80	60	80	40	400
Milk 3.92 % fat	127	73	56	72	40	368
Milk 3.32 % fat	121	68	55	68	40	352

Table showing average score of qualities in the cheese made from milk grouped according to the percentage of fat:

Percentage fat in milk.	Flavor. (Max. 35).	Closeness. (Max. 20).	Even color. (Max. 15).	Texture. (Max. 20).	Average total score. (Max. 90).
Under 3.00 per cent	28.33	18.16	14.16	16.83	77.48
3.00 to 3.50 "	28.43	17.93	13.70	17.00	77.06
3.55 to 4.00 "	29.81	18.25	13.56	17.25	78.87
4.05 to 4.50 "	29.75	18.00	13.00	17.25	78.00

Practical Results of the Experiments.

So far we have been discussing the more scientific aspects of the question, and we now turn to the more practical part, viz., the application of the results to factory work. All factories are conducted for the purpose of making profit. It is also necessary that the profits be equitably divided among those who have a right to share in them. The owner of the factory, the maker, the patrons and the distributors of the cheese are the main persons who have a right to share in these profits. All of those named receive, or ought to receive, their share according to some fixed and just rule. The patron, or producer of the milk, is entitled to the largest share, and hence it is important that this large share should be divided on a sound basis. The three systems of dividing proceeds among patrons of cheese factories in Ontario were fully discussed in bulletin No. 102 and in my last report. Hence, I shall only say here that we consider what may be called the fat and casein (% fat+2) the most just of the three systems there spoken of. It comes nearer to justice, and at the same time stimulates the sending of good milk to the factory. As will be seen in the tables which follow, the milk below 3.5 per cent. of fat does not receive quite so much money as would be represented by the amount of cheese made, while the milk with over 3.50 per cent. of fat receives a bonus.

Pounds milk.	Average per cent. fat.	Pounds cheese made.	Amounts of money (cheese 8c.) credited by three systems and according to weight of cheese.			
			Weight milk.	Per cent. fat.	Per cent. fat + 2.	Weight cheese.
			$ c.	$ c.	$ c.	$ c.
3,600	2.88	312.25	27 40	22 46	24 25	24 98
13,200	3.26	1,203.50	100 45	93 19	95 83	96 28
13,200	3.81	1,318.25	100 45	108 92	105 84	105 46
2,400	4.23	248.00	18 26	21 99	20 64	19 84

Difference in three systems compared with the actual value (at 8 cents per pound) of the cheese produced :

Value of cheese made.	Weight of milk.	Per cent. of fat.	Per cent. fat + 2.	Per cent. fat in milk.
$ c.	$ c.	$ c.	$ c.	
24 98	+ 2.42	- 2.52	- .73	2.88
96 28	+ 4.17	- 3.09	- .45	3.26
105 46	- 5.01	+ 3.46	+ .38	3.81
19 84	- 1.58	+ 2.15	+ .80	4.23

CONCLUSIONS: 1. The yield of cheese per 100 pounds of milk increased when the per-cent. of fat increased, but it did not increase in exactly the same proportion.

2. The yield of cheese per pound of fat in the milk decreased as the percentage of fat increased.

3. The yield of cheese is fairly proportionate to the fat and casein in the milk. The casein may be represented by the figure 2 added to the percentage of fat in the milk.

4. The highest average score of cheese made was in the group where the milk ranged from 3.55 to 4.0 per cent. of fat.

5. The H. cheese lost 3.1 per cent. in weight while curing; the L. cheese lost 3.3 per cent.

6. The loss of fat in whey, drippings and pressings was greater from the H. (rich) milk. This is especially marked in the drippings after salting, which include the grease pressed out of the cheese while in the hoops. The loss of fat at this stage is nearly double that from L. (medium and poor) milk.

7. In those experiments where the percentage of casein was determined, it showed a greater average loss of casein at each stage of the making, from the H. milk as compared with the L. milk.

8. We recommend the percentage of fat + 2 system for distributing proceeds among patrons of cheese factories.

RAPID CURING CHEESE *vs.* SLOW CURING CHEESE.

During May and June thirty trials were made, by comparing the use of an extra quantity of rennet and less salt with the usual amount of these, and noting the effect on the time required for curing the cheese and also the effect on quality. The May cheese were scored by Mr. Brill on June 18th; the June cheese were scored on July 14th and August 7th. About half the cheese made during each month was kept for about a month after the first scoring, to note the effect on the keeping quality of the cheese made by the two methods. Where the extra amount of rennet and the small quantity of salt were used the cheese ripened and went off in flavor more quickly. The tables show the main differences in making and in the quality of the cheese.

Kind of cheese.	Average lbs. milk used.	Average per cent. fat in milk.	Average rennet test, seconds.	Rennet used per 1,000 lbs. milk.	Average minutes curdling.	Average hours from setting to dipping.	Average hours from dipping to salting.	Average rate of salt per 100 lbs. curd.	Weight of cheese.	
									Green.	Cured.
				ozs.		h m	h m	lbs.	lbs.	lbs.
Slow curing	600	3 36	24.2	3½	35 8	3 24	3 44	2¾	58.28	56.13
Quick curing	600	3.36	24.0	4½	25 8	2 51	2 54	2	58.93	56.71

Kind of cheese.	Scoring.	Flavor. (Max. 35.)	Closeness. (Max. 20.)	Texture. (Max. 20.)	Total. (Max. 100.)
Slow curing	First	29.93	18.20	17.13	89.00
	Second	28.57	18.14	16.42	87.00
	Average	29.50	18.18	16.90	88.31
Quick curing	First	29.73	18.20	17.00	88.66
	Second	27.42	17.57	16.00	84.42
	Average	29.00	18.00	16.72	87.31

CONCLUSIONS: In the spring of the year, when it is usually the best policy to make cheese which will cure or ripen quickly, we advise the use of four to five ounces of rennet per 1,000 pounds of milk, or sufficient to cause coagulation in twenty to twenty-five minutes. Less salt—say two pounds per 100 pounds of curd or per 1000 pounds milk—may also be used. The cheesemaker will need to use judgment and watch the markets. If the demand for cheese is brisk, such as was the case in the spring of 1897, he would be quite safe in making a quick-curing cheese; on the other hand, if the markets are dull and there is a prospect of the cheese being held, he would need to be careful in making soft cheese. It would be better under such conditions to make them firmer by using less rennet, stirring more, and using more salt.

STIRRING CURDS.

It is customary among Canadian makers to stir the curds more or less after "dipping." It was suggested that curds need not be stirred so much if an extra quantity of salt were applied to the curd. This, it was said, would lessen the labor and produce just as good results.

During September and October seven trials were made, by dividing 1,200 pounds of milk into two vats and treating them the same, except that one vat was not stirred after dipping but to the curd an extra quantity of salt was added. There was practically no difference in the time of milling and salting the two curds. The table shows the chief points.

CONCLUSIONS.

1. By not stirring the curd there was an extra pound of cured cheese made from 600 pounds of milk.

2. The quality of the two cheese was much alike.

3. With a small curd the extra salt applied seemed to have the same effect as hand stirring of the curd.

Kind of cheese.	Average lbs. milk used.	Average per cent. fat in milk	Average lbs. cheese from 600 lbs. milk.	Average rate of salt per 100 lbs. curd.	Average Score.			
					Flavor.	Closeness.	Texture	Total
Extra moisture	600	3.41	59.85	3¼	30 59	17.71	17.28	89.49
Dry stirred...	600	3.41	58.78	2¾	30.42	17.57	17.71	89.49

AERATION OF MILK FOR CHEESE MAKING.

Fifteen experiments were made during July, August and September, in which one vat consisted of milk which had been aerated, while the other vat was unaerated milk. A part of the aerated milk was from our own cows and a part was from herds which supplied us with milk. Two kinds of aerators were used, viz, those which expose the milk to the air in thin sheets, and those which force air into the milk.

On July 26th, there were two vats of milk from the milking machine. One was aerated, the other was not. Both were very bad in flavor, both curds were "floaters," and both lost a great deal of butter fat. The drippings (whey from milking to and after, pressing) weighed 9¼ lbs., testing 23 per cent. fat from the aerated milk; while the unaerated tested 25 per cent. fat and weighed 12 pounds. The yield of cheese was 22½ lbs. from the aerated and 20½ from the unaerated. The flavor of the aerated milk cheese was scored 26 out of 35, while the unaerated scored 20. The total score was 83 and 75 respectively.

Conclusions.

1. While the average of the results does not indicate much difference in the yield or quality of the cheese, nor did aerating the milk prevent the formation of gas, yet the gas was easier got rid of from the aerated milk curds; and in case of badly flavored milk, the aeration made an improvement in the yield and quality of the cheese.

2. We shall need to make further experiments before making any very definite statements about the effects of aeration on milk for cheesemaking. In the meantime, we advise aeration in or with a pure atmosphere.

	Average lbs. milk used.	Average per cent. fat in milk.	Average lbs. cheese from 300 lbs. milk.	Scoring.	Average flavor. (max. 35)	Average closene s. (max. 20).	Average texture. (max. 20).	Average total. (max. 100).
Aerated	300	3.50	27.61	First	29 60	17.73	16.80	87.73
				Second	28.33	18 33	17.66	88.00
				Average	29.38	17.85	16.93	87.77
Unaerated	300	3 50	27.28	First	29 33	17.53	17.13	88.00
				Second	28 66	18 66	18.00	89.33
				Average	29.22	17.72	17.27	88.22

Pasteurizing of Milk for Cheesemaking.

Four methods of treating the milk after pasteurizing were tried with but limited success, viz, making up the same day as pasteurizing, with and without a starter, and making the day after pasteurizing, with and without a starter. The heating of the milk to 160 degrees changes the character of the milk in such a way that it does not work at all like an ordinary Cheddar curd. The cheese made from pasteurized milk resembles stilton cheese in many respects, in fact our experiments point to a new and successful method of making a famous stilton cheese.

The cheese made from heated milk to which a starter was added, more nearly resembled an ordinary Cheddar. The experiments so far made would lead us to doubt the value af pasteurization for Cheddar cheesemaking. In every case where the milk was kept over until the following day, the curds were very gassy.

Pasteurization of Milk for Cheesemaking.

Method of handling the milk.	No. experiments	Average lbs milk used.	Average per cent. fat in milk.	Average per cent. fat in whey.	Average hours from setting to dipping.	Average hours from dipping to salting.	Average lbs. cheese from 300 lbs. milk.	
							Green.	Cured.
					h. m.	h. m.		
(1) Cheese made same day as pasteurized but without starter	2	300	3 80	.45	5 00	3 30	38.87	35.12
(2) Made same day as pasteurized with starter	1	300	3.30	.20	3 40	4 00	32.00	30.25
(3) Made day after pasteurized with starter	3	300	3.43	.26	3 47	5 01	30.75	29.25
(4) Made day after pasteurized without starter	3	300	3.43	.35	3 54	5 11	32.08	30.58

Quality of Cheese made from Pasteurized Milk.

Method of handling the milk.	No. experiments.	Average score.			
		Flavor. (max. 35).	Closeness. (max. 20).	Texture. (max. 20).	Total. (max. 100).
(1) Made same day as pasteurized but without starter	2	27.0	17 5	15 5	81.00
(2) Made same day as pasteurized with starter	1	25 0	17.0	16.0	82.00
(3) Made day after pasteurized with starter	3	27.0	17.0	17.0	85 00
(4) Made day after pasteurized without starter	3	25.0	16.6	15.6	81.00

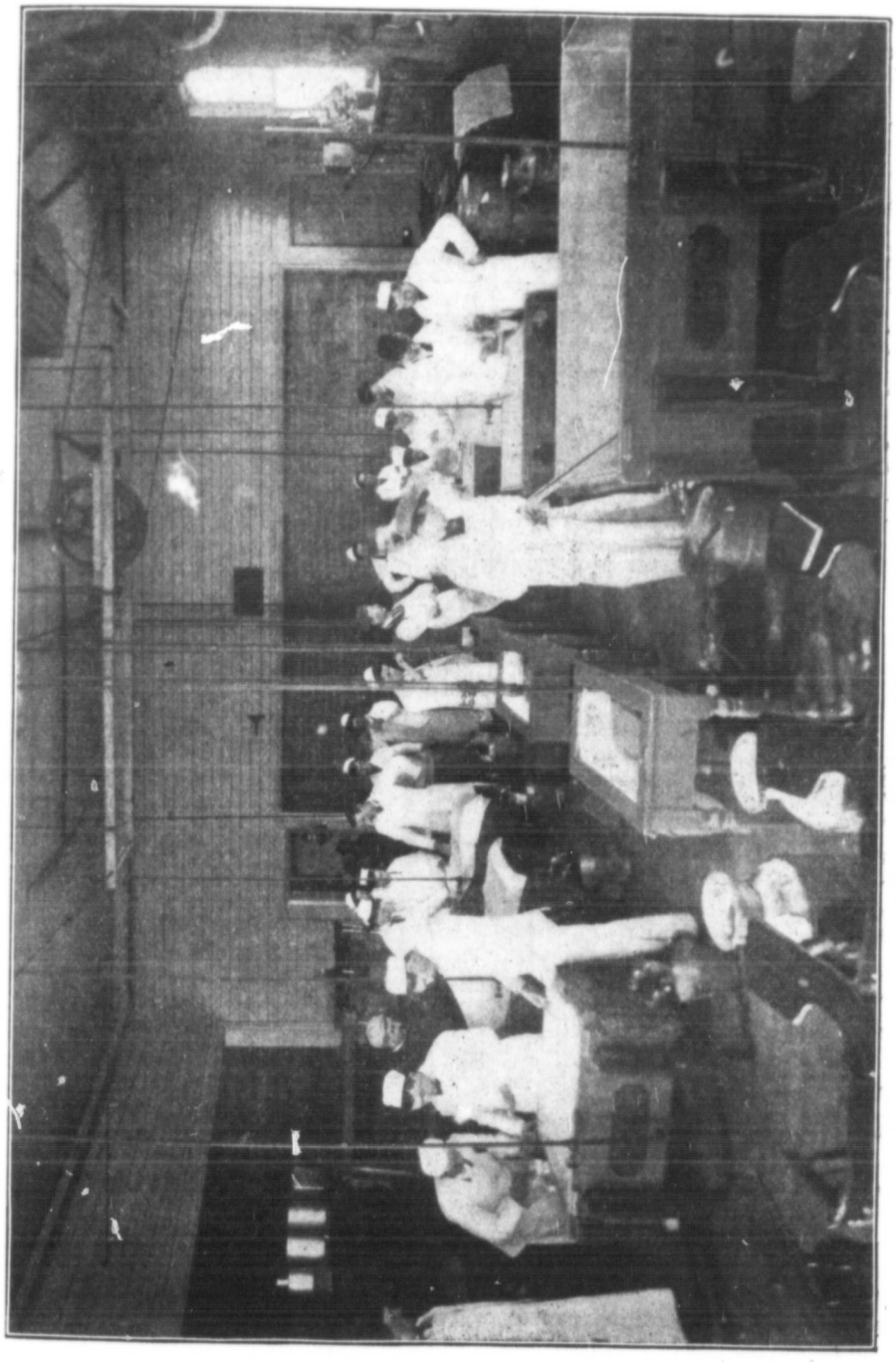
Ripening Milk before adding Rennet.

During May and June eight trials were made, to see the effect of ripening milk before renneting. This is a continuation of last year's work. The ripeness of the milk was determined by means of the rennet test commonly used in factories. The rennet test varied from thirteen to thirty-one seconds. The general rule seems to be that a difference of one second in the rennet test will make a difference of about two minutes in the time required for coagulation, although there are some marked exceptions to this rule.

In cases where the milk was set sweet, the curd remained in the whey for a longer time, but all were in a fit condition to salt in about the same length of time.

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

Date.	Per cent. fat in milk.	Rennet test — seconds.	Minutes coagulating.	Time from setting to dipping	Time from dipping to salting.	Per cent. fat in		Lbs. cheese.		Score.
						Whey.	Drippings and pressings.	Green.	Cured.	Max. 100.
				h. m.	h. m.					
May 5	3.40	19	37	3.19	3.00	.30	1.30	57.25	55.25	92
"	3.40	14	27	2.38	3.00	.40	1.20	55.50	53.50	89
" 6	3 60	19	35	2.53	2 52	.25	1 00	56.75	54 75	93
"	3.60	13	25	2.19	2.53	.25	1.00	56.75	54.75	95
" 8	3.50	18	31	3.11	3.02	.25	1.00	57.00	55.00	93
"	3.50	14	25	2.42	3.00	.25	1.60	56.25	54.25	96
" 15	3.70	20	40	3.07	2.37	.30	2 80	59.50	57.00	87
"	3.70	17	26	1.50	2.34	.35	2.50	60.75	58.00	83
" 31	3.40	25	33	3.00	2.54	.25	2.20	60.25	58.00	82
"	3.40	19	26	2.23	2.46	.20	1.50	60.50	58.25	81
" 27	3.40	24	35	2.57	2 57	.25	.50	58.00	55.00	87
"	3.40	20	30	2.22	2 52	25	1.00	58.00	55.00	85
" 20	3.50	30	43	3.10	2.53	.35	1 90	58 50	56.50	85
"	3.50	24	31	2.18	2.48	.35	1.90	58.50	58.50	88
June 2	3.20	31	45	3.27	3.05	.20	1.00	57.00	55 00	85
"	3.20	25	34	2.55	3.00	.20	1.00	57.00	55.00	83



Making Cheese at Dairy School, O. A. C., Guelph.

Effect of Different Quantities of Rennet.

These are further experiments in addition to similar ones made in 1895 and 1896. The milk was ripened to about twenty-two seconds The quantity of rennet varied from one ounce to eight ounces per 1,000 pounds milk. The minutes required for coagulation varied from seventeen and one half to seventy-nine.

Date.	Rennet test—seconds.	Rate of rennet per 1,000 lbs. milk.	Minutes coagulating.	Time from setting to dipping	Time from dipping to salting.	Lbs. cured cheese from 600 lbs. milk.	Per cent fat in		Score.
							Whole milk.	Whey.	Max. 100.
		ounces.		h. m.	h. m				
July 15	22	3	37	2.34	3.08	54.75	3.40	.30	86
" 15	.....	1½	59	2.47	3.03	54.00	3.40	.40	84
" 14	22	3	37	2.44	3.03	54 75	3.40	.30	90
" 14	.....	2	53	2.56	2.55	53.75	3.40	.40	89
" 19	22	3	38	2.53	3 28	53 50	3.30	.30	91
" 19	.....	2½	44	2 58	3.23	53.25	3.30	.35	93
" 17	22	3	38	3.12	3.00	54.75	3.40	.30	93
" 17	.....	3½	33	3.07	3 02	54.75	3.40	.30	87
" 22	23	3	38	3.11	3.30	53.50	3.30	.30	89
" 22	.....	4	26	3.16	3.03	54 50	3.30	.30	89
" 27	22	3	36	2.29	3 38	54.00	3.30	.20	91
" 27	.....	4½	24	2.34	3.27	53.75	3.30	.20	89
" 29	22	3	37	2.52	3.41	55.50	3.50	.30	91
" 29	.....	5	23	2.56	3.13	55.75	3.50	.30	91
" 30	22	3	37	2.54	3.25	54.50	3.50	.30	92
" 30	.....	5½	22	2.59	3.14	54.75	3.50	.30	92
" 31	22	3	39	3.04	3 20	54 00	3.40	.30	86
" 31	.....	6	20½	3.07	3.17	55.00	3.40	.30	88
Aug. 2	22	3	37	2.52	3.20	54.50	3.50	.30	92
" 2	.....	6½	19	2.57	3.03	54.75	3.50	.30	88
" 5	22	3	37	3.04	3.29	55.00	3.50	.30	83
" 5	.....	7	18	2.53	3.17	55.75	3.50	.30	79
" 14	23	3	37	3.30	3.37	56 50	3.50	.30	91
" 14	.....	7½	18	3.19	3.22	56.50	3.50	.30	89
" 23	23	3	38	3 03	4.02	58 75	3.50	.30	96
" 23	.....	8	17½	2.54	3.47	57.25	3.50	.30	93
Oct. 23	19½	3	29	2.48	3.03	61.00	3.60	.25	89
" 23	.....	2	48	2.49	3.05	59 50	3.60	.30	89
" 23	.....	1	79	2 50	3.05	60.00	3 60	.35	89
" 30	23	3	33	2.58	3.13	63.00	3.90	.30	89
" 30	.....	4	30	3 00	3.05	63.00	3.90	.30	89
" 30	.....	5	25	3.02	2.56	63.00	3.90	.30	90

Conclusions.

1. Where less than three ounces of rennet per 1,000 pounds of milk was used there was an extra loss of fat in the whey, and less cheese made. The extra quantity of rennet, above three and one-half ounces, made an extra yield of cheese.

2. The highest scoring cheese were made using two and one half and three ounces of rennet per 1,000 pounds milk.

Table 3. The time required for coagulation decreases with an increased quantity of rennet used in the milk, as shown by the table arranged in order of quantity of rennet used :

Rate of rennet per 1,000 lbs. milk.	Minutes coagulating.			
	1895.	1896.	1897.	Average for three years.
1 ounce	65	65.5	79	69.8
1½ "	.....	53	59	56
2 "	42	37	53	44
2½ "	40	36	44	40
3 "	33	.....	36.5	34.7
3½ "	27	.....	.....	27
4 "	26	28	26	26.6
4½ "	25.5	23	24	24.1
5 "	20	26	23	23
5½ "	.....	20	22	21
6 "	18	18.5	20.5	19
6½ "	.....	17.5	19	18.2
7 "	16	17	18	17
7½ "	.....	15	18	16.5
8 "	17.5	14	17.5	16.3
8½ "	.....	14	.....	14
9 "	13	13	.....	13

Effect of Dipping at Different Stages of Acid.

These are a continuation of the experiments made in reference to this question during the past two years. They were conducted in the months of June and July. The milk was first mixed together and then divided into two vats. In a number of trials the percentage of acid was determined with an alkali solution.

Date.	Hot iron test.	Hours from setting to dipping.	Hours from dipping to salting	Lbs. Cheese.		Per cent. Fat in			Score.
				Green.	Cured.	Milk.	Whey	Drippings.	Max. 100.
	inch	h. m.	h. m.						
June 3	⅛	2.45	3.04	57.25	55.50	3.30	.20	1.20	89
" 3	⅜	3.27	2.14	57.00	55 00	3.30	.25	1.40	88
" 7	⅛	3.21	3.20	58.50	56.75	3.50	.25	0.90	86
" 7	⅜	3.54	2.47	58.25	56.50	3.50	.25	1.20	83
" 11	⅛	2.33	2.56	58.50	56.75	3.30	.25	0.80	87
" 11	⅜	3.00	2.36	58.25	56.25	3.30	.25	1.20	87
" 12	⅛	3.10	2.32	57.50	55.00	3.30	.30	1.10	85
" 12	⅜	3.31	2.18	57.50	55.25	3.30	.30	1.40	87
" 14	⅛	2.43	3.13	59.00	57.00	3.60	.30	1.30	92
" 14	⅜	3.33	2.20	59.00	56.75	3.60	.30	2.70	86
" 17	⅛	2.51	3.22	58.25	56.75	3.30	.25	0.70	84
" 17	⅜	3.44	2.30	59.25	57.50	3.30	.25	0.80	88
" 30	⅛	2.42	3 28	57.25	55.50	3.30	.25	1.20	90
" 30	⅜	3.19	2 53	57.00	55.00	3.30	.25	1.50	86
July 2	⅛	2.29	3.13	57.75	55.25	3.30	.25	1.10	89
" 2	1	3.27	2.08	57.75	55.25	3.30	.25	2.30	85
" 5	⅛	2.41	3.27	55.50	53.75	3.20	.30	2.00	92
" 5	⅜	3.25	2.36	56.00	54.00	3.20	.30	2.20	88

Conclusions.

1. The time from setting to salting was about the same, irrespective of the time which the curds were allowed to remain in the whey.

2. The yield of cheese was greater by dipping at about one-eighth of an inch of acid, or two-tenths of one per cent, than where the curds were allowed to remain until over one-quarter of an inch of acid showed on the hot iron.

3. The percentage of fat in the drippings (whey from milling until the cheese are removed from the press) was higher in all cases where the curd remained in the whey for a long time.

4. The quality of the cheese was better in nearly every case from dipping at one eighth to one-quarter of an inch of acid as shown on the hot iron.

Hot Iron Test and Percentage of Acid in Whey at Dipping, Milling, and Salting.

Date.	Vat.	At dipping.		At milling.		At salting.
		Hot iron test.	% acid in whey.	Hot iron test.	% acid in whey.	% acid in whey.
		inch.				
June 3	H	$\frac{1}{8}$	.180	$1\frac{1}{2}$	.846	1.062
" 3	L	$\frac{1}{2}$	.261	$1\frac{3}{4}$	.702	1.152
" 7	H	$\frac{1}{8}$	.180	$1\frac{1}{2}$	.846	.999
" 7	L	$\frac{1}{2}$	.262	$1\frac{1}{4}$	.855	1.044
" 30	H	$\frac{1}{32}$	.207	$1\frac{1}{8}$	.....	.990
" 30	L	$\frac{1}{8}$	.225	$1\frac{1}{8}$	.....	1.089
July 2	H	$\frac{1}{4}$	.225	$1\frac{1}{2}$	.819	1.053
" 2	L	1	.252	$1\frac{1}{4}$	.954	1.224

Milling the Curd.

This is a repetition of last year's work. In addition, we have the loss of fat from dippings and pressings this year. Before milling the first half of the curd, it was divided into two parts. One part was milled at an average of about one hour and forty minutes after dipping. The hot iron at this time indicated about "one inch of acid." The other half of the curd was milled at periods ranging from one hour to three hours after dipping. The quantity of drippings and pressings from milling until the cheese were taken from the hoops ranged from six to eight pounds. The curd milled first, produced a larger weight of drippings but not so rich in butter fat.

Conclusions.

1. About one-and-a quarter inches was the longest "string" which could be got on the hot iron. After this the "strings" went back.

2. Whether milled at one-and-a-half hours after dipping, or longer, the curds were ready to salt at about the same time.

3. Allowing the curds to remain for two-and-a-half to three hours after dipping, and before milling, causes a greater waste of butter fat than milling earlier.

4. There did not appear to be so very much difference in the quality of cheese produced from the two methods.

5. We recommend milling about one-and-a-half hours aftea dipping, or when the curd becomes meaty and shows three-quarters to one inch of acid on the hot iron.

EFFECT OF MILLING AT DIFFERENT STAGES OF ACID.

Date.	Lbs. milk.	Per cent. fat in whole milk.	Hours from dipping to milling.	Acid on hot iron at milling.	Hours from dipping to salting.	Per cent. fat in		Lbs. cured Cheese.	Score. (Max. 100.)
						Whey.	Drippings and pressings.		
April 15	1,200	3.60	h. m. 1.30	inch. 1	h. m. 2.43	.20	1.40	59.25	93
			1.00	1	2.43	.20	1.20	59.00	92
" 17	1,200	3.80	1.40	1	3.05	.20	2.00	59.50	93
			1.15	1	3.02	.20	2.00	60.00	92
" 19	1,200	3.70	1.40	1	3.05	.20	2.40	59.25	90
			2.00	1	3.02	.20	3.00	59.50	91
" 21	1,200	3.80	1.40	1	2.53	.30	2.40	60.00	89
			2.15	⅞	2.53	.30	3.00	60.25	91
" 22	1,200	3.90	1.40	1	3.00	.25	1.60	59.50	95
			2.30	⅞	3.00	.25	2.40	61.25	93
" 23	1,200	3.60	1.40	⅞	3.25	.20	1.30	57.50	92
			2.45	¾	3.28	.20	1.30	57.25	91
" 26	1,200	3.80	1.40	1	3.17	.25	2.00	59.50	93
			3.00	¾	3.20	.25	2.20	60.75	91
May 3	1,200	3.60	1.40	1¼	3.05	.25	.90	58.25	95
			3.00	¾	3.08	.25	1.10	58.50	94
" 7	1,200	3.50	1.40	1	3.15	.20	1.00	55.00	93
			3.10	¾	3.25	.20	1.30	55.25	96

SALTING CURDS ONE HOUR SOONER THAN USUAL.

This is a continuation of last year's experiments under this head. Fifteen experiments were made during April, May, June, September, and October. As a rule, one-half of the curd was salted about one hour sooner than the other half, which was allowed to develop the "velvety feel." The table shows the main points of the experiments.

CONCLUSIONS.

1. The yield of cheese per 100 pounds of milk was slightly greater by salting one hour before the curds became "velvety."

2. The loss of fat in pressings and drippings was slightly greater by allowing the curds to "mellow down" before salting.

3. There was not much difference in the quality of the cheese whether salted early or late, what difference there was being in favor of mellowing the curds before salting.

EFFECT OF SALTING AT DIFFERENT PERIODS

Date.	Lbs. of milk.	Per cent. fat in milk.	Time from dipping to salting.	Lbs. cheese.		Lbs. cur'd cheese per 100 lbs. milk.	Lbs. drippings and pressings.	Per cent. fat in drippings and pressings.	Score.						Total second score.
				Green.	Cured.				Flavor.	Closeness	Even color	Texture.	Finish.	Total.	
			h.m.												
April 28	1,200	3.60	2.05	60.25	58.25	9.70	7.00	1.30	29	19	13	17	10	88	....
	....	.....	2.48	58.50	57.00	9.50	7.50	1.30	30	19	13	18	10	90	....
" 29	1,200	3.50	1.58	59 75	57.75	9.62	6.75	1.80	30	19	13	17	10	89	....
	.....	.....	2 40	59.50	57.25	9 62	7.00	1.80	29	19	13	16	10	87	....
" 30	1,200	3.40	2.15	59 00	57.00	9.50	6.00	1.00	32	18	15	19	10	94	88
	....	.....	3.25	58.50	56.50	9.41	6 00	1.20	32	19	15	19	10	95	87
May 1	1,200	3.60	2.06	58.50	56.50	9.41	7.00	1.00	32	18	14	18	10	92	87
	.....	.....	2.46	58.00	56.00	9.33	7.50	1.30	32	18	14	18	10	92	89
June 19	1,200	3.50	2.55	56.25	54.25	9.04	5.50	1.60	29	17	14	15	10	85	....
	....	..	3.43	56.25	54.25	9.04	5.00	1.50	29	18	14	16	10	87	....
" 21	1,200	3.40	2.05	60.00	57.75	9.62	5.00	.90	30	18	13	17	10	88	....
	.....	.....	2.55	59.00	57.00	9 50	5.00	.90	30	18	12	16	10	86	....
" 23	1,200	3.30	2.23	57.50	55.25	9.20	4.00	1.20	29	18	14	18	10	89	....
	....	.....	2.58	57.25	55.00	9.16	4.00	1.20	30	18	14	17	10	89	....
" 25	1,200	3.30	2.20	56.50	54.75	9.12	4.00	.80	30	18	14	18	10	90	85
	.....	.....	3.10	56.75	55.25	9.20	4.00	.80	28	18	14	18	10	88	89
Sept. 9	1,200	3.30	2.30	60.00	58.00	9 66	7.75	1.70	28	16	14	17	10	85	....
	.....	.....	3.20	59.00	57.00	9.50	8.00	1 90	30	17	14	17	10	88	....
" 10	1,200	3.30	2.40	58.50	56.50	9.41	5.75	1.00	30	18	14	17	10	89	...
	.....	....	3.53	57.50	55.50	9.25	6.00	1.30	32	17	14	18	10	91	....
" 11	1,200	3.50	2.15	59.25	57.50	9 58	8.00	1.00	31	15	14	17	10	88	....
	....	.	3.45	58.50	56.50	9.41	8.00	1.00	31	16	14	17	10	88	....
" 13	1,200	3.40	2 18	61.00	59.00	9.83	8 00	1 00	32	16	14	17	10	89	....
	.....	.....	3 22	60.00	58.00	9.66	8.50	1.00	31	17	14	17	10	89	....
" 25	1,200	3.40	2.15	64 00	62.00	10 33	6.75	.90	32	18	14	18	10	92	....
	....	.....	3.20	62 75	61.00	10.16	7.25	1.20	31	18	14	18	18	91	....
Oct. 11	1,200	3.70	2.17	67 50	65.00	10 83	6.50	1.00	31	18	14	17	10	90	....
	...	.....	3.27	65.50	64 00	10.66	7.75	1.20	31	17	14	18	10	90	....
" 12	1,200	3.50	2.12	63.25	61.50	10.25	7.25	1.00	30	18	14	18	10	90	....
	.....	.....	3.10	61.75	60.00	10 00	7.50	.90	32	18	14	18	10	92	....
Averages	....	Salted early	....	.....		9.67	6.35	1.14	30.3	17.6	13.8	17.3	10	89 2	....
	....	Salted late	.....	....		9.56	6 60	1.23	30.5	17.8	13.8	17.4	10	89.5	....

TEMPERATURE OF CURDS AT TIME OF PUTTING TO PRESS.

These are experiments conducted for the third year. Some time before pressing a curd was divided and put to press at different temperatures, as shown in the table. The range of temperature was from sixty-two degrees to ninety-five degrees at the time of hooping. The highest scoring cheese was made from a curd put to press at ninety-three degrees. Last year there was more openness in the cheese put to press at a high temperature. This difference did not seem to be so marked this year.

So long as the press room is kept moderately warm, there does not seem to be much difference in the quality of the cheese whether put to press at 65 degrees or 95 degrees, or at any temperature between these two points.

TABLE SHOWING EFFECT OF TEMPERATURE OF CURD WHEN PUT TO PRESS.

Date.	Lbs. of milk.	Per cent. fat in milk.	Lbs. cheese. Green.	Lbs. cheese. Cured.	Temperature when put to press.	Scoring of cheese. Flavor.	Closeness.	Even color	Texture.	Finish.	Total.
April 14	1,200	3 70	62.50	60 00	62°	31	19	14	18	10	92
	.....	.....	61.00	59.00	80°	31	18	13	18	10	90
" 9	1,200	3.60	62.25	60.00	63°	32	18	14	18	10	92
	.....	.....	60.75	58.50	75°	32	19	14	18	10	93
" 12	1,200	3.50	62.50	60.00	65°	32	19	13	18	10	92
	.....	.....	60.75	59 00	79°	31	18	13	18	10	90
" 8	1,200	3.60	62.25	60 00	66°	30	18	13	16	10	87
	.....	.....	60 50	58.50	80°	31	19	13	17	10	90
" 10	1,200	3.60	64 00	62 00	66°	32	19	14	18	10	93
	.....	.....	63.00	61.00	82°	33	19	15	18	10	95
" 7	1,200	3 80	61 50	59.50	68°	32	18	14	18	10	92
	.....	.....	60.50	58.50	80°	33	18	14	18	10	93
Aug. 3	1,200	3.40	55 50	53 75	93°	32	19	14	19	10	94
	.....	.....	56 50	54.50	83°	28	19	14	18	10	89
Oct. 27	600	3.80	31.25	30.00	95°	32	18	14	17	10	91
	.....		32.00	30.50	82°	32	18	14	18	10	92
" 28	600	3.80	31.50	30.00	95°	31	17	14	17	10	89
	.....	.....	32.50	31 00	78°	30	17	14	18	10	89

EXPERIMENTS IN BUTTERMAKING.

The experiments in the Butter Department, in charge of Mr. T. C. Rogers, relate to the following: Effects of feeding silage and turnips on the quality of butter; period of lactation on creaming of milk and quality of butter; straining milk through broken ice before setting; milking machine milk for butter making; pasteurizing milk and cream; best temperature for ripening cream; percentage of starter to use in cream ripening; washing butter; moisture in butter; centrifugal dryer in butter-making.

Other experiments were made, but not in sufficient number to base definite conclusions upon them, as follows: Cultures supplied by Mr. Harrison which gave a very bad flavor to the cream and butter; butter made from hay and mangels, together with meal, but our mangels were all fed before sufficient data was collected to be of much use; rye and alfalfa fed to cows by Mr. Day—but one churning, in which the butter was of fair quality—that from the green rye averaging slightly better in the two scorings—though the alfalfa butter scored higher when first made; testing the double-necked bottles used for determining the fat in skim milk, by which it was found that a dozen of these bottles gave practically the same readings when tested with twelve different samples of skim milk on different days. What difference there was in the readings was probably due to some fat from the previous test not having been thoroughly washed out of the finely-graduated neck.

FEEDING SILAGE TO COWS.

A correspondent wrote as follows in reference to an experiment in feeding silage to milch cows:

"You doubtless often receive suggestions, *re* experiments that are not workable, and what I shall mention may possibly fall into the same category.

"Admittedly, flavor and keeping qualities are two of the strongest points of excellence to be secured in butter-making. One of the stock objections to ensilage (and which we frequently hear) has been raised on both scores, and no later than a couple of days ago a leading farmer and breeder from a northern county expressed himself very strongly to me on that subject. He was sure that a creamery near him was going to lose its reputation for fine butter, because the patrons so generally were feeding ensilage to their cows. Now, could you not carry through an experiment that would determine what there is (if anything) in the objection raised against ensilage? Three lots of cows might be selected —one put on a heavy (fifty or sixty pounds) ration of ensilage, with comparatively little or nothing else; a second lot on about one-half the amount of ensilage, and more of other foods; and the third, no ensilage, but, say mangels and other foods, sufficient to make a good ration.

"After feeding the respective rations for a period sufficiently long to render the milk normal under these rations, then have the milk made up separately into butter, and, after being stored six weeks or a couple of months, have them submitted to some reliable dairy commission-house, or three chosen butter experts, for judgment."

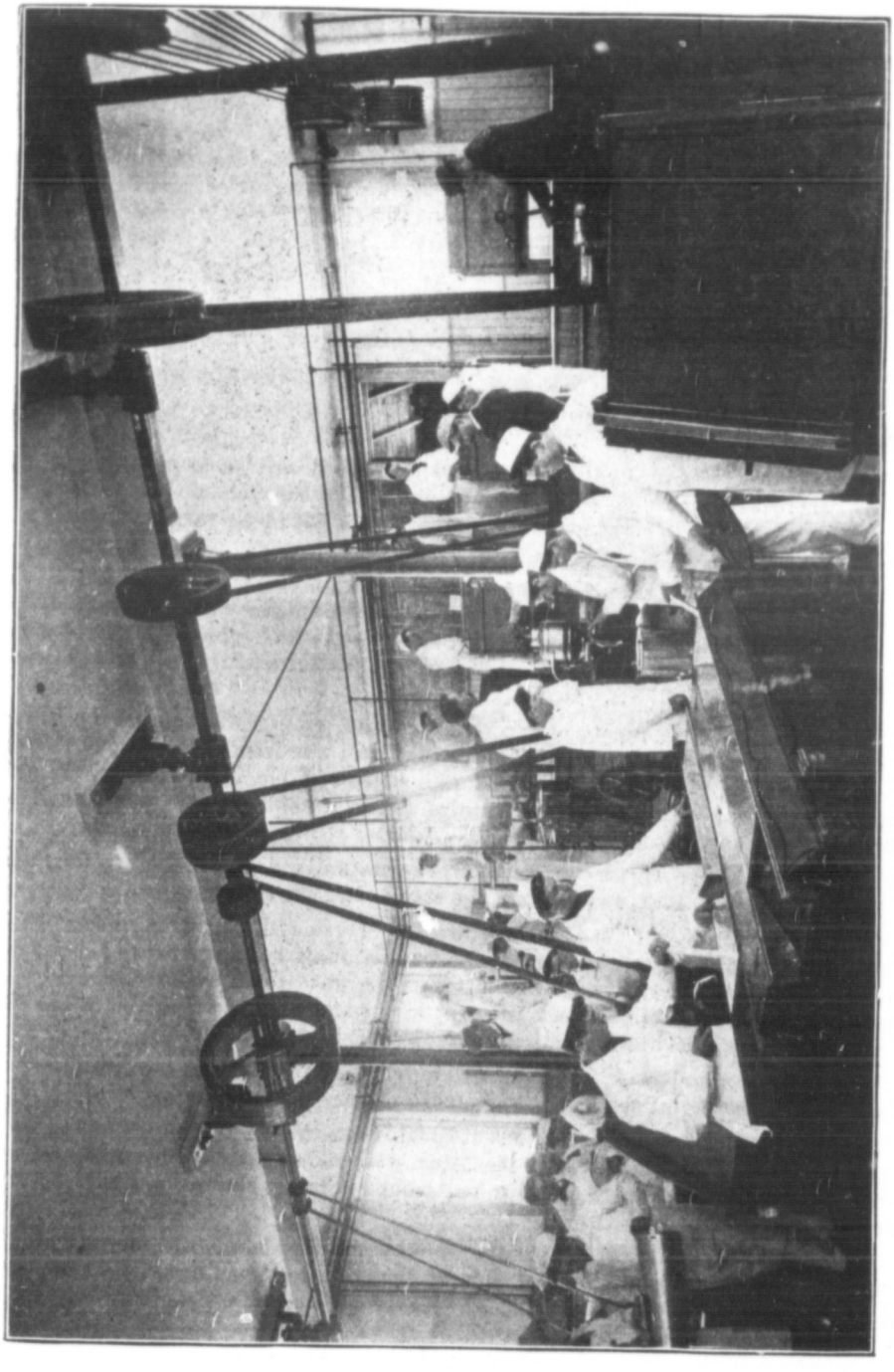
An experiment along the line of these suggestions was begun May 6th, and concluded May 26th, while the cows were still in the stable and the conditions favourable for the tainting of milk by ensilage feeding. The cows in the herd (20 in number) which were milking at this time, were divided into two lots—one lot on each side of the stable. To one lot was fed all the silage that they would eat clean, without making the manure too soft. They began on about thirty pounds each per day, and the amount was increased gradually until some of the cows were receiving fifty to sixty pounds each per day. In addition, they had some whole hay at noon, and eight pounds of meal mixed with the corn silage.

The other half of the cows received the regular ration of silage (thirty-five pounds) mixed with cut clover hay (ten to twelve pounds), mangels ($\frac{1}{3}$ bushel), and eight pounds of meal. The meal of both lots consisted of equal parts by weight of bran, peas, oats, and oil-cake.

Altogether thirteen different churnings were made. Of the silage milk 3,248 pounds were creamed and churned; while, of the mixed feed milk, 2,207 pounds of milk were made into butter. The average percentage of fat in the silage cream was 27.1, while the other contained 28.9. The temperature for churning the silage cream ranged from 55° to 61°, and averaged 57°. The mixed-feed cream ranged from 54° to 61°, and averaged 57°. The former churned, in an average of 33 5 minutes, while the latter required 42°. The butter, when made, was examined by myself and the butter-maker, and we considered that the butter made from silage milk was good in every respect. It was fully equal to that produced from mixed feed, in our judgment. When about one month old all the samples were scored by Mr. George Brill, of Guelph. When over two months old (July 30th) he scored them again. A few of the first lots were scored when made about one week.

SCORING OF BUTTER FROM SILAGE AND MIXED FEED MILK.

Scoring.	Silage Butter.			Mixed Feed Butter.		
	Flavor.	Grain.	Total Score.	Flavor.	Grain.	Total Score.
First	39.0	23.4	91.3	39.8	23.4	92.0
Last	35.6	23.0	87.0	36.8	23.0	88.2
Average of all	37.7	23.2	89.7	38.6	23.2	90 4



Making Butter at Dairy School, O. A. C., Guelph.

Conclusions.

1. The cream from silage feed churned more easily than that from mixed feed.

2. The highest score for flavor was forty-two points out of a possible forty-five. Two lots of silage butter scored forty-two, and three lots of the other scored this number. In grain, twenty-four points was the highest score obtained from a possible twenty-five. The silage butter scored twenty-four six times, and the mixed feed butter twenty-four five times. According to the judgment of the expert, the flavor of the butter was slightly better from the mixed feed (eight-tenths of a point in the average of thirteen trials), and it also held its flavor slightly better. The mixed-feed butter lost 2 points by keeping one month in an ordinary cool room, while the silage butter lost 3.4 points in flavor by keeping.

We can recommend good corn silage for feeding cows to produce milk for butter-making, but would prefer having it mixed with other foods, rather than feeding it in large quantities by itself.

Effect on Milk and Butter of Feeding Turnips to Cows.

We have always advocated that it is unwise to feed turnips to cows giving milk, especially where such milk is being manufactured into commercial butter or cheese. For home use it may be all right for those who do not object to a "turnipy flavor."

An experiment was commenced February 8th, 1897, to get some further light on the question, and also to see if simply allowing cows to remain in a stable where turnips are fed, without receiving any turnips themselves, would taint milk. Six cows were selected from the dairy herd and divided into three groups—two in each group. Mr. Stonehouse, our instructor in the home dairy, had charge of the buttermaking. I quote his report on the experiment :

"I beg to submit my report of experiments to ascertain the effects on the flavor of butter made from milk where turnips had been fed, and also from milk of cows that had not been fed turnips, but were confined and milked in a stable, the atmosphere of which was strongly charged with the odor of turnips fed to fattening steers, and alongside of which the cows were tied and milked.

"No. 1 lot was fed turnips immediately before milking, No. 2 lot was fed turnips after milking, and No. 3 lot was put into the stable with the steers.

"The experiment continued for five weeks. During the first week lots 1 and 2 were fed one peck of turnips each per day and no taint of turnips could be detected in the milk from any of the cows. The butter made was scored by the instructors and students of the dairy school one week after it was made, and no one detected any taint of turnips upon it. The scoring indicated first-class butter.

"During the second week, lots 1 and 2 were fed one-half bushel of turnips to each cow per day, and the scoring of the butter was practically the same as the first week.

"During the third week, the amount of turnips was increased to three pecks per day to each cow in lots 1 and 2, and still the taint was scarcely perceptible upon the milk, although the butter from lot 1 (turnips fed before milking) showed a slight flavor of turnips.

"During the fourth week, the turnips were increased to one bushel per cow per day, and the milk from lot 1 gave a decided odor of turnips after being heated to 110°, but it could not be detected before heating. The flavor on the milk from lot 2 (turnips fed after milking) was not so readily detected as it was on the milk from lot 1, but the flavor developed in the cream of both lots, and at the time of ripening there seemed to be but little if any difference. The cream was gathered for three days from each lot, and kept at a temperature below 45°. At the commencement of the ripening process, lot 1 was heated to 65° and 20 per cent. of starter was added. Lot 2 was heated to 75° and

allowed to develop its own acid for 24 hours. At the time of churning, lot 1 gave a pleasant acid flavor, while lot 2 had developed a strong odor of turnips. The same flavors predominated in the butter, which was scored by the instructors and class on the fourth day after churning. Lot 2 was scored low on account of the turnipy flavor, while lot 1 (turnips fed before milking) showed no turnipy flavor, indicating that the twenty per cent. of starter added to the cream had overcome the turnip flavor.

"During the fifth week the tests from lot 3 were discontinued, as the butter from those cows during the four weeks had maintained its good qualities, notwithstanding the strong odor of turnips in the stable where the cows were kept. The six cows were then given all the turnips they would eat for a period of four days, and the cream was placed in one can at a temperature of 45°. Before ripening, the cream was divided into three equal parts, all of which gave a strong odor of turnips. The first lot was heated to 75°, and allowed to develop its own acid. Lot 2 was heated to 65° and 20 per cent. of starter was added to the cream. Lot 3 was pasteurized and 20 per cent. of starter was added. At the end of 24 hours all three lots were churned.

"The butter from the first lot was very strong with the flavor of turnips. Lot 2 was not so bad as No. 1, while lot 3 (pasteurized) showed no turnip flavor at all. This indicates that pasteurizing and adding a starter will overcome the turnipy flavors in milk and butter.

"During the first three weeks one pound of pasteurized starter was put into each cream can with the first gathering of the cream and allowed to develop acid slowly during the three days the cream was being gathered for a churning. This may have had some effect on the flavor of the butter."

This experiment opens up several practical and interesting questions in reference to feeding milch cows on turnips. Does it disprove the "Breathing Theory" of turnips tainting milk? Was there any real difference in the turnipy flavor of the milk from cows fed turnips *before* and *after* milking? Is it safe to feed a small quantity of turnips to cows? Had the quantities of one peck, two pecks or three pecks per cow per day been continued for a month or so, would they eventually have caused a flavors in the milk? What part does a "starter" play in overcoming the turnipy flavor in cream? Is pasteurizing an effectual cure for turnipy flavor?

Kind of cream.	Av. score in flavor. (Max. 45.)			Av. score in grain. (Max. 25.)			Av. total all. (Max. 100.)		
	1st time.	2nd.	Av. all.	1st	2nd.	Av. all.	1st.	2nd.	Av. all.
Cows fed turnips before milking	39	37	38	23	23	23	90.6	89.5	90
Cows fed after milking	37.8	35.8	36.8	22.2	22.6	22.4	88.4	87.2	87.8
Turnipy cream pasteurized	40.75	40.0	40.37	23.2	23.0	23.1	93 7	92.0	92.8
Turnipy cream not pasteurized, but a starter added	40.00	38.0	39.00	23.3	23.0	23.1	91.6	90.0	90.8
Turnipy cream allowed to ripen of itself	36.0	33.0	34.5	21.6	23.0	22.3	86.0	85.0	85.5

From April 6th to 27th, a further test of feeding cows on turnips was made. Some more trials were made to see the results of pasteurizing and the effects of a starter in turnipy cream. All the cows milking at the time were divided into two lots. One lot was

fed turnips *before* milking, the other lot turnips *after* milking. They were started on a small ration, and it was gradually increased until the cows were getting nearly one bushel per day. The butter made was scored by Mr. Brill when about a month old, and again when about two months old. The table shows the averages of the scores in flavor, grain and totals, together with the scoring of butter made from turnipy cream pasteurized, where starter was added and where such cream was allowed to ripen by itself. It will be noticed that pasteurization and the use of a starter improved the flavor very much.

Effect of Period of Lactation on Creaming of Milk and Quality of Butter.

This is a continuation of last year's work on this question. The cows were divided into three lots—those which had been milking over six months, those under six and over three, and those milking less than three months. All three lots of milk were set in the same creamer, under exactly the same conditions. The average percentage of fat in the milk of the fresh cows was 3.78. The average percentage of fat in the skim milk from these cows was 0.26. The second lot (those milking over three and under six months) averaged 3.68 per cent. of fat in the whole milk and 0.50 in the skim milk, or nearly double that of the fresh milkers. Lot three (milking over six months) averaged 4 28 per cent. of fat in whole milk and 0.51 in skim milk.

Kind.	Av. % fat in cream.	Av. % fat in buttermilk.	Av. temp. for churning.	Av. time required to churn.	Av. score of flavor (45).	Av. score of grain (25).	Av. of total scores (100).
				Min.			
Fresh milkers	19.48	0.17	58°	21	41.2	22.7	93.0
3 to 6 months	20.1	0 21	58°	28	40.6	22 6	92.2
Over 6 months	18.4	0 17	58°	31.5	39.6	22.1	90.7

Effect of Straining Milk Through Broken Ice Before Setting.

At a creamery meeting held in Barrie last June the question was asked whether it was better or not to strain milk through broken ice before setting in the creamer. As we had never made any experiments directly on that point, I was unable to answer the question definitely but promised to do some experimental work in that connection and report the results to Mr. Thomas, the owner of the creamery. In June and July twelve trials were made by first mixing together 90 pounds of milk, one-third of which was strained through broken ice and then set in a creamer in ice water. The 30 pounds of milk melted about 3½ to 4 lbs. of ice, which, of course, went into the milk. The ice cooled the milk about 20 degrees as it passed through. The cream was removed at the end of about twelve hours, and it was found that the skim milk contained an average of 0.53 per cent. of fat without making corrections for the melted ice. Another third of the milk was set in the same creamer as the first, after adding 20 per cent. of cold water (58°), and it was skimmed at the same time as the previous lot. The average per cent. of fat in skim milk was 0.49 (no corrections for water) The balance of the milk was set in the same creamer in ice water, without the addition of either ice or water. The average per cent. of fat in the skim milk was 0.47.

Conclusion: It was no advantage to strain the milk through ice before setting, nor yet to add cold water to the milk. This accords with previous experiments where both hot and cold water were added before setting.

Milking Machine Compared with Hand Milking for Quality of Butter.

On certain days during the months of April, May, July and August, about half of the cows were milked with the Thistle machine, and the other half were milked by hand.

The milk was creamed and churned separately, and the butter was scored twice by Mr. Brill. As seen in the table, there was not so very much difference in the quality of butter when first made, but the machine butter spoiled, or went off in flavor, much more quickly:

Kind of butter.	Scoring.	Score in flavor (max. 45)	Score in grain (max. 25)	Average of total scores max. 100.
Milking machine	1st time	39.0	23.	91.4
	2nd time	32.7	23.	84.7
	Average of all	35.85	23.	88.1
Hand milking	1st time	40.0	22.6	91.4
	2nd time	36.0	22.5	87.5
	Average of all	38.0	22.6	89.5

Pasteurizing Milk for Butter Making.

It has been suggested that pasteurizing the whole milk *before* separating was preferable to heating the cream and skim milk *after* separating. To see what advantage, if any, may be derived from heating the whole milk, and also to see what difficulties there may be in thus treating the milk before separating, several trials were made in October. A vat of milk was heated to a temperature ranging from 95° to 98° (av. 97°), and half of it was separated. The other half was then heated from 150° to 160° (av. 158°), and separated. All the heating was done in a vat having a capacity of about 800 pounds. The chief difficulty was in preventing the milk from cooking on the sides of the vat. By carefully regulating the steam, and by keeping the milk in motion, this trouble can be largely prevented. A channel vat having a double bottom, and set in another pan heated with a steam pipe, is the best method we have yet tried. The pasteurizers on the market are too expensive and too complicated for the average creamery.

It was found that the cream was richer from the milk heated to 158°, and the feed had to be increased in order to prevent the cream outlet from clogging. The extra feeding did not increase the loss of fat in skim milk. All our experience goes to show that the capacity of a separator is increased, and that it will skim closer by heating the milk to 100° or over before skimming.

In churning the cream from the two temperatures for heating, it was found that the cream from pasteurized milk churned in a little less time (average 3 minutes) and with less loss of fat in the buttermilk —0.13 per cent. as compared 0.19 in the buttermilk from unpasteurized milk.

Both lots of cream had the same percentage of starter added, were ripened at the same temperature, and were handled in much the same manner, except in the heating of the milk.

The table shows the quality of the butter.

Butter made from—	Scoring.	Flavor (max. 45.)	Grain (max. 25.)	Total (max. 100.)
Pasteurized milk	1st score	41.5	22.8	93.3
Raw milk	2nd score	40.7	22.7	92.0

CONCLUSIONS: With a proper system of heating the milk, pasteurizing the milk may be successfully done. It will increase the capacity of the separator, give closer skimming, and insure a better quality of cream and skim-milk (pasteurizing the cream and skim-milk would insure good cream and skim-milk.)

The quality of the butter is better where pasteurization is practised. The difference is not so marked when cows are on grass, but in winter, when cows are kept in the stable and fed foods which are liable to taint the milk, pasteurizing the milk or cream will show a marked improvement in the flavor of the butter. If the cream is properly cooled for a sufficient length of time before churning, the grain of the butter will be all right.

PASTEURIZED CREAM.

The method of pasteurizing was that reported last year, viz., heating the cream in shot gun cans placed in a tank of hot water (180°). Twenty trials were made during the season. The average percentage of fat in the cream was 27. The churning temperature was 48 6° and the time required to churn averaged 36 minutes. The loss of fat in buttermilk averaged 0.15 per cent.

Twenty lots of the same cream were ripened without pasteurizing. The time required to churn was 39 minutes and the loss of fat in buttermilk averaged 0.16 per cent.

Kind of cream.	Scoring.	Flavor. (Max. 45.)	Grain. (Max. 25.)	Total score. (Max. 100.)
Pasteurized	First	40.1	22.85	92.05
	Second	39.3	22.63	90.84
	Average	39.7	22.74	91.49
Raw	First	39.2	22.6	90.85
	Second	37.85	22.4	88.95
	Average	38.52	22.5	89.90
Pasteurized in tank	First	39.77	23.15	92.
	Second	36.77	22.15	88.
	Average	38.27	22.65	90.
Pasteurized in C. C. & G. pasteurizer	First	39.61	22.84	91.46
	Second	36.70	22.46	88.07
	Average	38.15	22.65	89.76

MOISTURE IN BUTTER.

During the year forty-eight samples of butter were sent from the Dairy Department to the Chemical Laboratory to have the percentage of moisture determined. Very little work has been done in this connection with reference to Canadian butter. If the butter made in our dairy be a fair sample of average Canadian butter, the percentage of moisture is below that of European or United States butter. The average moisture in fourteen samples selected at random from our regular make, was 11.297 per cent. The average of the forty-eight samples was 11.034 per cent. of moisture. This is an indication that Canadians do not "load" their butter with water, and ought to be a point in favor of Canadian butter in the markets of Great Britain.

Several trials were made with a centrifugal butter dryer, in order to see its effect on the percentage of moisture retained in the butter. The dryer left an average of 9.402 per cent. of moisture in the butter treated with it, while lots of the same butter handled in the ordinary way contained 10.125 per cent. of water.

TEMPERATURE FOR RIPENING CREAM.

These experiments are a continuation of last year's work. Twenty-one trials were made by dividing cream into two lots after mixing thoroughly. One lot was ripened at

an average temperature of 73°, while the other lot was ripened at 60°. The time required to churn the cream ripened at 73° was 37 minutes and the percentage of fat in the buttermilk averagd 0.15. Of the 21 churnings of cream ripened at 60°, the average time required to churn was 33 minutes, and the fat lost in buttermilk averaged 0.165 per cent.

The table shows the effect on the quality of the butter, also the quality of the butter in seven trials where the cream was mixed and then divided into three lots ripened at 74°, 60°, and the third lot cooled to 49° for one to two hours and then warmed to 60° for ripening.

Cream ripened at		Flavor. (Max. 45.)	Grain. (Max. 25.)	Total. (Max. 100.)
73°	First score	45.	22.8	92.1
	Second score	39.	23.0	91.0
	Average of all	39.5	22.9	91.5
60°	First score	40.3	23.1	93.0
	Second score	38.4	23.1	90.5
	Average of all	39.35	23.1	91.7
74°	First score	39.86	23.0	91.8
	Second score	39.66	23.5	91.7
	Average score	39.76	23.25	91.75
60°	First score	40.4	23.1	92.0
	Second score	38.7	23.3	90.8
	Average score	39.55	23.2	91.4
Cooled to 49° and ripened at 60°.	First score.	40.8	23.3	93.3
	Second score	37.7	22.8	89.0
	Average score	39.25	23.05	91.1

Different Percentages of Starter Used to Ripen Cream.

There is some difference of opinion among butter makers as to what percentage of starter added to cream will give the best results in ripening. Some say 5 per cent. or less, and some recommend 20 per cent. of starter in order to get the best flavor in the cream and butter, and also to get exhaustive churning.

Thirteen trials were made with percentages of starter varying from 3 to 10—average 6.4. The cream contained an average of 27 per cent. butter fat, and required 37.4 minutes to churn at an average temperature of 49.6°. The loss of fat in buttermilk was 0.2 per cent.

In thirteen trials, where the percentage of starter averaged 11 and the per cent. of fat in the cream was 26.6, it took 38.7 minutes to churn at an average temperature of 50°. The loss of fat in the buttermilk was 0.22 per cent.

The table shows the scoring of the butter from the two lots:

Kind of cream	Scoring.	Flavor. (Max. 45)	Grain. (Max. 25)	Total. (Max. 100)
6.4 % starter	First	40.54	22.6	92.2
	Second	38.80	22.8	90.4
	Average	39.62	22.7	91.3
11 % starter	First	41.0	22.6	92.4
	Second	37.9	22.6	89.6
	Average	39.45	22.6	91.55

Effect of Washing Butter.

This is work continued for three years. Eighteen trials were made during the season. The method of conducting the experiments was similar to that of other years, viz.: When a churning was completed one-third was taken from the churn, salted, and worked. The remainder was worked once, and half of it removed from the churn and finished. The balance was washed twice, and then treated the same as the other two lots. The butter was kept in an ordinary cool room and was scored twice—once soon after being made and once when a month to two months old.

The table shows the results of the scoring:

Kind of butter.	Scoring.	Flavor. (Max. 45.)	Grain. (Max. 25.)	Total. (Max. 100.)
Unwashed	First	40.5	23.2	92.9
	Second	38.8	23.0	91.27
	Average	39.65	23.1	92.08
Washed once	First	40.66	23.44	93.55
	Second	39.40	23.00	91.50
	Average	40.03	23.22	92.52
Washed twice	First	40.4	23.47	93.2
	Second	38.9	23.00	90.9
	Average	39.65	23.23	92.05

Quality of Butter made with Centrifugal Dryer.

Butter made with the dryer was compared with that made according to the ordinary methods of handling it and the effects on quality were noted. The dryer was used as follows: Half the butter from a churning was put into the machine and made to revolve until no more moisture came from the butter. It was then removed, salted, and worked as usual, except that not quite so much salt was added to the dried butter. The other half of the churning was salted and worked in the ordinary way.

The table shows the effect on the quality of the butter, which was practically the same from both methods:

Kind of butter.	Scoring.	Av. flavor. (Max. 45.)	Av. grain. (Max. 25.)	Av. total. (Max. 100.)
Ordinary method	1st score.	41.62	22.36	93.0
	2nd "	38.12	22.75	89.9
	Average	39.87	22.55	91.4
Centrigugal Dryer	1st score.	41.75	22.62	93.25
	2nd "	38.14	22.82	90.14
	Average	39.94	22.72	91 69

DAIRY SCHOOL.

Previous to the dairy course last January, the College students took two weeks' work in the dairy under instruction from the heads of the different departments of the Dairy School. The Dairy School proper opened January 15th and closed March 26th. Thirty-nine students wrote on the final examinations, of whom thirty-four passed, and were granted their certificates of standing. The work was much the same as in former years—lectures, discussions, judging cheese and butter, along with practical work in cheese-making, running of cream separator, buttermaking and milk-testing. The butter and cheese made during the term were sold for good prices—chiefly in the local markets.

For 1898 we have added a lady instructor to the Home Dairy School staff, in order to induce a larger number of ladies to attend. We have also extended the course to twelve weeks. This will give more time for practical lessons in the dairy, and our graduates will be more fully equipped with the practical knowledge necessary to succeed in the creamery or cheese factory.

DIPLOMAS.—The following are applying for diplomas this year: A. E. Gracey, Trafalgar; Geo. Menzies, Sheffield; James Biffin, Bennington; W. M. Singleton, Newboro'. If there are no unfavorable reports at the first meeting of the Dairy School Instructors of 1898 their diplomas will be granted.

DAIRY STOCK.

Our stock, during the year, consisted of cows, pigs, and one horse. In the latter part of the year the dairy piggery was placed in charge of Mr. Day to conduct experiments. This will relieve the dairy department of the need to keep a large number of hogs to consume dairy by products, as Mr. Day has agreed to take these. The dairy will lose about $500 revenue per year by this change.

The dairy herd consists of five Jersey cows, three Holsteins, three Ayrshires, twenty grade cows and heifers, three Holstein calves, and one grade calf. At the annual sale three Jersey bull calves and one Holstein bull calf were sold. An Ayrshire bull calf was disposed of later, privately.

During the past year an approximate account of feed fed to each cow was kept by the cattleman. As in previous years each cow's milk was weighed morning and evening, and a weekly composite sample was taken and tested at the dairy. At the end of each month the cost of food given, together with the pounds of milk, butter and cheese produced by each cow was recorded. As our herd is continually changing we give the records for those only which have been in the herd for the *full* year.

The foods fed, which were furnished by the farm department, were charged as follows: Hay $6.00 per ton; silage $1.30 per ton; and mangles seven cents per bushel. The foods bought cost as follows, to which was added two-and-a-half cents per bushel for grinding the grains; Oats 20 cents per bushel; peas 42½ cents per bushel; bran $9.00 per ton; oil cake $19.00 per ton.

The same rules as last year were used for calculating the butter and cheese from the milk and butter fat, viz., ten per cent. was added to the butter fat in estimating the butter.

The pounds of butter were multiplied by two-and-a-quarter in estimating the cheese produced. The tables show the record of each cow which has been in the herd for a full year, and also the food, cost of milk, butter and cheese by months.

Record of Dairy Herd for 1896 and 1897.

ame of Cow.	Breed.	Total cost of food.		Pounds of milk.		Pounds of butter.		Pounds of cheese.		Food cost 1 gal. milk.		Food cost 1 lb. butter.		Food cost 1 lb. cheese.	
		1896	1897	1896	1897	1896	1897	1896	1897	1896	1897	1896	1897	1896	1897
		$ c.	$ c.												
Margaret	Holstein	39 89	27 98	7,994	9,131	312	335	702	753	5.0	3.06	12.7	8.35	5.6	3.71
Belle Temple	Jersey	37 50	29 32	6,702	5,907	424	360	954	810	5.6	4 96	8.8	8.14	3.9	3.62
Birdie	Grade	38 85	26 90	7,787	6,375	365	264	821	594	4.9	4 22	10.6	10.18	4.7	4.52
Annie	Grade	28 23	26 92	5,341	4,463	239	213	537	479	5.2	6 03	11 8	12.63	5.2	5.62
Lisgar's Rose	Jersey	30 94	23 92	5,865	3,730	325	189	731	425	5.2	6.41	9.5	12.65	4 2	5.62
Patience	Ayrshire	30 06	23 09	7,473	5 559	329	266	740	598	4 0	4 15	9.0	8.68	4.0	3.86
Mabel	Grade	32 55	26 78	5,683	7,581	235	299	528	652	5 7	3.53	13.8	9.23	6.1	4.10
Wedo	Holstein	19 90	28 52	3,434	6,617	119	238	293	536	5.8	4.31	16.7	11.98	6.8	5.32
Ontario Belle	Jersey	17 43	22 37	3,195	3,214	194	220	436	495	5.4	6.96	9.0	10.16	4.0	4.51
Rena Burnette	"	18 21	22 17	4,126	3,188	231	200	520	450	4.4	6 94	7.9	11 08	3.5	4.92
Lily X. Y	"	8 17	21 26	1,278	3,705	66	224	150	504	6.3	5.74	12.3	9.49	5.4	4 21
Meg	Holstein	.....	27 40	.....	4,442	....	159	....	397	....	6.17	....	17.23	...	6.90
Jennie	Grade	26 69	.....	4,028	.....	120	....	360	....	6.6	....	22.2	.....	7.4	....
Jessie	"	29 48	.....	3,780	.....	161	....	362	....	7.8	....	18 3	.....	8.1	....
Filpail	"	29 60	.....	5,006	.....	199	....	448	....	5.9	....	14.9	.....	6.6	....
Carrie	"	29 64	.....	3,979	.....	169	....	380	....	7.4	....	17.5	....	7.8	....
Minnie	"	24 36	.....	2,389	.....	133	....	300	....	10.1	....	18.2	....	8.1	....

Food Cost of Milk, Butter and Cheese, from Dairy Herd, O.A.C., by Months, for 1896-97.

Month.	No. cows milking.		Total food cost.		Pounds of milk.		Pounds of butter.		Pounds of cheese.		Food cost of 1 gal. milk.		Food cost of 1 lb. butter.		Food cost of 1 lb. cheese.	
	1896	1897	1896	1897	1896	1897	1896	1897	1896	1897	1896	1897	1896	1897	1896	1897
			$ c.	$ c.							c.	c.	c.	c.	c.	c.
December	16	19	62 00	49 25	7,767	8,246	329	384	740	864	8 0	5 97	18.8	12.82	8.4	5.70
January	16	*19	43 60	58 33	7,043	10,609	317	466	713	1,152	6.2	5.50	14.0	11.39	6.1	5.06
February	*15	19	46 00	50 91	8,029	8,839	373	392	839	969	5.7	5.76	12.3	11.81	5.5	5 25
March	17	18	45 53	48 62	7,224	8,590	334	411	722	924	6.3	5 66	13.6	11.82	6.1	5.26
April	*18	16	48 40	40 59	10,487	7,033	463	308	1,041	693	4 6	5.77	10 4	13 17	4.6	5.85
May	*17	*20	33 09	65 46	11,665	13,178	490	590	1,102	1,327	2.8	4.97	6.7	11.09	3.0	4.93
June	21	22	23 73	32 57	11,664	13,240	568	551	1,278	1,239	2.0	2.46	4.2	5.91	1.8	2.62
July	22	22	37 65	30 88	10,245	12,277	454	486	1,021	1,093	3.7	2.51	8.3	6.35	3.7	2 82
August	24	*21	58 64	31 27	11.511	14,633	464	575	1,045	1,293	5.1	2.13	12.6	5 43	5.6	2 41
September	21	19	69 34	35 87	8,939	9,334	400	423	900	951	7.7	3.60	17.3	8.48	7.7	3.77
October	*22	20	73 65	31 63	10,265	9,653	479	403	1,077	906	7.2	3.27	15.3	7 84	6.8	3.49
November	20	*18	54 38	63 12	9,237	9,209	435	420	979	945	5.9	6.86	12.5	15.02	5.6	6.67
Averages	19.1	19.4	49 66	44 88	9,501	10,453	425	450	955	1,029	5.2	4.53	11.6	10.9	5.2	4.48

* Contains five weeks.

MISCELLANEOUS DAIRY NOTES.

Special Bulletins.—During the year three special bulletins, in suitable form for the newspapers of the Province, have been issued from the Dairy Department. We would like to make this a special feature of our work in order that dairymen may quickly receive the information contained in these bulletins. It requires the co-operation of the press to make the plan succeed.

In addition, a special bulletin was prepared on the methods of building and conducting co-operative cheese factories and creameries, which was published by the Department of Agriculture, Toronto.

Bulletin No. 1.—Fodder and Spring Cheese.

To Makers.—It will be well to bear in mind that the cheese made in the spring of 1897 are almost sure to go into immediate consumption. Other years, makers have been undecided whether to make the cheese for early use or make them "to be held." This year there can scarcely be any room for doubt as to when spring cheese will be needed. They are wanted now. With this fact before them, makers should govern themselves accordingly and make use of all their art in order to produce a "quick-curing" article To obtain this end observe the following points:

1. Accept nothing but pure, sweet milk.

2. Heat to 86 degrees and then make a rennet test.

3. Set the milk when the rennet test is about 18 seconds, or at sufficient ripeness so that the curd will "dip" in about two and a half hours.

4. Use sufficient rennet to coagulate the milk in about twenty minutes. This will require from three to four ounces of standard rennet. (Be sure that your rennet is all right).

5. Do not cut more than three times, unless the milk is over ripe. Retain plenty of moisture in spring curds for an early market. Our spring cheese are usually too dry and harsh.

6. Heat slowly to 98 degrees—not above this temperature, as it is desirable to retain moisture.

7. Dip at the first appearance of acid. If the acid does not show on the hot iron, use the alkali test. Do not leave the curd in the whey more than three hours, even if the hot iron indicates "no acid." If you test with the alkali, you will find plenty of acid at the end of three hours, provided the temperature is kept up to 98 degrees. The hot iron is not always reliable at this point.

8. Mill early—as soon as the curd becomes meaty and shows about one inch on the hot iron.

9. Hand-stir sufficiently to improve flavor, but not enough to lose all the moisture.

10. Salt at the rate of about two pounds to 1,000 pounds of milk and before the grease runs too freely. Allow the curds to stand longer in the salt. You will thus save butter fat and will not be troubled with "greasy" curds. Many are sacrificing a good deal of butter fat for the sake of getting a "close" cheese.

11. Keep the temperature of the curing room at about 70 degrees and thus hasten the curing.

12. Do not allow the cheese to go into the curing room which is not nicely finished, nor one to leave it until it is at least two weeks old. Not a few are ruining their reputation by shipping curd to their customers. The writer heard of a case this spring where cheese were made on Saturday and shipped the following Tuesday. Such a practice cannot be too strongly condemned. Don't do it, no matter what the pressure from salesmen,

buyers or patrons, who may be anxious to secure the advantage of the present high price. The reputation of Canadian cheese is at stake. I repeat, don't do it.

13. To sum up: in order to obtain fat, meaty, quick-curing cheese, which will be fit to eat in about one month after making, use plenty of good rennet; leave sufficient moisture in the curd; salt lightly; keep the temperature of the curing room up to 70 degrees, night and day; and keep the cheese in the curing room for at least two weeks.

In conclusion, take a little trouble to inform patrons as to the best methods of caring for milk. Do not send milk home without first trying to remedy the trouble. Pay a visit to each patron at least once a year. Keep the factory clean and tidy.

To Factory Owners.—Please see that the factory is in good repair before commencing the season's work. Have all holes in the floor made good. Look over the vats, presses, hoops, etc., carefully and put them in good shape for the maker. Tidy the yards and approaches to the factory. Plant some trees about the place. Make the factory a place where patrons will like to come, rather than a place to be shunned on account of bad smells, untidy surroundings, and an ill-tempered cheese-maker. Prizes given to patrons who send the best and largest quantity of milk will help the business.

To Patrons.—Endeavor to supply the factory with first-class milk. Take a pride in sending a large quantity of the best quality of milk that your section can produce. Strain and aerate the milk well. Deliver it at the factory every day, if possible. There is always more loss of fat in making up milk two or three days old. The maker is also likely to be troubled with greasy curds and other things which will give him difficulty in making fine cheese.

What the Trade says about Fodder Cheese.

Mr. W. A. Grant, of Montreal: "The statistical position of cheese in England to-day is the strongest for the past seventeen years. There are practically no English cheese, and the new Cheshire cheese, when I left England, on the 7th of April, was selling at 70 s. per cwt., or equal to 15c. per pound. Of course these prices will not be maintained. I am very glad that factorymen have seen it to their advantage to make as few fodder cheese as possible, and I hope those who have made them will keep them on the shelves until they are at least two or three weeks old, so that they will be cured and meaty when they are sent forward, as the cheese does not properly cure in the box."

Messrs. A. A. Ayer & Co., Montreal: "It is a great mistake to ship fodder cheese so very young All fodder cheese should be made soft, fat and quick-curing, as they are intended for immediate consumption. The present price is very tempting, and we fear lecturing the farmers under such circumstances will do very little good, at the same time, one's duty demands that they should warn the farmers in shipping cheese so very, very green. They are no credit to the country and are very apt to spoil, or rot in some instances."

Messrs. J. C. & G. D. Warrington, of Montreal, report that of 27 factories in Eastern Ontario, whose cheese had been inspected by them, they found all to be clean in flavor, solid and close in cutting, and none showing signs of greasy curd or stable flavors.

Montreal *Trade Bulletin*, April 30th: "In this market we have just heard of the sale of a lot of the finest western colored at 10¼c., and two lots of finest white at 10c. and 10½c., respectively. Less desitable goods are quoted at 9c. to 9¾c.—a lot of French fodders, lean and hard, selling at the inside figure."

"The first few small lots of French fodders were received here a few days ago, but the quality was very disappointing, being, as a rule, lean, leatherly, and improperly cured, which sold for 9½c. to 9¾c."

Bulletin No. 2.—The Curing of Cheese.

When cheese enter the curing-room they are but half made. The proper curing of cheese is as important as the making. Temperature is the most important factor in the curing of well made cheese. The best temperature for curing cheese is from 60 to 70 degrees. Below 60 degrees too much moisture is retained near the outside, which causes

discoloration, uneven curing, and poor flavor. Above 70 degrees, evaporation takes place so rapidly that curing is retarded rather than hastened, as moisture is necessary for the ferments which cause ripening. There is also loss by cracking of the cheese, loss in weight, and loss of butter fat, when the temperature of the curing-room remains for any length of time above 70 degrees F. A prominent cheese buyer remarked recently, "that the loss by evaporation and loss of butter fat from cheese in one year in an ordinary cheese factory would pay the whole cost of storing ice, and the cost of suitable ice boxes or racks for cooling the curing-room during a hot spell. The arrangements for curing cheese are very deficient, and we have practically no means for controlling the temperature of curing-rooms in hot weather."

The usual plan of keeping cheese warm in cold weather is by the use of an ordinary wood stove. This is not a satisfactory method. A cheese one foot from an ordinary stove receives 100 times more heat than a cheese 10 feet away from the same stove. The point to be aimed at is to maintain an even temperature in all parts of the room night and day. Cheese should not be allowed to cool off at night; hence wood is not a suitable fuel to keep cheese at an even temperature.

The curing-room should be properly constructed, with paper and air spaces to assist in controlling temperature. The method of heating may be by steam, by hot water, or by a warm air process which will cause a circulation of the air in the room. At the Black Creek factory near Stratford, at the Strathallan factory, and possibly at others, thay use a furnace known as the "Alaska" (made by Burrow, Stewart & Milne, of Hamilton, Ont., which gives entire satisfaction. Mr. R. M. Ballantyne, speaking for the cheese buyers of Western Ontario, recommends this system as the best he has seen in use. The main features seem to be a heater surrounded by a galvanized iron casing, lined on the inside with asbestos and corrugated tin. It is so made that it allows a free circulation of air—cold air goes in at the bottom and warm air goes out at the top. The casing of the furnace should extend as high as the bottom of the highest cheese in the room (about 6½ or 7 feet from the floor), so that the warm air may be conducted *above* the cheese. The casing should be so made that no heat is radiated therefrom into the room or against the cheese near the furnace.

The wholesale prices of these furnaces are:

No. 20	(capacity 12,000 cubic feet).....	$35 00
No. 22	(" 17,000 " ").....	42 00
No. 24	(" 25,000 " ").....	52 00

The supply of ice should be stored during this winter for use next summer. To preserve ice it is not necessary to have an expensive building. Any sort of building which will shed water and allow the melted ice to flow away from the body of unmelted ice will answer the purpose, if it be properly packed in sawdust. Straw is of little use for packing ice. Use plenty of sawdust around and over the ice, and pack all openings between the blocks with broken ice. Now is the time to prepare for next summer's hot weather, and thus prevent loss of cheese. Store plenty of ice (8 to 10 cords for an ordinary factory) and use freely in hot weather.

There are several ways in which the ice may be used in the curing-room. In the curing-room at the O. A. C. dairy we use for holding the ice a large open pan made of galvanized iron, which sits on the upper shelves of a cheese rack. This pan is about 6ft. long, 2½ ft, wide, and 3 inches deep. In one corner is an inch hole, which is connected with piping to convey the melted ice ontside. This is a simple and effective method in a small curing-room.

For a larger curing-room with high ceilings, the plan adopted at the Black Creek factory is satisfactory. Ice boxes are suspended from the ceiling and supported by a cross piece from two of the uprights which are used for supporting the cheese shelves. The boxes are lined with galvanized iron on the sides and bottom, and form a trough in the centre to catch the drip, which is conveyed outside. In the boxes are racks for holding

the blocks of ice. These racks may be taken out at any time. The size of the racks is 3 ft. wide and 10 ft. long. There should be three or four of these in an ordinary curing-room 30 x 40.

Another way suggested by Mr. Ballantyne is to build a box, say 4 x 6x6. Have the box lined with galvanized iron, and open at top and bottom. Place the rack and ice in this box, and provide for the outflow of water. Or, in this box place galvanized iron cylinders, about 2 ft. in diameter, and fill them with broken ice and salt. In this way the temperature can be very quickly reduced.

The proper curing of cheese is so important a question that we trust makers and factory owners will give it the attention which its importance demands.

Bulletin No. 3.—The Winter Creamery.

The winter creamery offers many advantages to dairymen with few or many cows milking during the winter. The chief of these are a better average quality of butter, which is sure to bring a higher price, and the extra yield of butter per 100 pounds of milk which is got by using the cream separator. Either of these advantages will pay the cost of mannfacturing the butter, which ought not to exceed three and one-half cents per pound where the milk is delivered at the creamery. Again, the labor is very much less for the farmer's wife where the milk is sent to the winter creamery. In addition, the farmer and his wife feel much better when going to town to buy household necessaries, if they have five to ten dollars in a pocket as a result of the sale of creamery butter, than if they have twenty to fifty pounds of butter in a basket.

Location.—The creamery may be located in a summer cream-gathering creamery, in a summer separator creamery, in a summer cheese factory, or in a place where there are none of these. If on average of 15,000 pounds of milk per week can be relied upon during the winter season, it will pay to purchase winter creamery apparatus and hire a butter maker. There is no reason why our cream-gathering creameries and cheese factories should hang out this sign about October 15th each year: "Gone out of business until May 1st. Patrons must make dairy butter and trade it at the corner grocery, until we open up again, or else manage a 'dry' dairy for the winter."

This ought not to be. The money lost through "dairy" butter, dry cows, and ignorance of the first principles of economic dairying, would pay the municipal taxes in every dairy township of the Province.

Machinery and Building.—The building should be made as warm as possible with paper and dead air spaces, and should, where practicable, be heated with "live" steam or with "exhaust" steam from the engine. A room 20 x 30 to 30 x 30 is required for making the butter, also an office, boiler and engine room, a refrigerator and an ice house —say 600 square feet of ground space for these latter.

The cost of the building will be from $1,000 to $1,200. The machinery to handle 15,000 to 25,000 pounds of milk weekly will cost about $1,000.

The leading makes of separators used in Canadian creameries are:

Alpha de Laval, sold by the Canadian Dairy Supply Co., Montreal.

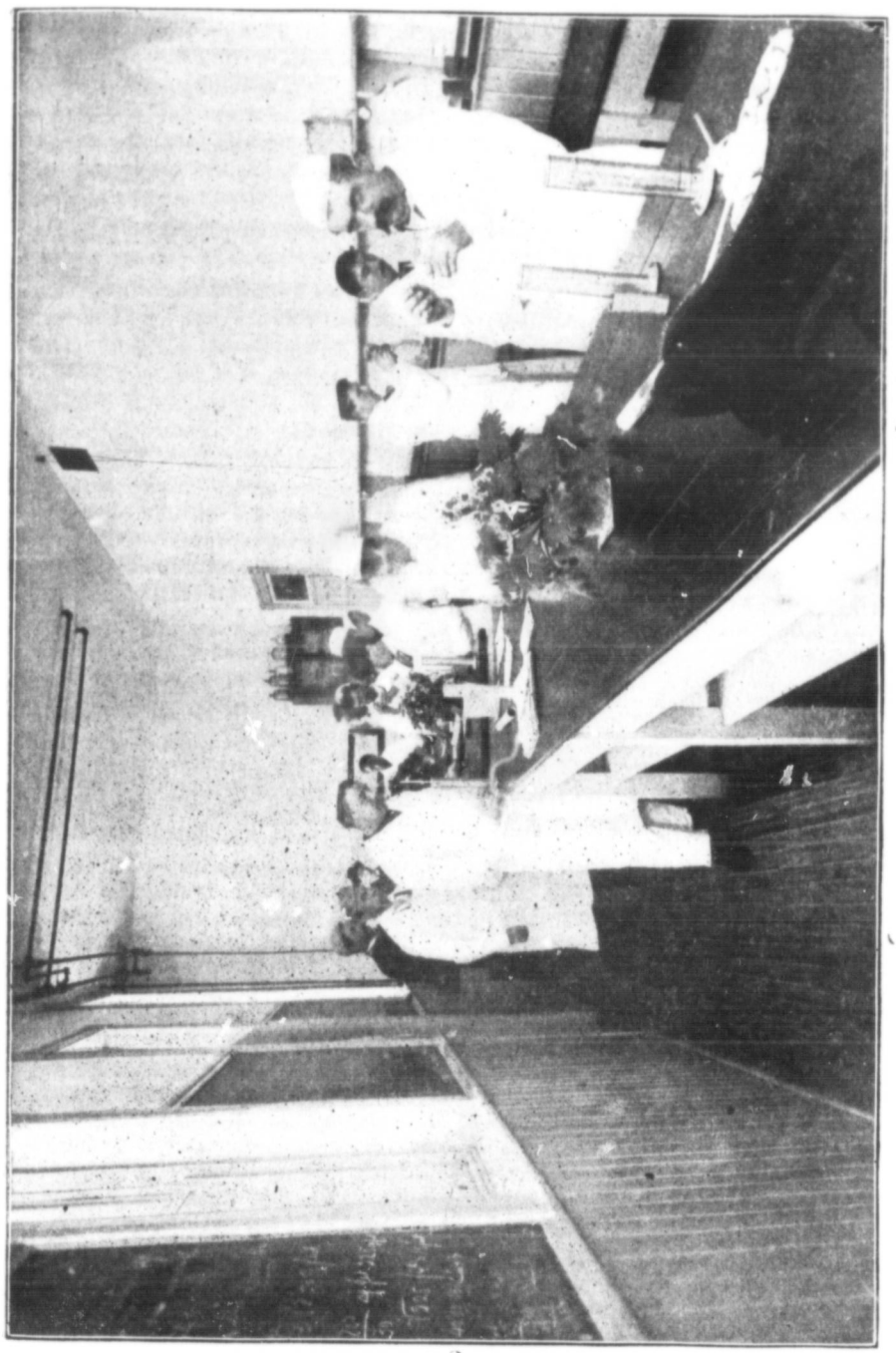
Alexandra, sold by J. S. Pearce & Co., London, Ont.

Russian, sold by D. Derbyshire & Co., Brockville, Ont.

Danish Weston, sold by Richardson & Webster, St. Marys, Ont.

These separators cost from $350 to $550 each, depending upon the make and size. They all have their good points, and we do not care to recommend any one of them in preference to another. The agents will explain the good points of each and quote prices on application.

Next to the separator the most important part of the machinery is the boiler and engine. The boiler should have a capacity of from twelve to twenty horse-power, and



TESTING MILK AT DAIRY SCHOOL, O. A. C., GUELPH.

the engine from six to eight. A "half-trunk-lid" churn made of whitewood or pine is convenient. A narrow cream vat with plenty of space at the sides and ends for ice is needed to cool the cream rapidly where a cooler is not used.

Where the cream vat is not adapted to rapid cooling, one of the various coolers on the market may be used; or a coil of galvanized iron pipe having cold water running through it may be placed in the cream and be worked by the engine. This will cool the cream rapidly.

A Babcock tester for dividing proceeds among patrons and for detecting losses of butter fat in skim-milk and buttermilk, is an essential part of the machinery in every creamery.

A complete list of all machinery needed, together with their prices, may be obtained from any of the dairy supply firms.

To the Patrons.—Aim to have about half of the cows fresh for the winter creamery. Feed them liberally. Give the cows plenty of salt and water. Care for them regularly, treat them kindly, keep them clean and you will have your reward. We find that corn silage, mangels, clover hay, bran, peas, oats and some oil-cake, if it can be got for twenty dollars per ton or less, give us good results in the milk flow. Swede turnips or rape should not be fed to cows giving milk for butter or cheese-making.

Do not allow the milk to freeze or be exposed to any bad odor. Three times per week is often enough to deliver the milk at the winter creamery. Make arrangements with one or more of your neighbours to "take turns," hauling the milk and bringing back the skim-milk. This will lessen the labor. If the skim-milk is properly fed to calves and young pigs, it will pay for the hauling of the milk to, and the skim-milk from, the creamery. Our future dairy cows depend largely upon the judicious use of skim-milk.

Finally, help the butter-maker by supplying him with first-class milk, and you have your reward.

To the Butter Maker.—Be on your guard against stable, turnip, potato, brewer's grains, or other flavors which taint milk and injure the quality of butter. If the milk is frozen or very cold, you will have difficulty in detecting these flavors, and it will be safer for you to heat a small portion of such milk separately, where you suspect bad flavor. Where a can has much ice on the top, remove the ice before weighing and sampling, or else melt it before sampling, as the frozen part, containing an undue proportion of water, will not allow you to take a fair sample.

To preserve the milk for testing, use in each composite bottle about what will lie on a ten cent piece, a mixture of seven parts bi-chromate of potash and one part corrosive sublimate. Once a month is often enough to do the testing. Test very carefully and exactly, so as to render to each patron his just reward for labor done in caring for his cows and milk.

Look over the machinery each evening to see that it is in good condition for the morning run and thus avoid delays to patrons.

Heat the milk from 100 to 130 degrees before separating. The higher temperature will increase the capacity of your separator and enable it to skim more closely. It will also give smoother cream with some separators. Speed the separator to its full rate and maintain it at full speed during the whole skimming. (It is economy to use the exhaust steam for heating the whole milk or the skim-milk). Use hot water for heating rather than "dry" steam, and the milk will not cook on your heater so much. (To remove cooked milk from heater or vat, add some washing soda to warm water and allow it to stand in the heater for some time before washing). Aim to have about twenty-five to thirty per cent. of fat in the cream. If the milk requires to be lifted to the separator use a pump which may be easily cleaned, in preference to an ejector.

To insure a uniform flavor of good quality, we recommend the system known as pasteurizing. Either pasteurize the whole milk before separating, or heat the cream and skim-milk after separating. For heating the whole milk a channel heater about eight or

ten inches deep with six or seven channels about four feet long and three to four inches wide would answer the purpose after a portion of the heating has been done in the receiving vat. Place this channel vat in a tank or pan with a steam pipe under it for heating the water. The milk or cream enters one side and passes out at the other, having been heated to 160 degrees on the way. Keep the cream covered by means of a tin cover placed over the channel vat. The cream may be pasteurized in one of four ways:

(1) By using ordinary shot gun cans (8 in. diameter by 20 in. deep) set in a tank of water kept at about 180 degrees. Keep the cream stirred all the time it is heating and when it reaches 160 degrees remove the can from the water. Allow it to stand for twenty minutes, then empty into the cream vat and begin the cooling.

(2) By the use of a smaller channel vat, similar to the one described for pasteurizing whole milk. Size, three feet long, twenty inches wide, three inches deep, with six or seven channels. This is the least labor and expense.

(3) By heating the cream in the ordinary cream vat.

(4) By means of a pasteurizer, which is a machine specially built for the purpose of heating milk or cream.

(For ordinary creamery work, pasteurizing the cream is likely to be more practicable than heating the whole milk).

The next step is the cooling of the cream. It should be cooled to about ninety to ninety-five degrees (after pasteurizing) and then the "starter" should be added. (We recommend making the starter from pasteurized skim-milk, and using the same cultures as far as possible during the winter, thus insuring uniformity of flavor during the whole season).

Use from ten to twenty per cent. of starter when ripening in twenty-four hours, and about five per cent. when ripening in forty-eight hours. (If pasteurizing is not practised the starter may be added to the cream vat as soon as, or before, the cream is put in). Continue the cooling until the cream reaches a temperature of sixty-five to seventy degrees, when it should be allowed to stand until the acid begins to develop quite strongly and thickening commences. The cream should then be cooled to churning temperature, which will be from fifty degrees to fifty-five degrees. This may be done in the evening and during the night. To insure good grain and body in the butter, be sure to cool the cream to churning temperature for two to four hours before churning, to allow the fat to harden. When ripening at a high temperature (seventy degrees) allow the cream to remain over night at churning temperature, if at all possible.

Use the alkali test for determining the acidity of the cream the first thing in the morning. If there is from six to seven-tenths of a per cent. of acid present, the cream is ready for churning. Do not allow over eight-tenths of a per cent. of acid in the cream if you wish the finest flavor in the butter.

The square box churn, or the combined churn and worker, will give good results. If the butter is for export to Great Britain, use little or no coloring in the cream. Have the temperature of the cream such that the butter will come in granular form in forty to sixty minutes. After drawing off the buttermilk, wash very lightly for quick consumption, and once for the regular trade. Salt at the rate of about one-half ounce per pound of butter for export, and three-quarters of an ounce to one ounce for home market. Work the butter until the salt is thoroughly mixed through it, the color is even, and until the water is not more than twelve per cent. of the finished butter.

For the home market there is no form more suitable than the oblong print, wrapped in good parchment paper which is stamped with the name of the creamery. For export, use the square box lined with paraffine wax and parchment paper. Pack the butter in the box firmly, so that when emptied it will look like a solid cube of butter, without holes into which gather the brine and buttermilk, giving the butter an unsightly appearance.

Ship the butter weekly to a reliable commission house, or directly to exporters or importers of the finest Canadian creamery butter, thus building up for our butter branch of the dairy industry a reputation similar to that which Canadian cheese has acquired.

The winter creamery is a branch of dairying which needs and is capable of almost unlimited extension.

Milk Tests.

Liberal prizes were given under this head at the Victorian Era Exposition, at Toronto, and at the Southern Fair, Brantford. I took charge of these tests. The conditions were much the same as last year. Most of those competing at Toronto milked their cows three times per day. Only one exhibitor did so at Brantford. An American breeder of Holsteins had competing cows in the test at Toronto. Five Canadian cows were ahead of the best American cow in the test. This speaks well for the skill of Canadian breeders and feeders. Nineteen cows entered, and twelve finished the test.

The results of the test at Toronto are:

Rank.	Name of Cow.	Breed	Owner.	Lbs. milk in two days.	Lbs. butter fat in two days.	Lbs. milk solids in two days.
1.	Carmen Sylva	Holstein	Gilray & Son	133.25	3.849	15.380
2.	Emery Queen	"	Hoover & Son	133.00	3.634	14.958
3.	Emery Beauty	"	"	127.00	3.752	14.365
4.	Edgely Mol.	"	"	127.75	3.108	13.812
5.	Edgely Frena	"	"	116 50	3.621	13.723
6.	Korndyke Queen	"	Stevens & Son, N.Y.	113.75	3.137	12.422
7.	Helena Burke	"	" "	108 50	3.015	11.966
8.	Lida 4th	"	Ellis Bros	110 50	2.710	11.692
9.	Aggie Grace 2nd's Pietertje.	"	Stevens & Son	96 75	3.209	11.376
10.	Rose	"	G. W. Clemons	104.50	2.817	11.093
11.	Artis	"	"	90.75	2.385	9.915
12.	Lady of Glen Rouge	Jersey	W. Rolph	70 50	3.297	9.692

At the Southern Fair, there were eight cows competing in two classes—one open only to those whose milk had been sent to a cheese factory for a part of the season, and the other class open to all.

Class.	Rank.	Name of Cow.	Breed.	Owner.	Lbs. milk in 24 hours.	Lbs. fat in 24 hours.	Lbs. solids not fat in 24 hours.	Total score.
Open to factory cows.	1.	Edgely Frena	Holstein	A. & G. Rice	59 00	1.883	5.169	136.74
	2.	Roany	Grade shorthorn	J. R. Alexander	45.00	1.602	4.069	108 72
	3.	Gertie	Ayrshire	W. M. & J. C. Smith	26.75	0.917	2.652	70 70
Open to all.	1.	Sunbeam	Jersey	P. H. Bull & Son	29.75	1.591	2.663	96 82
	2.	Maud	Grade Holstein	Wm. Brittain	33.00	1.437	2.819	91.72
	3.	Annie Laurie	Ayrshire	W. M. & J. C. Smith	32 00	1.189	2.829	84.50
	4.	Daisy Texal 2nd.	Holstein	A. & G. Rice	38.50	0.943	3.174	82.46

While the prizes at Toronto were given to the cows producing the largest quantity of milk solids in two days, the basis of award at Brantford was the following scale of points:

20 points for conformation.
1 point " each pound of milk.
20 points " " of butter fat.
4 points " " of solids not fat.
1 point " ten days in milk after the first ten days.
10 points to be deducted for each per cent. of fat below three.

The test continued for twenty-four hours on September 23rd. Eight cows entered, and seven completed the period of testing.

Square Cheese.

During the dairy school and early in the spring, we made a number of square cheese to continue our tests of last year. We forwarded these to London, England, through two firms of cheese buyers in this country. Both lots brought satisfactory prices, but the buyers report that the shape was not suitable for the London trade.

The Hon. Thos. Ballantyne and Sons, through whom one lot was forwarded, received the following note from Messrs. Lovell and Christmas, West Smithfield, London, England.

" With regard to the square cheese, the quality was everything that could be desired, but we do not think that this shape would take with the public here. The only point we can see in their favor is, that they would take up less space, and even this would not be altogether beneficial, as when the cheese were packed closely together no air would get between them, and it is sometimes an advantage to have the air circulating among the cheese."

The Milking Machine.

Early in the year you had fitted up for us a rope-drive from the engine at the dairy to connect with the Thistle milking machine at the dairy barn. From various causes the drive did not work properly and caused a great deal of trouble, until finally it gave out altogether, and we have been unable to use it since the middle of the summer.

As to the machine and its work, we would say that it milked the cows clean, and, after a few times' use, nearly all of the cows seemed to enjoy being milked by it, as well as by hand. The greatest trouble we had was with the flavor of the milk. The pipes through which the air is forced by the machine become very foul from the milk drawn into them whenever a cup drops from a teat. I believe that this difficulty has been remedied; but so far the firm has not supplied us with the necessary attachments to prevent this tainting of the milk.

In reference to its practicability for average dairymen, we would say that only with a large herd of cows, where hand milkers are unavailable, is it likely to be of much service. We could not recommend it at all unless the flavor of the milk was very much better than it was most of the time during which we used it.

The Air Process of Butter Making.

Butter making, by means of forcing air through the cream, had quite a boom in Toronto during the past summer. The " press " gave the matter considerable space, and, as a consequence, a great many letters came to the department here making enquiries about the new process which " would revolutionize butter making." I went to Toronto to investigate and found that it was a revival of the method reported on by us a few years ago. There was nothing new whatever in the system, and the butter made was of very inferior quality. A member of a Toronto firm paid us a visit and promised to send us a complete outfit to further test it before they invested, but, so far, they have not done so.

Working over Old Butter.

A commission house sent us five tubs of stale butter to work over and see if we could improve the flavor. We tried various methods of handling this butter, but did not succeed in improving it very much. When butter becomes very rancid it is almost impossible to restore it to a condition fit for table use. By melting the butter and churning it in fresh butter milk, the flavor is improved somewhat, but the grain and body of the butter are spoiled.

The lesson from this is plain : make nothing but good butter, and do not hold good butter until it becomes rancid and unfit for table use. A great deal of money is lost each year on bad butter.

Dairy and Institute Meetings.

I have attended and delivered dairy addresses at the following places during the year : St. Marys, (Creameries), Brantford, (Western Dairy Association), Milverton, Listowel, Port Elgin, (special meeting arranged for by Western Association), Burford, Hamilton, (Pure Food Show), Welland, Essex Union Factory, Cottam, Malden, Harrow, Madoc, Barrie, and Hillsburg. In December I shall attend a series of institute meetings as follows : Harwood, Grafton, Wooler, Frankford, Wallbridge, Bloomfield, Demorestville, Plainfield, Shannonville, Napanee, Centreville, Tamworth, Madoc, Stirling, Warkworth, Norwood, Keene, Lakefield, and Peterboro'.

Testing Cows.

Several requests have been made for a representative of the college to make official tests of Holstein cows at the farms of the owners. Last year Mr. Gilroy's herd was tested by a representative of the dairy department. This year Messrs. Gilroy, Rice and Clemons have reqested us to make official tests for them. At the time of writing, only Mr. Gilroy's cows have been tested, while Messrs. Rice have requested a representative to be sent to their farm on November 23rd. The American Holstein Friesian Association are offering liberal cash prizes for the best records of butter made in seven days by Holstein cows. A number of Canadian breeders are entering the competition, and the prospects are that they will win a fair share of the money to be competed for.

Improvements During the Year.

The chief improvements during the year have been the levelling of the dairy yard with coal ashes and gravel ; the painting and whitewashing of the inside of the dairy buildings ; the purchase of a combined churn and worker for use in the dairy school of 1898 ; and the placing of the latest improved separators for the classes of 1897 and 1898 ; and in this connection I would beg leave to thank Messrs. R. A. Lister & Co. Dursley, Eng., for the gift of a No. 1 Alexandra separator, and the Canadian Dairy Supply Co., Montreal, for a No. 2 Baby Alpha de Laval separator.

In addition there is being erected at the present time a large brick chimney for the boilers at the dairy. The old smoke stacks were completely spoiled and threatened to fall and damage the buildings, and perhaps do more injury. The new chimney will be a credit to the department.

All of which is respectfully submitted,

H. H. DEAN,
Professor of Dairying.

Ontario Agricultural College,
Guelph, Ont., November 30, 1897.

PART VII.

REPORT OF THE AGRICULTURIST.

To the President of the Ontario Agricultural College :

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

Teaching. As in previous years, teaching has constituted an important part of my work, and my lectures have followed very closely the outline of work in agriculture and live stock, given in the College circular. In addition to lectures in the College, I may mention those delivered at farmers' institute meetings and at the Toronto Normal School.

Experimental Feeding. My work in this department has developed considerably during the past year, and I expect to extend it still further. Increased facilities have been afforded by taking over the dairy piggery, which is being refitted for breeding purposes. A report of the live stock experiments conducted during the past year is given below :

EXPERIMENTS IN CATTLE FEEDING.

DIFFERENT QUALITIES OF MEAL FOR FATTENING STEERS.

During the winter of 1896-97, an experiment was conducted in feeding steers light, medium and heavy meal rations. For this purpose nine steers of only medium quality were purchased on the Toronto market, and divided into three groups, each group comprising three steers. The experiment commenced on December 3rd, and it was intended to feed for June shipment ; but, to suit the convenience of the purchasers, the steers were kept until July 8th, and received their last feed on July 7th. Thus the feeding extended over a period of 216 days, the first three weeks of which constituted a preparatory period, during which all the steers received the same ration.

The plan of experiment was to increase the meal ration of group 1 until it reached one pound per day for every hundred pounds live weight of the animals ; group 2, to two-thirds of a pound of meal for every hundred pounds live weight, and group 3, to one-third of a pound of meal per hundred pounds live weight—that is, group 2 received just two-thirds of the meal ration of group 1, and group 3 received one-third of the meal ration of group 1. The other foods used were the same for all groups.

Some difficulty was experienced in getting group 1 to take the full quantity of meal intended, but by February 19th they had reached ten pounds of meal each per day, when their average weight was 1,079 pounds. By March 19th they had reached eleven pounds of meal per day, and before the end of April they had reached twelve pounds per day, which was as high as we deemed it safe to go. No difficulty was experienced with the other two groups, but it was found that the meal ration of group three was insufficient ; so it was increased on April 14th to the same amount as that received by group two, viz., two-thirds of a pound per day per hundred pounds live weight, and this ration was continued until the close of the experiment.

The meal was fed in two feeds, except in the case of the heavy ration steers, whose meal ration was divided into three equal parts. Until April 8th, the steers all received what straw they would eat morning and evening, with ten pounds of hay at noon. After April 8th, they were fed as much hay as they would eat. They were fed turnips at noon, receiving twenty pounds each during part of the time, and twenty-five pounds during the remainder of the time up to May 20th. On May 20th the turnips were finished, and ensilage was substituted, the steers being fed at first fourteen pounds, which was eventually increased to twenty pounds each per day.

The meal ration consisted of equal parts by weight of peas, barley, and oats, and the values attached to the foods used are as follows : Meal $13 ; hay, $6 ; straw, $3 ; ensilage, $2 ; and roots, $2 per ton.

During the course of the experiment, one steer in group 2 and one in group 3 were found to be entirely unsuitable for the experiment, and consequently they were discarded and the experiment completed with but two steers in each of these two groups.

The results are briefly stated in the following tables :

Table I. Weights and gains.

——	Weight when bought.	Weight when sold.	Total gain.	Aver'ge gain per steer.	Aver'ge gain per steer per day.
	lbs.	lbs.	lbs.	lbs.	lbs.
Group I, heavy ration (3 steers) ..	2,700.	3,870.	1,170.	390.	1.80
Group II, medium ration (2 steers).	1,999.	2 765.	766	383	1.77
Group III, light ration (2 steers)....	1, 75.	2,650.	675.	337.5	1 56

Table II. Financial statement.

——	Cost price.	Selli'g price.	Difference between cost and selling prices.	Cost of food.	Net profit.	Net profit per steer.
	$ c.	$ c.	$ c.	$ c	$ c.	$ c.
Group I, heavy ration (3 steers	78 50	181 95	103 45	74 59	28 86	9 62
Group II,medium ration (2 steers	58 10	130 00	71 90	42 89	20 01	14 50
Group III, light ration (2 steers	57 40	124 60	67 20	39 92	27 28	13 64

From Tables I. and II. it wi l be seen that the heavy ration steers made the greatest gain, but gave the smallest profit, the largest profit being obtained from the medium ration steers.

Before the steers were shipped, the buyers, Messrs. Strachan & White, of Guelph, visited the stable and judged them for fatness.

Table III. shows the order in which they were placed according to degree of fatness, and the group to which each steer belonged.

Order of merit.	Steers.	Group.	Ration.
1st	Steer No. 1	I	Heavy.
2nd	" 6	III	Light.
3rd	" 2	I	Heavy.
4th	" 7	III	Light.
5th	" 4	II	Medium.
6th	" 5	II	Medium.
7th	" 3	I	Heavy.

The classification shown in Table III. is rather surprising, since the two light ration steers are placed above the medium ration steers. This is only one experiment, however, and it will be well to reserve judgment until further tests are made. A similar experiment is in progress this season.

Sweet and Dent Corn for Milch Cows.

This was an experiment undertaken to compare green sweet and dent corn for milch cows. Four cows were obtained from the Dairy department, care being taken to select cows as nearly as possible in the same stage of lactation. Previous to the commencement of the experiment, the cows were on clover pasture, and received about one pound of meal each per day. The meal was composed of about equal parts of bran and oil meal.

During the first ten days of the experiment, the cows were fed green corn alone, cows 1 and 2 receiving sweet corn, and cows 3 and 4 dent corn. At the end of ten days, four pounds of meal were fed to each cow per day, and the meal ration continued throughout the remainder of the experiment, or a period of eleven days. The meal ration consisted of equal parts by weight of barley, shorts and oil meal. The variety of sweet corn used was Evergreen Sweet, and the dent corn was Mammoth Cuban. The corn was grown on the experimental plots, under the supervision of Mr. Zavitz.

The cows did not eat the dent corn so readily as the sweet, and for a time wasted a considerable quantity of it, the waste becoming less as time went on. The waste corn was carefully weighed and recorded. Table I. shows corn fed and eaten.

Table I. Green corn fed, eaten, etc.

Amount of green corn fed.		Amount of green corn eaten.		Amount wasted.		Amount of green corn eaten per 100 lbs. live weight of cows.	
Sweet.	Dent.	Sweet.	Dent.	Sweet.	Dent.	Sweet.	Dent.
lbs. 3,641	lbs. 3,410	lbs. 3,624	lbs. 3,156	lbs. 17	lbs. 254	lbs. 151.63	lbs. 145.10

The total weight of the two cows on sweet corn was 2,390 pounds, and of those on dent corn, 2,175 pounds. For this reason the fourth column has been added, which shows that cows on sweet corn consumed more per hundred pounds live weight than did the others.

Table II. shows the effect of the feeding upon the milk yield, and includes the milk yield during the six days preceding and following the corn feeding.

	Period I. Clover pasture with 1 lb. meal.	*Period II.* Green corn alone.		*Period III.* Green corn with 4 lbs. meal daily.		*Period IV.* Pasture and meal	
	Average daily milk yield during 6 days preceding experiment.	Average daily milk yield during last 6 days that cows received corn alone.	Average daily shrinkage in milk yield during Period II.	Average daily milk yield during last 6 days that cows received green corn and meal.	Average daily increase in milk yield during Period III.	Average daily milk yield during 6 days following close of experiment.	Average daily increase or shrinkage in milk yield during Period IV.
Cow No. 1, sweet corn ...	19 8	16 0	3 8	17.4	1.4	15.6	−1.8
Cow No. 2, sweet corn ...	23.1	14.6	8.5	15.8	1.2	14.6	−1.2
Cow No. 3, dent corn	19.6	14 3	5.3	15.3	1.0	15 8	+0.5
Cow No. 4, dent corn ...	25.6	16.2	9.4	17.5	1 3	18.5	+1.0
Average for sweet corn group	21.4	15.3	6.15	16.6	1.3	15.1	−1.5
Average for dent corn group	22 6	15.25	7.35	16.4	1.15	17.15	+0.75

1. That when fed corn alone, the dent corn group suffered a greater shrinkage in milk yield than the sweet corn group.

2. That when meal was added to the ration, both groups increased in milk yield, but the sweet corn group increased slightly more than the dent corn group.

3. That when returned to pasture, both cows of the sweet corn group decreased in milk yield, while both cows of the dent corn group slightly increased in milk yield.

These three points all seem to indicate that sweet corn is better adapted to maintaining the milk flow than is dent corn. But when Table I. is taken into consideration, it appears that the superiority of the sweet corn in this experiment was due to its greater palatability, since the cows on sweet corn consumed more corn per hundred pounds live weight than those on dent corn.

There is one more important consideration. The sweet corn yielded at the rate of 29,280 pounds of green fodder per acre, while the dent corn yielded at the rate of 36,376 pounds per acre, or a difference of 7,096 pounds of green fodder per acre in favor of the dent corn. This greater yield of dent corn more than compensates for what is lost when compared with sweet corn for milk production, and therefore this experiment would indicate that the dent corn proved more economical than the sweet.

Oats and Peas and Oats and Tares for Milch Cows.

In this experiment a comparison was made of green oats and peas and oats and tares for milch cows. The fodders were grown on the experimental plots by Mr. Zavitz. The seed was mixed in the proportion of two bushels of oats to one of peas, and two bushels of oats to one of tares per acre. Four cows were used in the experiment, two cows being fed on each ration.

The experiment brought out the following points:

1. The oats and peas yielded at the rate of 14,760 pounds of green fodder per acre, and the oats and tares 14,688 pounds per acre.

2 Neither fodder could be said to excel the other as a milk producer.

3. Both fodders were eaten readily by the cows, no difference being noticeable in this respect.

4. The oats and peas had a slight advantage in yield per acre.

Green Rye and Alfala for Milch Cows.

This was a short experiment for the purpose of comparing the early soiling crops, rye and alfalfa. The fodders were grown on the experimental plots. Four cows were used, two receiving rye and the other two alfalfa.

The following points in connection with the experiment are of interest :

1. The rye, which was a medium crop, yielded at the rate of 12,375 of green fodder per acre, and the alfalfa yielded a first cutting at the rate of 15,300 pounds of green fodder per acre.

2. The alfalfa was eaten rather more readily by the cows than the rye.

3. The milk yielded was slightly in favor of the alfalfa.

4. When scored by an expert, the rye butter scored thirty-five points of flavor, and the alfalfa butter forty points for flavor, out of a possible score of forty-five points.

5. The plot of alfalfa furnished two subsequent crops, which made the total yield from the alfalfa plot more than double that stated above, whereas the rye made but an indifferent second growth.

6. In this experiment, therefore, alfalfa proved very much superior to rye as a soiling crop.

EXPERIMENTS IN PIG FEEDING.

Comparison of Sweet and Sour Whey.

During the summer of 1896, two experiments were conducted for the purpose of comparing the feeding value of sweet and sour whey for fattening hogs. During the past summer the work was continued and three additional experiments completed. In each experiment nine hogs were used, making three groups, with three hogs in each group. During the preparatory period all groups received sweet whey and meal, commencing with a small quantity of whey and gradually increasing. Exactly the same amount of whey and meal was fed to each group during this period. At the end of the preparatory period the whey was omitted from the ration of one group and water substituted. In another group, sour whey was fed instead of sweet whey, while the third group continued to receive sweet whey. In each experiment the two whey groups were fed the same quantities of meal and whey, and were given all they would eat readily. A full feed of whey consisted of two pounds of whey to one of meal. The groups receiving water and meal also was given as much food as the animals would eat readily ; but the hogs in this group naturally consumed more meal than those receiving whey. The meal ration for all groups consisted of equal parts by weight of peas, barley and shorts. The sour whey was kept in a whey tank which had not been cleaned since early in the summer of 1896.

The results of Experiment No. 3 are summarized in the following tables :

Table I. Weigh s and gains (live weight) of hogs used.

	Preparatory period, 7 days.				Experiment proper, 29 days.		
	Weight at beginning.	Weight at close.	Total gain.	Average gain per hog per day.	Weight at close.	Total gain.	Average gain per hog per day.
Group I. (sweet whey)	374	400	26	1.24	521	121	1.33
Group II. (sour whey).....	377	404	27	1.29	514	110	1.26
Group III. (water).....	377	409	32	1.52	527	118	1.35

Table II. Food consumed during experiment proper (29 days.)

	Total food consumed.		Food consumed per 1 lb. gain, live weight.	
	Meal.	Whey.	Meal.	Whey.
Group I. (sweet whey)	407.5	747.	3.36	6.17
Group II. (sour whey).....	407.5	747.	3.70	6.79
Group III. (water)	506.	.....	4.28	

In experiment No. 4, the hogs in the sweet whey group became crippled just as they reached the full feed of whey, and, though they recovered within a short time, still they received such a serious check that it was deemed advisable to leave them out of the comparison, and make the experiment merely a comparison of sour whey and meal with water and meal. It is rather strange, however, that the sour whey group suffered no injury, though receiving the same amount of whey.

Table III. Weights and gains (live weight) of hogs used.

	Preparatory period, 14 days.				Experiment proper, 64 days		
	Weight at beginning.	Weight at close.	Total gain.	Average gain per hog per day.	Weight at close.	Total gain.	Average gain per hog per day.
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Group I. (sour whey).....	230	283	53	1 26	545	262	1.36
Group II. (water).....	227	282	55	1.31	554	272	1.41

Table IV. Food consumed during experiment proper (64 days.)

	Total food consumed.		Food consumed per lb. gain, live weight.	
	Meal.	Whey.	Meal.	Whey.
	lbs.	lbs.	lbs.	lbs.
Group I. (sour whey)	914	1,825	3.48	6.96
Group II. (water).....	1,138 5	....	4.18	

Whey Experiment No. 5.

Table V. Weights and gains (live weight) of hogs used.

	Preparatory period, 10 days.				Experiment proper, 31 days.		
	Weight at beginning.	Weight at close.	Total gains.	Average gain per hog per day.	Weight at close.	Total gain.	Average gain per hog per day.
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Group I. (sweet whey)	290	343	53	1.76	517	174	1.87
Group II. (sour whey)	295	340	45	1.50	523	183	1.96
Group III. (water).....	289	340	51	1.70	533	193	2.07

Table VI. Food consumed during experiment proper (31 days)

	Total food consumed.		Food consumed per lb. grain, live weight.	
	Meal.	Whey.	Meal.	Whey.
	lbs.	lbs	lbs.	lbs.
Group I. (sweet whey)	617.	1,060	3.54	6.09
Group II. (sour whey)	617.	1,060	3.37	5.79
Group III. (water).....	754.5	.....	3.91	.....

Experiment No. 5 is remarkable for the rapid gains made by the hogs in the "water group," thus making the food required for one pound of gain less than that required by the water groups in any preceding experiment. The hogs of this experiment were shipped to the Wm. Davies Co., Toronto, along with the hogs of the breed experiment, in order to ascertain whether the whey had any injurious effect upon the quality of the meat, and the report of Mr. J. W. Flavelle, managing director of the company, is given below. Group A received sweet whey, Group B sour whey, and Group C, water. The numbers refer to the ear labels.

Mr. Flavelle's Report.

Group A. 59, 60 and 61 ; fat firm ; 59 too fat.

Group B. 56, 57 and 58 ; fat firm ; all three hogs quite too fat.

Group C. Number 1, 54 and 55 ; fat firm.

We can see no difference in the firmness of these three lots of hogs. They are all alike good.

It will be seen from this report that no bad effects followed the use of the whey, though the sour whey group seems to have produced fat more rapidly than the others. The hogs were kept somewhat longer than they should have been, in order to complete the experiment ; hence the excessive fat.

Table VII. Summary of Five Experiments.

—	Amount of meal saved by 100 lbs. sweet whey.	Amount of meal saved by 100 lbs. sour whey.
	lbs.	lbs.
Experiment No. 1 (1896)	13.32	13.61
" 2 (1896)	13.32	13.81
" 3 (1897)	14.88	7.87
" 4 (1897)	No test.	10.07
" 5 (1897)	6.08	9.34
Average	11.90	10.94

Thus it will be seen that in experiment No. 3, the sweet whey gave much better results than the sour; but in the other experiments the sour whey had the advantage. Experiment No. 3, therefore, is a marked exception to the rule, and it is this experiment which makes the difference in the average in favor of the sweet whey. In making up the average for the sour whey, five experiments were included, whereas there are only four for the sweet whey. Leaving out experiment No. 4 in both cases, the average number of pounds of meal saved by 100 pounds of sour whey would be 11.15 instead of 10.94.

In order, if possible, to throw more light on the question, six chemical analyses of the sweet and sour whey were made at different times by Mr. Harcourt.

Table VIII. Analyses of Sweet and Sour Whey.

—	Sweet whey.		Sour whey.	
	Nitrogenous matter.	Sugar.	Nitrogenous matter.	Sugar.
	per cent.	per cent.	per cent.	per cent.
Analysis No. 1	.846	5.015	.974	None
" 2	.838	4.940	.940	.....
" 3	.866	4.950	.952	.....
" 4	.806	5.005	1.019	.44
" 5	1.062	3.870	.944	.05
" 6	1.106	4.475	1.009	None.
Average of six analyses	.920	4.709	.973	.081

From the analyses it would appear that the fermentation of the sour whey took place entirely at the expense of the sugar, of which only a trace remained, while the nitrogenous matter of the sour whey was somewhat higher than that of the sweet. It is difficult to account for the higher percentage of nitrogenous matter in the sour whey, unless the sour whey had become somewhat concentrated from evaporation.

A general review of the work performed up to date, taking into consideration the health of the animals, their gains, the quality of their flesh, and the composition of the sweet and sour whey, seems to point towards the conclusion that fermentation does not seriously detract from the value of whey for pig feeding.

Comparison of Different Breeds of Swine.

This experiment is a continuation of the work commenced last year, and in the spring thirty-six pigs were purchased, comprising six animals of each of the following

breeds: Improved Yorkshire, Chester-White, Duroc-Jersey, Tamworth, Poland-China and Berkshire. Accurate account was kept of the food consumed and the gains made by representatives of the different breeds, between the ages of 90 and 180 days, the results of which are given in the following table:

Table showing gains, food consumed, etc., between ages of 90 and 180 days:

Breed.	Average weight at 90 days.	Average weight at 180 days.	Total gain per hog in 90 days.	Average gain per hog per day during 90 days.	Average meal consumed per hog in 90 days.	Average meal consumed per 100 lbs. gain live weight.
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Berkshire	53.00	145.00	92.00	1.02	301.	327.17
Tamworth	52.00	139.33	87.33	.97	289.	330.92
Poland-China	52.33	128.33	76.00	.84	253.	332.89
Chester-White	51.66	126.66	75.00	.83	255.	340.00
Yorkshire	60.33	144.00	83.67	.93	285.	340.62
Duroc-Jersey	64.66	149.00	84.34	.94	302.	358.05

In the above table, the breeds are arranged in order of economy of gain, but it will not do to draw conclusions as yet, since individuality plays a very important part in such an experiment.

With a view to obtaining information relative to the suitability of the different breeds for export trade, the hogs of this experiment were shipped to the Wm. Davis, Co. Ltd., Toronto. On reaching the yards, the foreman, who grades all the hogs brought to the factory, was asked to select from each breed the three hogs which he regarded as best suited to make export bacon. This he did, and these eighteen animals were slaughtered separately. Mr. J. W. Flavelle, managing director of the firm, inspected the carcases and furnished the notes which appear below. Mr. Flavelle was not given the names of the breeds, but simply the groups and the ear labels of the hogs in each group. Following is the arrangement of the groups:

Group 1, Yorkshire.....Average weight at time of killing .....153 33 lbs.
" 2, Chester-White.. " " " .....155 00 "
" 3, Duroc-Jersey .. " " " .....186 66 "
" 4, Tamworth ..... " " " .....163 33 "
" 5, Poland-China... " " " .....158 33 "
" 6, Berkshire..... " " " .....156 66 "

Report of Mr. J. W. Flavelle, Managing Director of the Wm. Davies, Co., Toronto:

"Covering the hogs which you delivered to our house the past week, please note the following:

"*Group 1.* Hogs 11 and 12: lean; fat even down the back; thick bellies; shoulders sizeable; for their size, lengthy between shoulder and ham; generally desirable; very desirable if they had been a little larger. This, we suppose, could have been secured by giving the hogs a longer time to grow. Number 10 of this group is quite too fat on the back for best side, yet the general characteristics of the other two are noticeable here, also that the fat is even on the back; this is a good pig spoiled by too rapid feeding and too much of it. The fat in 12 feels tender; it is more noticeable in it than in 11, while 10 is the firmest of the three.

"*Group 2.* 16, 17 and 18: general character, short and thick; an absence of flesh; bone sizeable; generally undesirable for export sides. Number 16 particularly fat; very little flesh and somewhat tender.

"*Group 3.* 23, 24 and 25: general character, coarse shoulders and large heads. Number 23 fat. Numbers 24 and 25 will make Number One Sides, but not desirable owing to coarse shoulders and shortness of side between ham and shoulder. Number 24 and 25, a little tender in the fat.

"*Group 4.* 27, 28 and 30: general character, lean lengthy and full of flesh; good belly and desirable for best sides, except that head is a little large, and the gammon (ham) looks as if it were poorly developed, but this we will determine when the hogs are cut up; fat, very even down the back.

"*Group 5.* 33, 37 and 38: Irregular in size; coarse; short between ham and shoulder, particularly 38; head, large and coarse; shoulder thick and undesirable; fat even on the back. 33 quite tender and off color. 37 and 38 tender, but not so bad as 33; undesirable for export trade.

"*Group 6.* 39, 42 and 44: generally short and thick; shoulders of 39 and 42 thick and too heavy; these two hogs quite too fat with very little flesh. 44 very short, but fairly lean and even down back. Not a desirable class for export bacon."

Additional notes on groups 1 and 4, by Mr. Flavelle.

"We have this morning carefully inspected the sides from groups 1 and 4. These two groups we considered quite the best of the lot when they were hanging, and were inclined to think group 4 the better of the two.* We find, however, after inspecting the sides, that group 4 pinches in the loin, and the gammon is meanly developed—a great long shank with an insufficient supply of meat to balance it up. In group 1 the side is singularly even and level throughout; the loin full, and an absence of the pinched appearance of loin in group 4; the gammon is well developed, and therefore the sides from group 1 are distinctly better than from group 4."

Mr. Flavelle's report requires little explanation. The tenderness of fat must not be regarded as due to pecularities of the breeds, nor yet was it due to the food, since the hogs received the same meal ration as the hogs of the whey experiment previously noted, all of which were firm. It was more likely due to the fact that the hogs were too closely confined, and were possibly kept in rather too high condition. It would be well, therefore, not to take the "tenderness" into consideration in reading the report.

It is the intention to carry this work further, not with the view of showing that any one breed excels all others in every respect, as no doubt such a breed does not exist, but for the purpose of studying the characteristics of the different breeds so far as such experiments permit. The aim is not to injure any breed, but to further the interests of all by setting breeders on their guard against any weaknesses which may be found to exist. Moreover, the careful study of the different breeds will form a basis for intelligent cross breeding, which work will be undertaken as soon as circumstances permit. Once more I must appeal to all who may read this report not to form hasty or one sided conclusions, for the difficulties in the way of such work are numerous and great, and progress is necessarily slow.

Acknowledgment.

The experimental feeding department is indebted to the farm, dairy, experimental, chemical, and horticultural departments, for valuable assistance and co-operation, all of which is gratefully acknowledged.

Respectfully submitted,

G. E. DAY,
Agriculturist.

ONTARIO AGRICULTURAL COLLEGE,
November 30th, 1897.

PART VIII.

REPORT OF THE HORTICULTURIST.

To the President of the Ontario Agricultural College :

SIR,—I have the honor of presenting herewith the annual report of the Horticultural Department, for the year 1897. The extent and varied character of the work in this department presents many interesting and important fields for investigation. The limited attention which must necessarily be paid to some of these often causes us to regret that more cannot be accomplished. It gives me pleasure, however, to state that, in many branches of the work considerable progress has been made during the past year, as may be seen by a perusal of our report.

LECTURES. One of the first and most important duties in conection with our work is the instruction of students in attendance at the college. We have endeavored to make all students under our charge as proficient as possible in both the theory and practice of the subjects taught. A full course of lectures on the different branches of horticulture, as outlined in the college circular, has been given to second and third year students. This course covers pretty fully the subjects of Fruit Growing and Vegetable Gardening, and, as fully as is thought to be usefnl for our students, the subjects of Landscape Gardening, Aboriculture and Floriculture.

On account of the long illness of our esteemed friend, Prof. Panton, I have endeavored to the best of my ability, to take up his work of teaching entomology. Three lectures a week on this subject have been given to the students of the second year during the fall term.

PRACTICAL WORK. The studies covered in lectures have been supplemented as much as possible by practical work in the afternoons in the various branches of the department. This work has been done under my personal supervision, and is found to be the most satisfactory way of impressing lessons taught in the class. Along this line students have had practice in planting and pruning fruit trees and berry bushes; pruning and training grape vines; preparing and applying spraying mixtures; practising different methods of grafting on herbaceous and hard wooded plants; originating new varieties by hand pollination; germinating and testing seeds; transplanting seedlings; forcing vegetable crops; potting and handling house plants; studying and identifying forest trees, etc.

The regular work of this department, apart from that of teaching, inspecting Fruit Experiment Stations, directing co-operative fruit tests, lecturing at Farmers' Institutes, and attending to a large correspondence, is of a varied character and requires a great deal of time and thought. It includes the care and management of: 1. The orchards; 2. Small-fruit plantations; 3. Vegetable garden; 4. Lawn and grounds; 5. Forestry plantations; 6. Conservatories and greenhouses. The work undertaken in these branches during the past year will be briefly noted in the order mentioned.

The Orchards.

The greatest need of this department for years past has been an orchard of the different kinds of fruit trees, not only for the purpose of supplying the requirements of the College, but to afford an opportunity for practical instruction to students in the care and management of such trees. What trees we have had are insufficient for this purpose, and are so scattered about the place that they can hardly be said to constitute an orchard.

To meet this long-felt want, an orchard of 600 trees was set out early in the spring. This orchard is made up of 280 apple trees, 120 pear trees, 120 plum trees and 80 cherry trees. As a preparation for planting, the land was thoroughly underdrained a year ago. Last summer it was plowed out of a clover sod, then deeply cultivated and worked until the sod was made fine, and ridged up in the fall according to Mr. Rennie's method of preparing land for corn. In the spring the ridges were worked down, the land put in fine tilth, and the trees planted as early as possible. Corn was afterwards sown in drills between the rows of trees, care being taken that it did not encroach upon the trees. For several reasons we consider this one of the best crops to grow in a newly planted orchard. It permits of thorough cultivation and gives a partial shade to the trees, much like what they have had in the nursery row, and protects them from sweeping winds until they become established.

With the especially favorable season for planting which we have had, very few of the trees have failed to grow. The principal failures being among the sweet cherries, which, although they leafed out nicely, seemed very slow to take root after transplanting. All such vacancies will be filled in the spring.

That this orchard might be not only a means of instruction for students, but one of interest to intending planters, it has been made up of a large number of varieties, of which we wish to detrmine the value for this section of the country. In this way it will be of the same public value to this inland part of the country that the various fruit experiment stations are to the districts in which they are located. Three trees of each variety were planted, and additional blocks set for grafting and experimental purposes of Talman Sweet apples, Flemish Beauty pears, Glass Seedling plums, and Early Richmond cherries. The following is a list of the varieties planted :

Apples.

Alexander
Babbit
Baldwin
Belle de Boskoop
Ben Davis
Benoni
Bethel
Blenheim Pippin
Bottle Greening
Canada Baldwin
Canada Red
Colvert
Cooper's Market
Cranberry Pippin
Delaware Red
Duchess of Oldenburg
Early Harvest
Fallawater
Fall Jenetting
Fall Pippin
Fall Sweet
Fameuse
Fanny
Gano
Gideon
Golden Russet
Golden Sweet
Gravenstein
Grime's Golden
Haas
Hare Pipka
Hastings
Hubbardston Nonsuch
Hurlbut
Jonathan
King
Lady
La Rue
Longfield
Magog Red Streak
Maiden's Blush
Mann
Milding
McIntosh Red
McMahon's White
Northern Spy
Northwest Greening
Ontario
Peck's Pleasant
Peter
Pewaukee
Princess Louise
Pumpkin Sweet
Red Astrachan
Red Bietigheimer
Ribston Pippin
Rhode Island Greening
Rolfe
Roxbury Russet
Salome

APPLES.—*Continued.*

Scott's Winter
Shackleford
Shiawassee Beauty
Stark
Stump
St. Lawrence
Sutton Beauty
Talman Sweet
Tetofsky
Trenton
Utter's Red
Wagener
Wallbridge
Wealthy
Westfield Seek-No-Further
Wellington
Winter St. Lawrence
Wolf River
Yellow Transparent

Crab Apples.

General Grant
Hyslop
Martha
Montreal Beauty
Transcendent
Whitney

PEARS.

Bartlett
Bartlett Seckel
Belle Lucrative
Bessemianka
Beurre Bosc
Beurre Clairgeau
Beurre d'Anjou
Beurre Diel
Beurre Giffard
Beurre Hardy
Clapp's Favorite
Dempsey
Doyenne Bussock
Doyenne d'Ete
Duchesse d'Angouleme
Easter Beurre
Flemish Beauty
Goodale
Howell
Idaho
Josephine de Malines
Kieffer
Lawrence
Lawson
Lincoln
Louise Bonne
Manning's Elizabeth
Petite Marguerite
President Druard
Ritson
Seckel
Sheldon
Tyson
Vermont Beauty

PLUMS.

Abundance
Beauty of Naples
Bradshaw
Burbank
Coe's Golden Drop
De Soto
Diamond
Duane's Purple
Field
French Damson
General Hand
German Prune
Gueii
Glass Seedling
Grand Duke
Hawkeye
Imperial Gage
Lombard
McLaughlin
Monarch
Monroe
Montreal
Moore's Arctic
Niagara
Pond's Seedling
Prince Englebert
Purple Egg
Quackenbos
Reine Claude
Saunders
Shippers' Pride
Shropshire Damson
Smith's Orleans
Stanton
Victoria
Washington
Weaver
Wolf
Yellow Egg

CHERRIES.

Belle Magnifique
Black Eagle
Black Heart
Black Tartarian
Coe's Transparent
Downer's Late
Dyehouse
Early Purple
Early Richmond
Elton
Empress Eugenie
Governor Wood
Knight's Early
Late Duke
May Duke
Montmorency
Napoleon Bigarreau
Olivet
Reine Hortense
Schmidt's Bigarreau
Vladimer
Windsor
Wragg
Yellow Spanish

SMALL FRUIT PLANTATION.

In the new plantation of small fruits set out in the spring of 1896 there were quite a number of failures owing to the extremely dry weather for a month or six weeks after the plants were set out, the chief failures being among the raspberries and gooseberries.

Of the currants and blackberries very few plants died. Early in the spring all of the spaces were filled, and with the favorable season the plants have made a good growth.

On most varieties there was a very fair crop of fruit, considering that the bushes have been but one year planted. Where possible six good representative bushes of each variety were selected and the crop carefully weighed. The yields given below are the average per bush ; and although this is but the beginning of our tests, and these results cannot be taken as conclusive, yet they are indicative of the productiveness of the different varieties.

RASPBERRIES.

Rank.	Varieties.	First picking.	Last picking.	Yield per bush. (ounces).
	Black.			
1	Palmer	July 16	July 30	11.90
2	Souhegan	" 16	" 28	10.12
3	Older	" 16	" 30	9.75
4	Carpenter's Early	" 16	" 28	8.79
5	Ohio	" 19	" 30	6.92
6	Eureka	" 16	" 23	4.62
7	Mammoth Cluster	" 16	" 30	3.75
8	Kansas	" 19	" 26	3.37
9	Conrath	" 19	" 26	2.12
10	Hilborn	" 19	" 23	1.75
11	Gregg	" 23	" 30	1.75
12	Johnston's Sweet	" 26	" 26	.50
	Red.			
1	Shaffer's Colossal	July 21	Aug. 21	22.87
2	Louden	" 19	" 21	14.45
3	Cuthbert	" 26	" 21	11.81
4	Marlborough	" 16	" 14	10.29
5	Royal Church	" 26	" 21	8.92
6	Turner	" 16	" 21	8.21
7	Highland Hardy	" 16	" 4	3.50
8	Reliance	" 16	" 4	2.50
9	Rancocas	" 19	July 28	1.42
10	Clarke	" 28	Aug. 9	1.42
11	Brandywine	" 26	" 2	1.04
12	Hansell	" 16	July 28	1.00
13	Thompson's Early	" 16	" 28	.83

CURRANTS

Rank.	Varieties.	Yie'd per bush. (ounces).
	Red.	
1	Raby Castle	9.66
2	North Star	6.71
3	Victoria	6.46
4	La Versailles	3.21
5	Fay's Prolific	2.83
6	Prince Albert	1.00
7	Belle de St. Giles	.06
8	Cherry	.06
	White.	
1	White Grape	7.83
2	White Imperial	3.16
	Black.	
1	Black Naples	7.12
2	Black Champion	6.71
3	Lee's Prolific	6.54

GOOSEBERRIES.

Rank.	Varieties.	Yield per bush. (ounces).	Weight of 50 average berries.
1	Pearl	30.83	6.00
2	Houghton	22.96	4.25
3	Downing	17.08	4.75
4	Champion	11.04	3.75
5	Red Jacket	10.83	7.25
6	Crown Bob	6.79	6.50
7	Keepsake	6.25	11.50
8	Smith's Improved	5.62	6.50
9	Autocrat	1.12	5.00
10	Whitesmith		
11	Triumph		
12	Industry		

TEST OF VARIETIES OF STRAWBERRIES.

For the past two years we have been testing varieties of strawberries. In last year's report the results are given of a trial 121 of these. This year we had 150 varieties in fruiting, and have added eighty to our collection to fruit next year. The results with many of these during the past two years have shown them to be of little or no value, and if next season's yields confirm these results such varieties will be placed on our discarded list. On the other hand, a number have made excellent records for both seasons, and if, after repeated trials, these records are maintained, such varieties may with confidence be recommended to intending planters.

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

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

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

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

After the ground had frozen hard in the fall it was lightly covered with long strawy manure, which helped to hold the snow, and protected the plants from injury early in the spring by preventing their alternate freezing and thawing. When growth had commenced in the spring, this covering was raked off the plants and left as a mulch between

the rows. This not being heavy enough to keep down the weeds and properly conserve the soil moisture, an additional heavy mulch of coarse grass was put on before the fruit began to ripen. This kept the berries clean and retained the soil moisture while the crop was ripening.

Owing to the cold spring the plants came into bloom about two weeks later this year than last; yet, notwithstanding the lateness of the bloom, many of the first blossoms were blackened by the repeated late spring frosts. But this did not so seriously affect the crop as the extremely hot, dry weather about the middle of the fruiting season in July. The showers following, however, prolonged the fruiting on those varieties which were hardly enough to withstand the effects of the preceding drought.

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

Rank.	Rank in 1896.	Varieties.	Sex { B. bi-sexual. P. pistillate.	Number of plants lived.	Vigor of growth—scale 1-10.	Freedom from rust scale 1-10.	Date of first bloom.	Date of first picking.	Date of last picking.	Yield.	Firmness.	Color.	Weight of 50 average berries.
									July	ounces.			ounces.
1	33	Tennessee Prolific	B	12	10	9	May 21..	June 26..	17	281.00	F	C	13.00
2	13	Stone's Early	P	12	10	10	" 21.	July 1..	14	263.75	M	S	6.25
3	8	Saunders	B	12	10	6	June 2..	" 1..	20	261.00	F	D C	11.25
4	17	No Name	B	12	10	7	May 24..	June 28..	20	245.75	F	C	13.75
5	52	Woolverton	B	12	9	9	" 25..	July 1..	20	240.00	M	C	16.00
6	45	Shuster's Gem	P	12	9	5	" 18..	June 26..	20	234.00	F	D C	10.75
7	....	Wm. Belt	B	12	10	7	" 24..	" 28..	20	232.25	F	D R	13.25
8	10	Haverland	P	12	10	9	" 18..	" 23..	20	232.00	M	L S	12.00
9	....	Ruby	B	11	10	7	" 21..	" 26..	22	229.75	F	D C	14.25
10	40	Isabella	B	12	10	5	" 23..	" 23..	17	228.25	V F	D C	11.25
11	....	Dominion	B	10	10	4	" 21..	July 3..	22	217.75	S	L S	12.00
12	47	Van Deman	B	12	8	6	" 18..	June 23..	17	214.50	F	D C	10.00
13	..	Tubbs	B	9	9	7	" 18..	" 23..	20	210.00	F	D R	12.25
14	..	Liddle	B	9	10	9	" 25..	July 1..	20	209.75	M	L	7.50
15	26	Jocunda Improved	B	12	9	7	" 28..	June 28..	17	205.00	V F	D C	10.75
16	1	Warfield	P	12	10	7	" 21..	" 26..	20	202.50	V F	D C	9.50
17	62	Aroma	B	12	8	10	" 27..	July 3..	20	193.25	F	D R	10.75
18	7	Barton's Eclipse	P	11	9	5	" 18..	June 26..	20	193.00	F	B C	11.50
19	35	Prince of Berries	B	12	9	5	" 23.	July 3.	22	192.50	M	B S	11.75
20	....	Enormous	P	12	10	8	" 25..	June 26..	20	191.75	F	C	13.75
21	37	Northern	B	12	10	5	" 21..	July 1..	20	188.75	F	C	7.50
22	79	Judsonia	B	12	9	5	" 24..	June 26..	14	181.25	F	L S	19.75
23	....	Beebe	B	12	7	5	" 21.	July 1..	20	180.25	S	D R	10.50
24	87	Ona	P	12	10	9	" 18..	June 26..	20	177.75	M	S	9.00
25	58	Princeton Chief	P	12	8	6	" 24..	July 3.	22	173.00	F	C	7.75
26	15	Seedling A	P	11	9	5	" 21..	June 28..	20	173.00	S	L C	7.75
27	38	Enhance	B	12	10	7	" 18..	July 3..	20	171.00	V F	D R	7.75
28	65	Muskingum	B	12	8	8	" 25..	" 3.	20	169.75	S	L C	12.00
29	16	Lovett	B	12	10	6	" 18..	June 23..	17	167.75	F	L S	9.75
30	....	Arrow	P	12	10	9	" 21..	" 26..	14	166.50	M	D C	8.00
31	42	Howard's 41	P	12	9	9	" 25..	July 3..	20	162.50	V F	S	7.75
32	39	Leader	B	12	10	4	" 17..	June 28..	20	162.00	M	D C	8.50
33	5	Prize	P	12	10	6	" 18..	" 26..	20	161.75	M	S	7.75
34	....	Phipen	B	5	9	8	" 24..	" 28..	20	161.50	F	B C	10.25
35	54	Ohio Centenial	B	11	8	9	" 21..	July 3..	22	161.50	M	L S	11.25
36	22	Belle(Crawford's 51)	B	12	10	8	" 23..	" 3..	22	158.50	F	B S	9.25

Varieties of Strawberries under test.—*Continued.*

Rank.	Rank in 1896.	Varieties.	Sex (B. Bisexual. P. Pistillate.	Number of plants lived.	Vigor of growth. Scale 1-10.	Freedom from rust—scale 1—10.	Date of first bloom.	Date of first picking.	Date of last picking.	Yield.	Firmness.	Color.	Weight of 50 average berries.
									July	ounces.			ounces.
37	....	Gandy Belle	B	10	8	3	May 18..	June 26..	12	158.25	M	D C	13.50
38	....	Hunt's No. 3	B	12	9	9	" 18.	" 26..	17	156.50	F	C	12.50
39	...	Thompson's No. 40	P	11	10	9	" 25..	July 1..	20	156.00	F	L S	8.75
40	....	Cruese's No. 9	B	12	8	8	" 18..	June 26.	17	155.00	F	D C	11.75
41	51	Bessie	B	12	7	6	" 24..	" 23..	14	154.75	F	L S	7.50
42	3	Edgar Queen	P	10	10	5	" 25..	July 1..	22	154.50	S	L R	10.75
43	36	Southard	B	12	8	9	" 18..	June 26..	14	152.50	S	C	9.25
44	34	Splendid	B	12	10	7	" 21..	July 1..	20	152.25	F	D R	10.75
45	72	Hatch Expt Sta. 24	B	12	10	6	" 29..	" 3..	22	151.50	M	D C	12.50
46	31	Williams	B	12	10	6	June 2..	" 1..	22	151.25	F	D C	12.50
47	53	Snowball	B	10	8	6	May 24..	June 28..	20	151.00	F	D R	6.00
48	55	Dayton	B	12	10	6	" 24	" 26..	12	150.50	S	L S	13.00
49	44	Charlie	P	12	9	7	" 25..	" 28..	20	149.50	F	S	6.25
50	14	Boynton	P	12	10	4	" 15..	" 23	14	148.50	M	S	6.75
51	20	Oberholtzer No. 1	B	11	9	9	" 14..	" 26..	20	148.25	M	S	11.25
52	....	Giant	B	9	7	7	" 27..	July 1..	20	146.00	F	L R	17.00
53	4	Bisel	P	10	10	7	" 24..	June 28..	20	145.00	F	D C	9.50
54	27	Phillips	B	12	10	6	" 25..	July 3..	17	144.00	F	D C	10.00
55	....	Longfield	P	6	9	6	" 18..	June 26..	20	142.50	V F	D C	7.25
56	32	Dr. Arp	P	12	8	4	" 25	July 3..	22	141.25	F	D R	7.25
57	6	Standard	P	11	10	7	" 24..	" 3..	20	139.25	F	S	6.50
58	68	Caughell's No. 2	P	12	10	8	" 25..	" 3..	20	138.00	S	C	12.00
59	43	Rio	B	12	9	8	" 17..	June 23..	12	134.75	F	S	9.25
60	....	Brandywine	B	7	8	7	" 18..	" 26..	20	133.75	V F	D R	13.75
61	46	Effie May	B	12	8	6	" 14	" 28..	14	133.00	M	L R	12.25
62	86	Beder Wood	B	9	7	5	" 17..	" 23..	12	132.75	F	B S	9.75
63	48	Michel's Early	B	12	10	6	" 14..	" 23	12	131.00	S	L R	6.00
64	21	Eureka	P	10	9	7	" 21..	" 26..	17	130.75	S	L S	13.00
65	49	Cyclone	B	11	10	9	" 18..	" 26..	14	127.75	M	S	8.00
66	70	Nehring's Gem	P	12	9	7	" 27..	July 1	20	127.00	V F	D R	9.50
67	....	Kansas prolific	B	12	10	4	" 18..	June 28..	20	126.50	F	L S	5.00
68	69	Alabama	B	12	10	6	" 25..	July 1..	20	126.25	V F	D C	10.25
69	19	Gandy	B	11	7	5	" 18..	June 26..	20	125.25	S	B S	11.00
70	30	Robinson	B	12	10	6	" 25..	July 1..	20	126.25	S	D R	7.25
71	....	Epping	P	12	9	6	" 25..	June 28..	20	126.00	S	L R	12.00
72	78	Ivanhoe	B	12	8	7	" 24..	" 26..	20	123.00	F	C	9.50
73	67	Marshall	B	12	8	7	" 18..	" 26..	20	122.75	F	D C	11.75
74	50	Equinox	B	11	9	4	" 27..	July 3..	22	121.25	M	L R	7.25
75	23	Gertrude	B	12	9	8	" 18..	June 23..	14	119.75	M	L S	10.50
76	9	Mrs Cleveland	P	12	9	7	" 24..	July 1..	20	118.00	M	L S	9.75
77	12	Chairs	P	12	10	5	" 17..	June 26..	14	118.25	M	D R	6.25
78	60	Sunnyside	P	12	10	7	" 27..	July 1..	20	118.00	M	S	6.25
79	74	Klickita	P	12	10	4	" 24..	" 3..	20	114.75	S	D R	6.00
80	63	Beverly	B	9	7	8	" 18..	June 26..	20	114.25	S	D C	11.50
81	80	Scarlet Ball	P	12	7	5	" 27..	July 5..	22	113.75	S	L R	11.25
82	....	Westlawn	P	10	10	8	" 25	" 1..	20	113.25	M	D R	9.75
83	2	Afton	P	11	10	6	" 18..	June 26..	14	111.00	F	D C	7.75
84	77	Fremont	B	12	7	4	" 27..	July 3..	14	110.75	M	L C	4.00
85	61	Timbrell	P	12	8	3	" 24..	" 3..	20	110.25	S	G R	11.50
86	106	Anna Forrest	B	12	6	6	" 18..	June 28..	20	108.75	M	G R	13.50
87	....	Gillespie	B	12	7	8	" 21..	" 26..	14	198.25	F	L S	11.75
88	....	Jessie	B	12	8	8	" 21..	" 28..	20	107.25	M	D R	13.50
89	71	Beauty	B	12	6	9	" 18..	" 26..	12	106.50	S	B S	13.50
90	28	Crescent	P	12	10	6	" 18..	" 28..	14	105.50	M	S	6.50
91	73	Gov. Hoard	B	12	7	6	" 21..	" 28..	20	105.25	S	L S	6.00
92	90	Jersey Queen	P	12	7	6	June 3..	July 3..	22	104.25	S	L S	12.50
93	....	Hersey	B	10	9	9	May 21..	June 26..	14	104.25	M	D C	5.75
94	91	Parker Earle	B	11	7	8	" 15..	" 23..	12	103.75	M	D C	8.50
95	88	Watson	P	12	6	4	" 25..	" 26..	20	102.00	S	C	6.50
96	....	Crimson Cluster	P	11	7	6	" 18..	" 28..	14	101.00	S	D C	9.75
97	....	Edith	P	8	5	8	June 2	July 1..	20	97.75	F	L C	23.50
98	93	Wicomico	P	12	7	9	May 24..	June 26..	12	96.50	S	D R	9.25
99	....	Princess	P	6	10	7	" 25..	" 28..	20	96.25	F	S	11.25

Varieties of Strawberries under test.—*Concluded.*

Rank.	Rank in 1896.	Varieties.	Sex { B. bi-sexual. P. pistillate.	Number of plants lived.	Vigor of growth—scale 1-10.	Freedom from rust—scale 1-10.	Date of first bloom.	Date of first picking.	Date of last picking.	Yield.	Firmness.	Color.	Weight of 50 average berries.
									July.	ounces.			ounces.
100	24	Swindle	P	11	7	3	May 21	July 3	20	96.25	S	D R	6.75
101	41	Smith's Seedling	B	12	10	7	" 14	June 26	12	93.75	M	D R	6.00
102	89	Oberholtzer's No. 2	P	12	10	7	June 2	July 7	22	92.50	F	L R	9.25
103	94	Auburn	P	12	10	9	May 31	June 28	12	91.00	F	B C	8.75
104	56	Lady Rusk	P	12	7	5	" 21	July 1	17	90.75	F	D C	7.75
105	11	Greenville	P	11	9	8	" 25	" 3	14	89.75	M	D R	6.50
106	75	Farnsworth	B	11	8	4	" 18	June 28	14	88.50	M	L R	8.25
107	....	Fountain	B	4	7	7	" 21	" 28	14	83.75	F	D C	11.50
108	....	Kossuth	B	12	10	3	" 14	" 28	12	83.50	S	D C	9.50
109	84	Stone's No. 7	B	12	10	3	" 18	" 28	20	81.00	S	C	8.00
110	82	Glenfield	B	12	10	5	" 15	" 23	7	79.25	M	D C	8.00
111	....	Huntsman	B	6	7	7	" 25	" 23	12	78.50	F	D C	9.50
112	85	Alpha	P	9	8	9	" 18	" 28	14	77.00	S	L S	12.00
113	.	Edward's Favorite	B	11	6	3	" 21	" 26	20	77.00	S	L S	11.00
114	57	Mary	P	12	9	6	" 25	July 5	20	74.25	M	L R	15.50
115	....	Beede's No. 1	B	7	8	9	" 24	June 28	14	67.25	F	D C	13.00
116	117	Clark's Early	B	11	7	4	" 21	" 23	12	65.50	M	D C	8.50
117	....	Irene	P	2	7	8	" 24	" 26	17	65.00	V F	D C	9.25
118	114	Wentzel	B	12	6	9	" 21	" 26	10	64.25	S	L R	9.50
119	39	Martha	P	12	10	7	" 21	July 3	14	63.50	M	D C	9.00
120	....	Belle of Lacrosse	B	12	7	7	" 25	" 1	22	61.00	M	L S	7.50
121	....	Annie Laurie	B	7	6	8	June 2	" 1	17	60.25	F	L C	13.00
122	....	Lady Franklin	P	9	8	7	May 25	June 28	12	60.50	M	L S	10.00
123	....	Howard's 25	B	10	8	8	" 18	" 26	12	60.25	S	D R	11.00
124	99	General Putnam	P	10	7	4	" 18	" 26	14	59.75	M	L S	12.50
125	83	Oberholtzer's No. 4	P	12	10	5	" 31	July 7	22	59.25	F	L R	10.25
126	...	Gov. Fifer	B	4	7	9	" 21	" 3	17	59.25	S	L R	7.00
127	....	Hiawatha	B	4	5	10	" 24	June 26	20	57.50	S	L S	13.50
128	....	Eleanor	B	2	9	6	" 25	" 26	12	56.50	S	B S	10.25
129	....	Columbian	B	8	10	5	" 24	" 28	14	51.25	M	L S	13.25
130	....	Steven's Early	B	12	7	3	" 18	" 23	7	49.50	F	C	4.00
131	....	E. P. Roe	B	11	7	5	" 24	July 3	22	48.00	S	G R	11.00
132	....	Leviathan	B	3	9	10	" 24	" 3	20	46.50	S	L R	10.00
133	109	Regina	P	12	7	8	" 27	" 5	20	43.50	S	B S	5.75
134	....	Gunton Park	B	3	6	3	" 15	June 23	12	35.00	S	D C	5.00
135	....	Berlin	P	6	7	8	" 25	" 26	10	34.25	M	D C	9.50
136	....	Royal City	B	3	7	6	" 24	" 26	12	32.50	F	D R	10.00
137	.	Beecher	B	7	8	10	" 31	July 3	12	30.50	S	L S	8.00
138	...	Leroy	P	2	7	9	" 24	" 1	20	29.50	S	D R	4.00
139	104	Price	B	12	8	4	" 15	June 28	10	28.00	M	D R	4.50
140	.	Little's No. 7	B	1	8	7	" 25	July 1	20	27.75	F	L S	
141	103	Accomack	B	12	6	8	" 18	June 28	12	25.25	S	L S	7.00
142	....	Westbrook	P	10	6	7	" 13	" 26	10	25.00	S	D C	3.00
143	....	Lady Thompson	B	4	7	6	" 25	" 28	12	18.75	S		
144	....	Iowa Beauty (fall planted)	B	12	....	9	" 24	" 23	5	16.00			
145	...	Cumberland	B	2	6	7	" 25	" 23	12	14.50	M	L R	
146	...	Alpine (everbearing)	B	12	5	8	" 7	" 23	Oct.	*14.50	S	wht	
147	....	Holland	P	2	5	6	June 4	July 10	17	9.50			
148	....	Laxton's No. 1	B	5	6	5	May 22	June 26	7	5.00	M		
149	111	Dew	B	3	5	8	" 28	Ju'y 3	7	4.50	S		
150	....	Meek's Early	B	2	6	8	" 14	June 23	3	3.50			

*One Picking.

In column two is given the relative positions of those varieties fruited in 1896 which had a full or nearly full stand of plants. The great change in position of many of these shows very clearly how little value should be placed upon the results of but a single test. It is only by the average of a number of trials that we can arrive at a reliable estimate of the value of a variety.

ARM.

Firmness.	Color.	Weight of 50 averag berries.
		ounces.
S	D R	6.75
M	D R	6.00
F	L R	9.25
F	B C	8.75
F	D C	7.75
M	D R	6.50
M	L R	8.25
F	D C	11.50
S	D C	9.50
S	C	8.00
M	D C	8.00
F	D C	9.50
S	L S	12.00
S	L S	11.00
M	L R	15.50
F	D C	13.00
M	D C	8.50
V F	D C	9.25
S	L R	9.50
M	D C	9.00
M	L S	7.50
F	L C	13.00
M	L S	10.00
S	D R	11.00
M	L S	12.50
F	L R	10.25
S	L R	7.00
S	L S	13.50
S	B S	10.25
M	L S	13.25
F	C	4.00
S	G R	11.00
S	L R	10.00
S	B S	5.75
S	D C	5.00
M	D C	9.50
F	D R	10.00
S	L S	8.00
S	D R	4.00
M	D R	4.50
F	L S	
S	L S	7.00
S	D C	3.00
S		
M	L R	
S	wht	
M		
S		

uited in 1896
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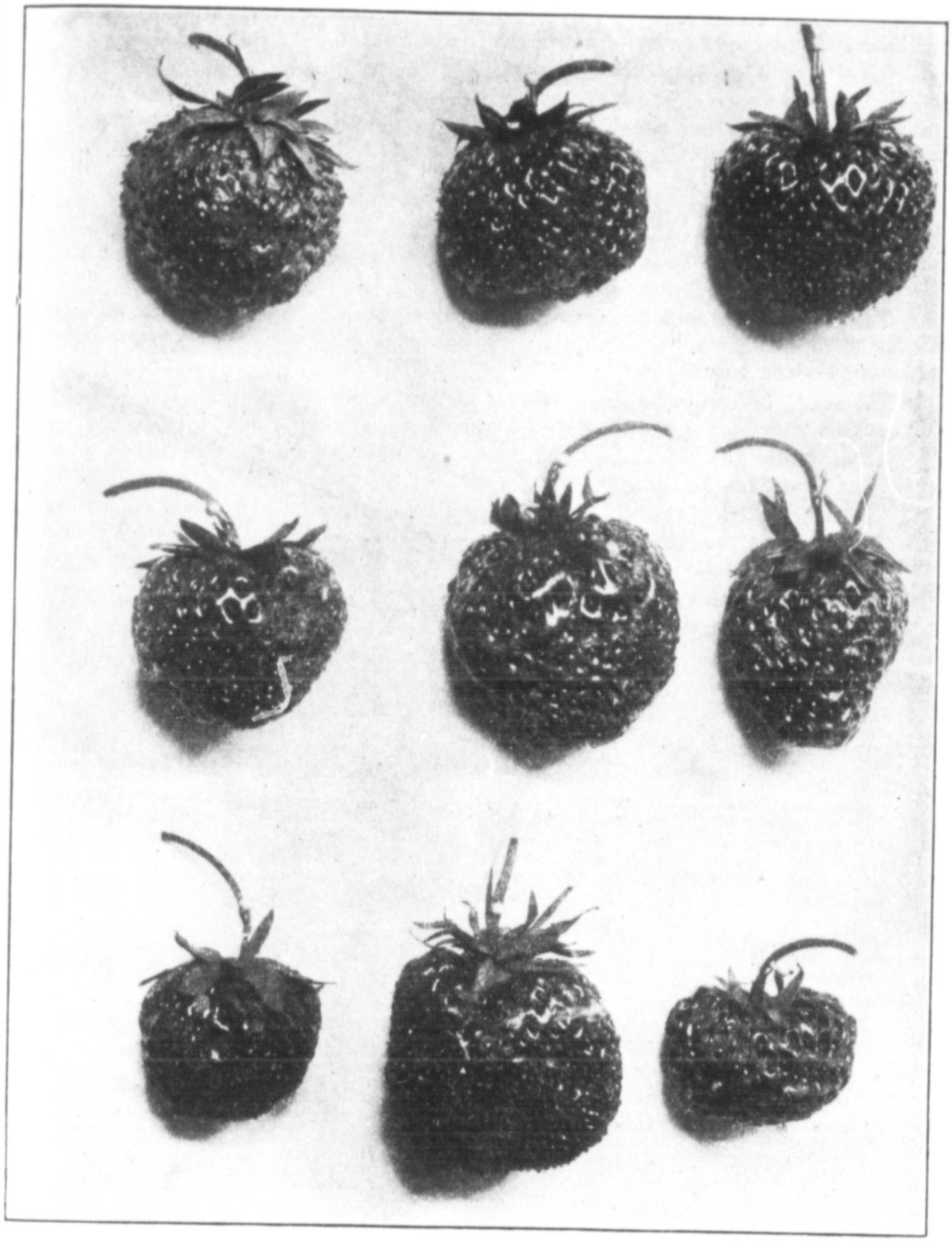
sults of but a
n arrive at a



Ohio Centenial.
Hatch Experimental Station.
Princeton Chief.

Edgar Queen.
Mrs. Cleveland.
No Name.

Aroma.
Dr. Arp.
Klickita.

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

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

The date of bloom, as noted in column 8, should be carefully noted by planters who wish to select bisexual varieties to fertilize the bloom of pistillates. The former should, if possible, be a little earlier than the latter, to insure the fertilization of all early blossoms.

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

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

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

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

Early Varieties.

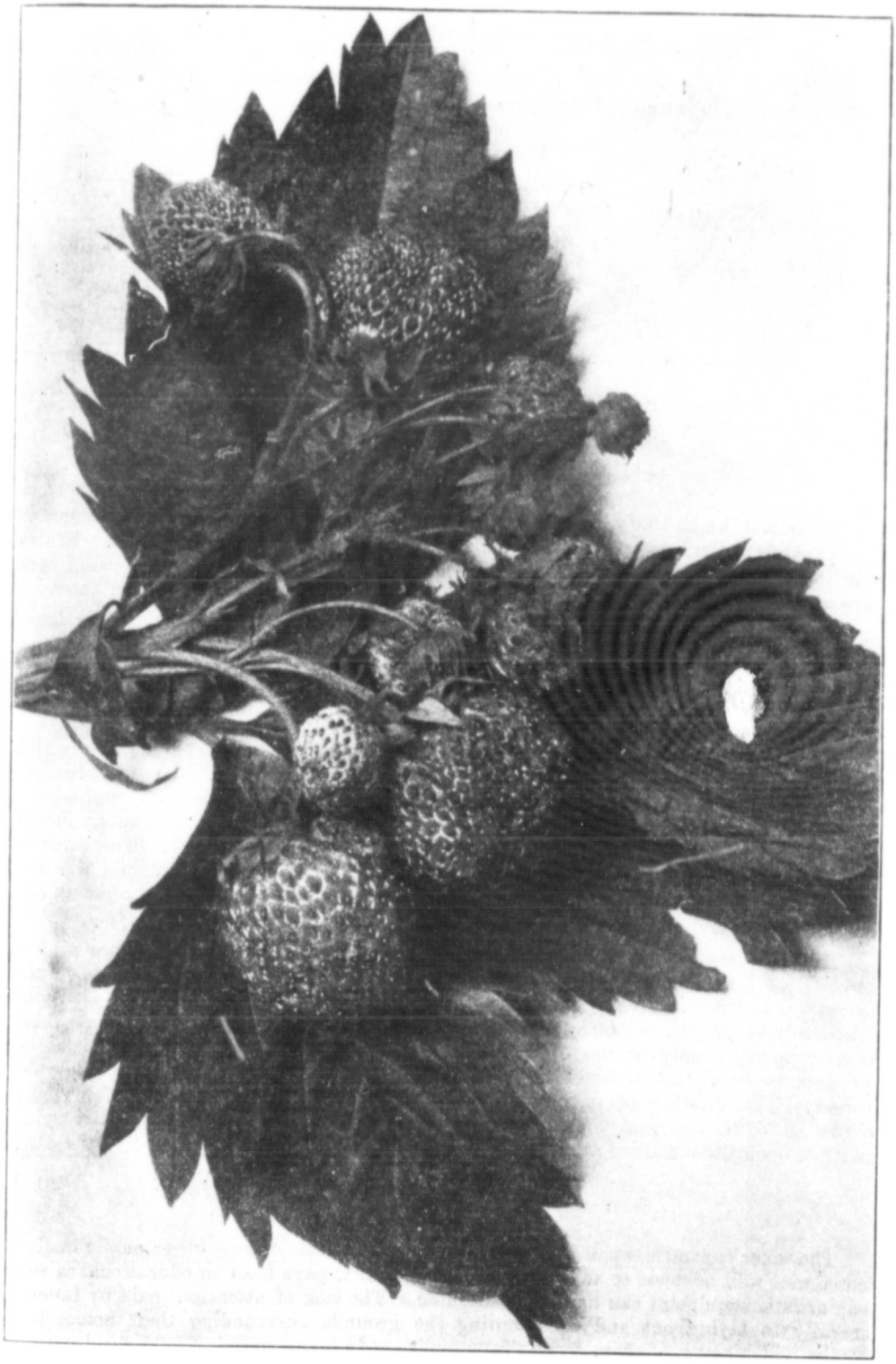
In the following list is given a few of those varieties giving the largest early yield, ranked according to their yield for the first week ending July 1st.

Rank.	Varieties.	Sex	Date of first picking.	Yield before July 1st.	Total yield.	Rank for total yield.
				Ounces.	Ounces.	
1	Van Deman	B	June 23	136.75	214.50	12
2	Bessie	B	" 23	73.25	154.75	41
3	Shuster's Gem	P	" 26	68.25	234.00	6
4	Michel's Early	B	" 23	65.75	131.00	63
5	Rio	B	" 23	61.25	134.75	59
6	Haverland	P	" 23	55.50	232.00	8
7	Ona	P	" 26	50.00	177.75	24
8	Smith's Seedling	B	" 26	47.50	93.75	101
9	Beauty	B	" 26	46.50	106.50	89

Late Varieties.

In the following list is given a few of these varieties giving the largest late yield, ranked according to their yield after July 12th.

Rank.	Varieties.	Sex.	Date of last packing.	Yield after July 12th.	Total yield.	Rank for Total yield.
				Ounces.	Ounces.	
1	Dominion	B	July 22	87.75	217.75	11
2	Equinox	B	" 22	68.00	121.25	74
3	Prince of Berries	B	" 22	55.50	192.50	19
4	Scarlet Ball	P	" 22	51.50	113.75	81
5	Hatch Expt. Stn. 24	B	" 22	47.25	151.50	45
6	Belle (Crawford's 51)	B	" 22	46.75	158.50	36
7	Princeton Chief	P	" 22	45.50	173.00	25
8	Edith	P	" 20	40.50	97.75	97



EDGAR QUEEN.

Large Berries.

In the following list is given a few of these varieties bearing the largest berries, ranked according to the size of the berries.

Rank.	Varieties.	Weight of 50 average berries.	Firmness.	Rank for total yield.
1	Edith	23.50	F	97
2	Wm. Belt	16.75	F	7
3	Woolverton	16.00	M	5
4	Mary	15.50	M	114
5	Ruby	14.50	F	9

The accompanying photographs are all natural size, and are taken in most cases from medium sized berries.

Vegetable Garden.

Much as it might be desired, we have found it impracticable, for various reasons, to attempt systematic variety tests of the various kinds of garden vegetables. In this branch of the work, so far, we have had to confine our attention to the production of such crops as are desired, and in such quantities as are needed to supply the College tables.

Formerly nearly all of the kitchen garden, comprising five and three quarter acres, was required for this purpose. Since, however, the garden has been underdrained and subsoiled, and a system of close cropping and rotation of crops adopted, we have been able to devote over one-third of this area to strawberries, and yet grow on the remaining two-thirds all that is required to meet an increased demand.

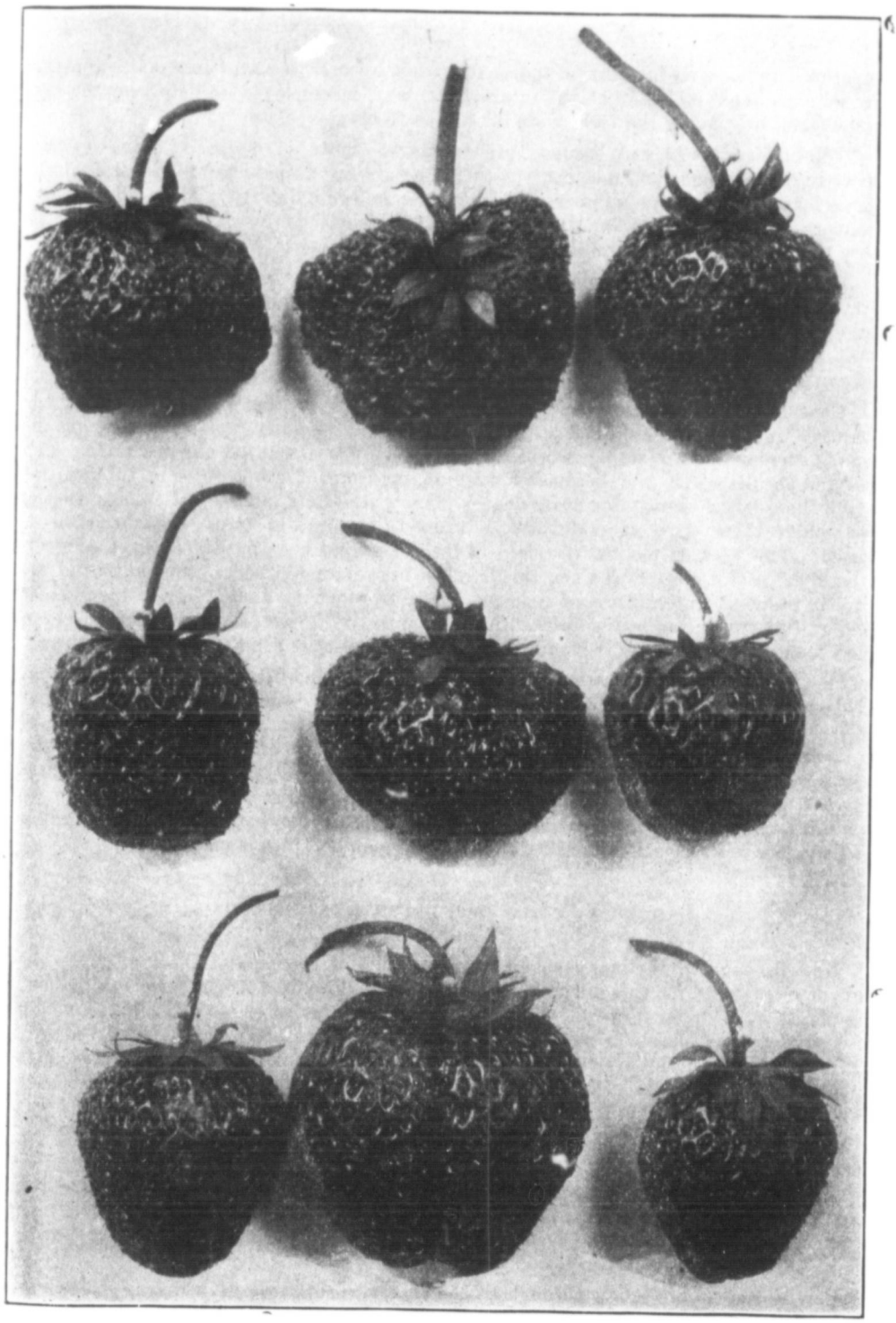
The fertility of the soil is maintained by heavy applications of stable manure, which can be obtained in large quantities from the city during the winter. The introduction into the rotation of strawberries, which are plowed under after the second crop, will, it is expected, greatly improve the friability, or mechanical condition, of the soil by means of the large amount of vegetable matter or humus incorporated with it. The value of friability, as well as of fertility, of the soil is readily understood by any one who has attempted to grow garden crops. With a friable fertile soil we seldom fail to get a good stand of plants, and a good crop if the season is at all favorable.

The past season has been a remarkable one, showing at different times all the extremes of heat and cold, wet and dry. These have had different effects upon the various garden crops. Nearly all of the root and vegetable crops requiring plenty of moisture have made a wonderful growth and are better than the average, but those crops requiring plenty of heat to develop and ripen their fruits, such as tomatoes, squashes, melons, etc., have not matured a full crop and have been much below the average. The growing of melons we have been compelled to discontinue, not only because of their uncertainty even in a favorable season, but because of their trying influence upon the morals of students.

Lawn and Grounds.

The labor expended upon the lawn and grounds of this or any other public institution cannot well be made to show a revenue, but that it pays from an educational as well as an artistic standpoint can hardly be disputed. The lack of attention paid by farmers generally to laying out and ornamenting the grounds surrounding their homes is a mistake which many of them do not fully realize. In many ways it would pay to give a little more attention to matters of this kind. It adds materially to the value of farm

Rub
Gre
Bar



Ruby.	Wm. Belt.	Williams.
Greenville.	Southard.	Shuster's Gem.
Barton's Eclipse.	Saunders.	Jocunda Imp.

property. It lends an interest to the country home which is better felt than expressed, and without doubt it is one of the means that may be employed to help keep the boys on the farm, by making the farm more attractive to them.

The college lawns and grounds are extensive—more so, perhaps, than we could expect to find throughout the country; still they are in keeping with the size of the college farm and with the number and size of the college buildings. They offer plenty of opportunity for study in landscape gardening, which students, after leaving here, can apply to suit the conditions on their own farms.

The frequent rains throughout the summer kept the lawn fresher and greener this year than it has been for many a year. There was also an abundance of bloom on many of the flowering shrubs, which added greatly to its beauty, and caused it to be generally admired and commented upon by the thousands of excursionists who visited the college during the month of June.

Considerable work has been done during the year in the way of improving the grounds. A great deal of filling, levelling, grading and seeding has been done on the grounds surrounding the sewage works, the engineer's house, and the new reservoir. The trees and shrubs which had become crowded at the front of the lawn were thinned out to give those left a chance for proper development, and in a number of clumps on the lawn, where there were vacant spaces, additional varieties of trees and shrubs were planted. The work of paving the sides of the drives has been pushed forward as much as possible, and a great deal along this line has been accomplished. This will avoid the formerly frequent expenditure of time and labor in repairing these drives, due to their being gullied out during heavy rains. A large quantity of screened gravel has also been added to many of the drives, which has put them in first-class condition.

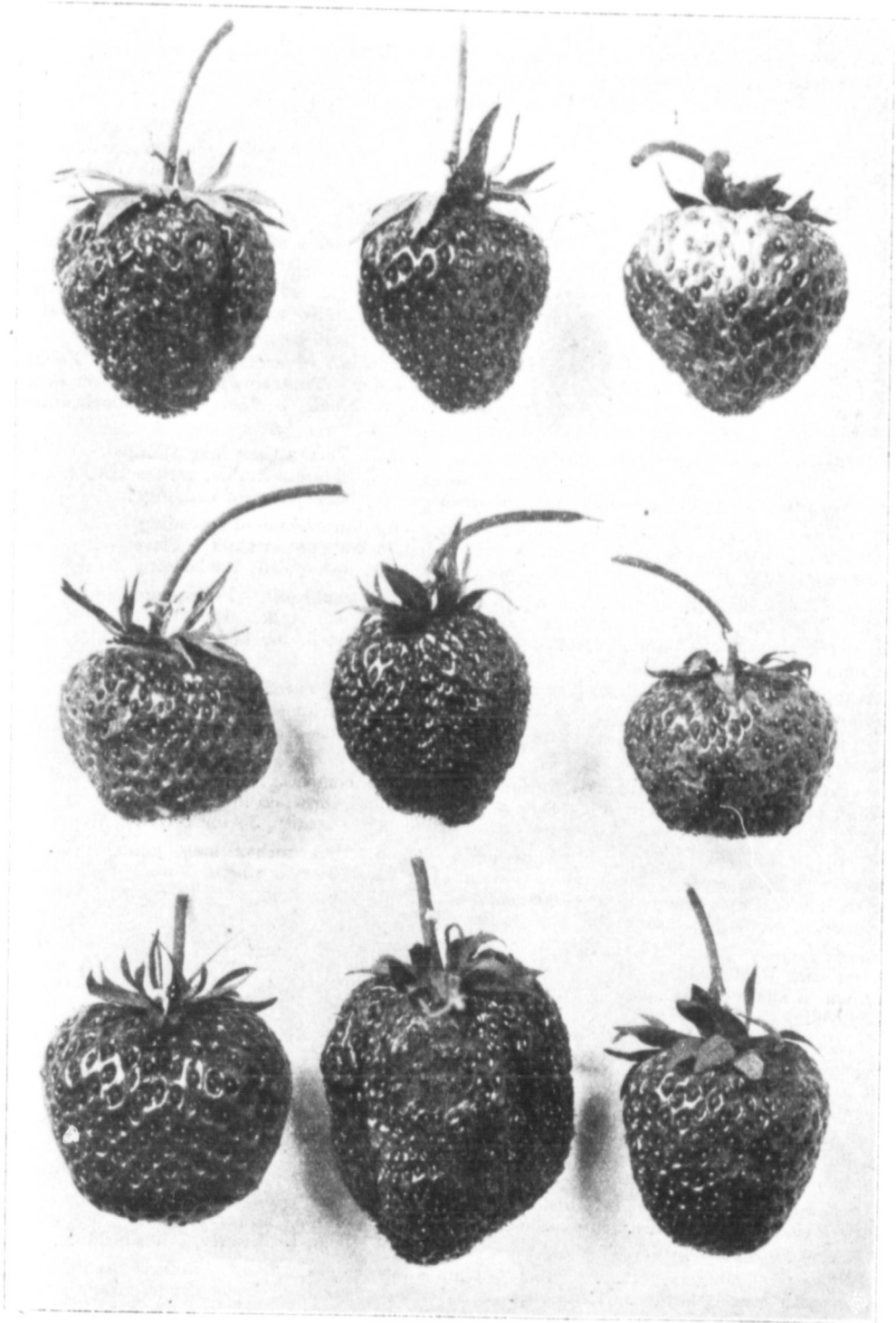
One of the changes on the lawn of more than local importance has been the removal and destruction of all of the barberry bushes. It has long been an established fact that the barberry is a host plant for the rust which affects grain crops. That is, one stage in the life history of grain rust is passed on the leaves of the barberry. On account of the injury done here more or less every year by rust on the grain crops, it was thought best this year to root up and burn all the barberry bushes on the place. So that, although we were sorry to see them go, we committed to the flames three beautiful barberry hedges and a number of fine specimen bushes of both the green and purple varieties.

Test of Varieties of Geraniums for Bedding.

Notwithstanding the many changes in the styles of ornamental bedding, and in the kinds of plants used for this purpose, the geranium still holds a front rank among bedding plants. There is, however, a great difference in the value of varieties. Some of those which are excellent for pot culture in the house are of little or no use for bedding, and likewise some of the most excellent bedding varieties make a very poor show under pot culture. The marked difference in this respect makes the subject one of importance to any one growing geraniums either in the house or outside for bedding. A test was begun this year with fifty-seven varieties to ascertain their relative values for bedding purposes.

Vigorous young plants were grown from cuttings taken last fall. These were first potted into three inch pots, then repotted during March into four inch pots. Early in the spring they were put into cold frames to "harden off," and four plants of each variety were set a foot apart in a well prepared flower border early in June.

Careful notes were taken throughout the season, a summary of which is given, hoping that it may be of interest not only to florists and towns-people but to farmers' wives throughout the country. The results of one year's tests cannot be considered definite, yet they will give some idea of the value of the varieties named. We hope to continue



Lovett.
Beder Wood.
Muskingum.

Warfield.
Tennessee Prolific.
Belle.

Prince of Berries.
Ona.
Bisel

these tests with the same and additional varieties, and have at the present time about 100 varieties in the greenhouse to ascertain their relative values for pot culture. The values given below are on a scale of points from one to ten :

Alfred Tennyson.—Plant 12 inches in height, compact and short jointed. Foliage medium size, dark green with distinct zone. Truss large on long flower stalk. Florets semi-double, light orange scarlet. Values—freeness of bloom, 10; beauty, 10; for bedding, 10.

Armand Sylvestre.—Plant 9 inches in height, compact, short jointed. Foliage medium size, dark green with faint zone. Truss medium in size on long flower stalk. Florets double, light lilac pink. Values—freeness of bloom, 7 ; beauty, 9; for bedding, 5.

Beatrice.—Plant 9 inches in height, weak grower. Foliage medium in size with fain zone. Truss small on medium flower stalk. Florets single, white shading to rose centre. Values—freeness of bloom, 7 ; beauty, 5; for bedding, 2. No use for bedding, but said to be excellent for pot culture.

Bijou.—Plant 8 inches in height, short jointed but of rather open habit. Foliage medium size, crinkled, glossy green with wide silver border. Truss small on short flower stalk. Florets single, bright scarlet. Values—freedom of bloom, 3; beauty, 5; for bedding, 8. Valuable for its foliage rather than for its bloom.

Buffalo Bill.—Plant 11 inches in height, compact but rather long jointed. Foliage large with faint zone. Truss large on long flower stalk. Florets double, dark centre, creamy white marbled with rose. Values—freeness of bloom, 7 ; beauty, 6; for bedding, 7.

Charles Larelle,—Plant 10 inches high, rather long jointed and of spreading habit. Foliage large, dark green with distinct zone. Truss large on long flower stalk. Florets single, salmon rose with white eye. Values—freeness of bloom, 9; beauty, 10; for bedding, 7.

Cloth of Gold.—Plant 6 inches in height, compact dwarf habit. Foliage medium in size, light golden yellow. Truss small and loose on short flower stalk. Florets single, of light cerise (cherry) color. Values—freeness of bloom, 6; beauty, 5; for bedding, 9. Valuable on account of its golden foliage.

Copernic.—Plant 9 inches in height, compact, short jointed. Foliage medium in size without zone, does not stand the sun well. Truss medium on long flower stalk. Florets single, rosy carmine shading to salmon, with light border. Values—freeness of bloom, 9 ; beauty, 8 ; for bedding, 5.

Crystal Palace Gem.—Plant 7 inches high, dwarf, compact habit. Foliage medium in size, golden yellow with light green centre. Truss medium, loose, on long flower stalk. Florets single, of light cerise color. Values—freeness of bloom, 6; beauty, 5; for bedding, 10.

Dr. Levavasseur.—Plant 13 inches high, compact but rather long jointed. Foliage large with faint zone. Truss large on long flower stalk. Florets single, lower petals orange cerise, marked with lilac ; upper petals lilac, veined with red and edged with cerise. Values—freeness of bloom, 8 ; beauty, 10 ; for bedding, 7.

E. Legouve—Plant 14 inches high, compact, short jointed. Foliage large, very dark green with distinct zone. Truss large on medium flower stalk. Florets semi-double, orange salmon, a shade darker than Mrs. E. G. Hill. Values—freeness of bloom, 8; beauty, 10; for bedding, 9.

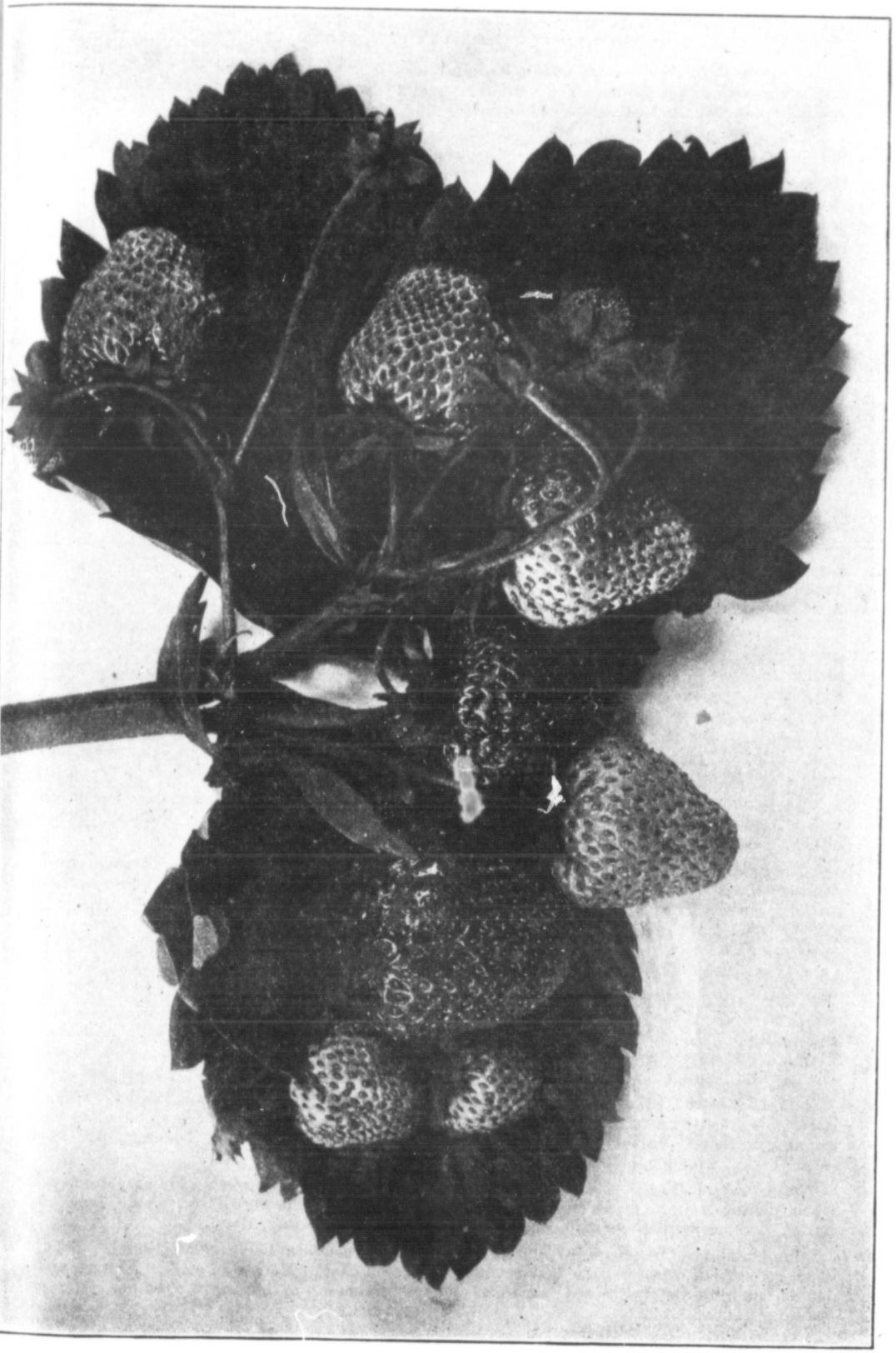
Emile de Gerardin.—Plant 12 inches high, compact habit, moderately long jointed. Foliage large and vigorous, dark green with no zone and few incisions in margin. Truss small on long flower stalk. Florets double, magenta pink, with light centre. Values—freeness of bloom, 9; beauty, 6; for bedding, 8.

Ernest Lauth.—Plant 10 inches high, moderately compact, rather long jointed. Foliage medium in size, bright green with no zone. Truss medium in size on long flower stalk. Florets double, bright magenta crimson. Values—freeness of bloom, 8; beauty, 5; for bedding, 7.

Fanny Thorpe.—Plant 11 inches high, compact, short jointed. Foliage large, very dark green, with very distinct broad zone. Truss large on long flower stalk. Florets single, pale rose white with darker centre. Values—freeness of bloom, 10; beauty, 7; for bedding, 9.

Flower of the Day.—Plant 7 inches high, dwarf compact habit. Foliage small, glossy green with creamy border. Truss small on short flower stalk. Florets single, bright scarlet. Produces very little bloom. Value for bedding, 6.

General Grant.—Plant 18 inches high, very vigorous, compact and short jointed. Foliage large, dark green with distinct zone. Truss large on long flower stalks. Florets, semi-double, brilliant scarlet. Values—freeness of bloom, 10; beauty, 10 ; for bedding, 10. The most popular variety of its color for bedding, but of little use for pot culture.



TENNESSEE PROLIFIC.

Gloire de France.—Plant 10 inches high, compact, short jointed. Foliage medium in size, dark green with distinct zone. Truss small on long flower stalk. Florets double, mottled white and lilac pink. Values—freeness of bloom, 4; beauty, 5; for bedding, 6.

Grand Chancellor—Plant 12 inches high, vigorous compact grower, short jointed. Foliage medium in size, light green without zone. Truss small on long flower stalk. Florets semi-double, rich dark crimson. Values—freeness of bloom, 7; beauty, 8; for bedding, 9.

Happy Thought.—Plant 7 inches high, compact, short jointed. Foliage small, light green with yellow centre. Truss loose, medium sized, on short flower stalk. Florets single, of pale cerise color. Values—freeness of bloom, 6; beauty, 5; for bedding, 10. Valuable on account of its beautiful foliage.

Henri de Bornier.—Plant 7 inches high, compact, short jointed. Foliage, pale green without zone; does not stand the sun well. Truss small on medium flower stalk. Florets double, pure white. Values—freeness of bloom, 4; beauty, 5; for bedding, 3.

Imogene.—Plant 12 inches high, compact, long jointed. Foliage medium in size, dark green, faint zone. Truss medium in size, on long flower stalk. Florets, single, pink shading to crimson centre. Values—freeness of bloom, 8; beauty, 6; for bedding, 8.

Ingenieur Parlier.—Plant 10 inches high, compact, long jointed. Foliage medium size, light green, no zone. Truss medium size, long flower stalk. Florets double, violet rose, upper petals scarlet. Values—freeness of bloom, 7; beauty, 9; for bedding, 10.

Jeanne d'Arc.—Plant 8 inches high, compact, short jointed. Foliage small, light green with faint zone. Truss small on long flower stalk Florets semi-double, rich dark crimson. Values—freeness of bloom, 5; beauty, 8; for bedding, 7.

J. J. Harrison.—Plant 10 inches in height, vigorous compact grower, short jointed. Foliage large, pale green with faint zone. Truss large, on long flower stalk. Florets very large, semi-double, of brilliant scarlet color. Values—Freeness of bloom, 8; Beauty, 10; for bedding, 10. A valuable new variety, rivalling General Grant in everything but size.

John Good.—Plant 15 inches high, vigorous, compact, short jointed. Foliage large, luxuriant dark green, with broad very distinct dark zone. Truss large on long flower stalk. Florets single, pale salmon color shading to dark salmon centre. Values—freeness of bloom, 10; beauty, 8; for bedding, 10.

La Favorite.—Plant 13 inches high, vigorous, compact but rather long jointed. Foliage large, pale green without zone. Truss medium size on medium length of stock. Florets double, pure white. Values—freeness of bloom, 8; beauty, 10; for bedding, 10. The most promising variety of its color.

La Vestale.—Plant 10 inches high, compact, short jointed. Foliage medium size, pale green, without zone. Truss large, on long flower stalk. Florets single, pure white. Values—freeness of bloom, 8; beauty, 10; for bedding, 8.

Leon Perrault.—Plant 11 inches high, of loose spreading habit, long jointed. Foliage small, dark green with faint zone. Truss large, loose, on long flower stalk. Florets single, brilliant scarlet. Values—freeness of bloom, 10; beauty, 10; for bedding, 8.

Lord Lytton.—Plant 10 inches high, of spreading habit, long jointed. Foliage medium size, pale green with faint zone. Truss medium size on medium length of stalk. Florets double, upper petals orange red, lower ones bright magenta crimson. Values—freeness of bloom, 5; beauty, 10; for bedding, 7.

Mad. Thibaut.—Plant 11 inches high, vigorous, compact, short jointed. Foliage very large and luxuriant, glossy green without zone. Truss medium size, on medium length of stalk. Florets semi-double, magenta pink, with pale centre. Values—freeness of bloom, 9; beauty, 8; for bedding, 9.

Mad. Adrien Corret.—Plant 12 inches high, vigorous, compact, short jointed. Foliage large, pale green with distinct zone Truss large, on long flower stalk. Florets double, light magneta crimson. Values—freeness of bloom 8; beauty, 10; for bedding, 10. One of the best of its color for bedding and pot culture.

Mad. Alfred Mame.—Plant 10 inches high, compact, short jointed. Foliage large, pale green, distinct zone. Truss large on long flower stalk. Florets very large, single, pale rose scarlet. Values—Freeness of bloom, 6; beauty, 10; for bedding, 10.

Mad. Amye de Chevreliere.—Plant 11 inches high, of compact habit, short jointed. Foliage large, pale green, without zone. Truss medium size on medium length of stalk. Florets semi-double, pure white, with red anthers. Values—freeness of bloom, 6; beauty, 10; for bedding, 8.

ANNA F
OBERHO
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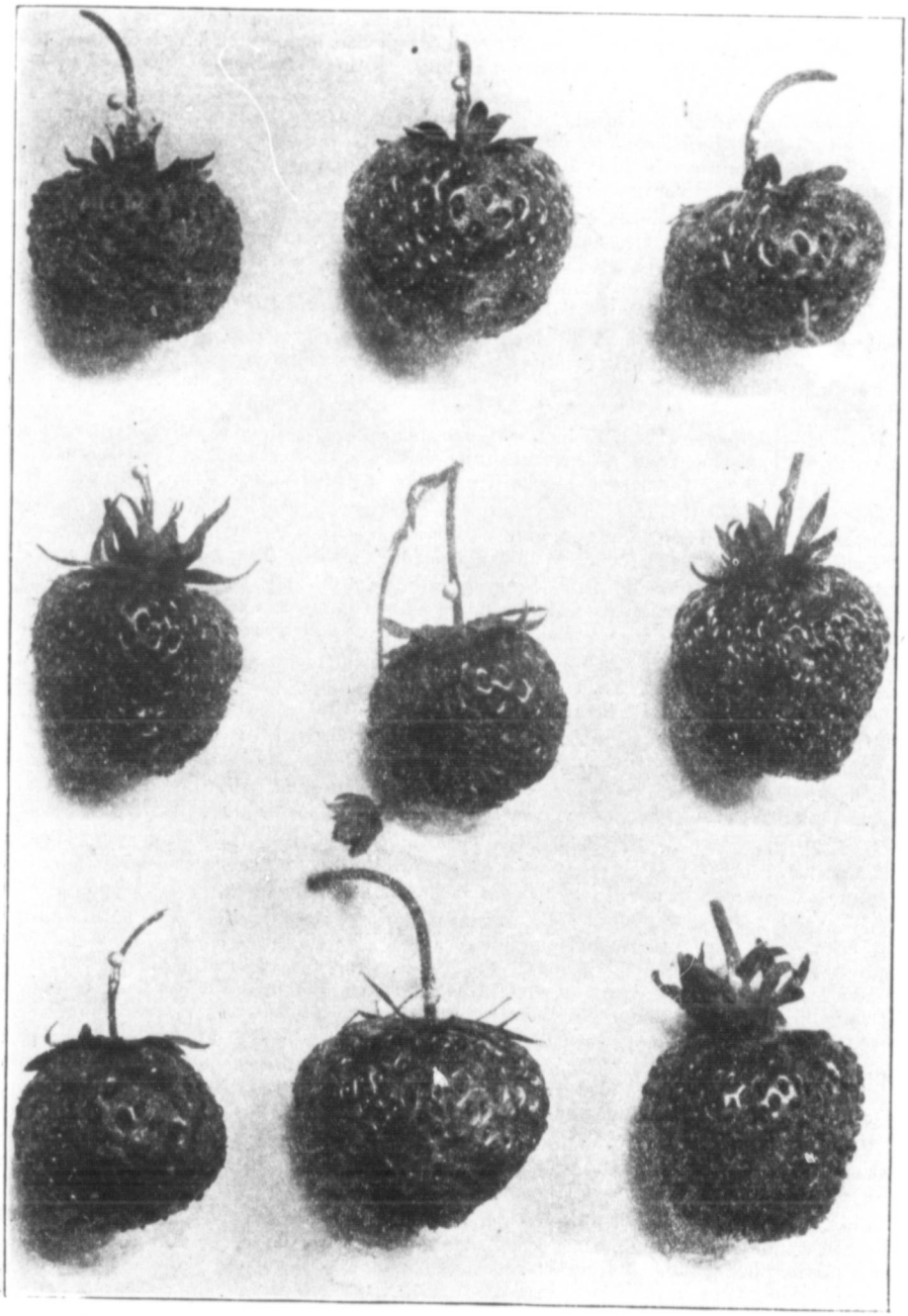


ANNA FOREST.
OBERHOLTZER No. 2.
NORTHERN.

DOMINION.
STANDARD.
SCARLET BALL.

JERSEY QUEEN.
MARSHALL.
MARY.

Mad. Remy Martin.—Plant 9 inches in height, of dwarf compact habit, very short jointed. Foliage small, pale green without zone. Truss medium size, on medium length of stalk. Florets double, violet rose upper petals marked with white. Values—freeness of bloom, 10 ; beauty, 10 ; for bedding, 8.

Mad. Saleroi.—Plant 8 inches in height, of dwarf, compact, free branching habit, very short jointed. Foliage medium size, dark glossy green with narrow margin of silvery white. Produces little or no bloom, but is valuable on account of its beautiful foliage and compact habit of growth. One of the best of the silver leaved varieties for bedding.

Madonna.—Plant 13 inches in height, of a rather spreading habit, long jointed. Foliage large, pale green with no zone, and a little or no incisions on the margin. Truss very large, on very long flower stalk. Floret very large, single, of a beautiful soft shade of light pink. Values—freeness of bloom, 10 ; beauty, 10 ; for bedding, 10. One of the best of its color for bedding, and excellent also for pot culture.

Marechal MacMahon.—Plant 11 inches high, of dwarf compact habit. Foliage medium size, of golden yellow color with a broad dark chocolate colored zone. Truss small, on short flower stalk. Florets single, bright scarlet. Values—freeness of bloom, 2 ; beauty, 5 ; for bedding, 10. Valuable on account of its foliage, and ability to stand the sun.

Mary Hallock Foote.—Plant 15 inches high, compact, long jointed. Foliage large, luxuriant dark green, with distinct zone. Truss medium size, long flower stalk. Florets single, light salmon pink. Values—freeness of bloom, 5 ; beauty, 5 ; for bedding, 8.

Master Christine.—Plant 8 inches high, weakly, poor grower. Foliage small, pale green, without zone. Truss medium size on long flower stalk. Florets single, rosy pink with light centre. Values—freeness of bloom, 9 ; beauty, 7 ; for bedding, 2.

Mazeppa.—Plant 10 inches high, loose spreading habit, long jointed. Foliage not dense enough, medium in size, pale green, faint zone. Truss large and loose, on long flowerstalk. Florets single, carmine scarlet. Values—freeness of bloom 10 ; beauty, 10 ; for bedding, 8.

Memphus.—Plant 11 inches high, of spreading habit, long jointed. Foliage large, dark green with distinct zone. Truss large on long flower stalk. Florets single, brilliant scarlet. Values—freeness of bloom, 8 ; beauty, 10 ; for bedding, 10.

M. G. Meynot.—Almost if not identical with Mrs. E. G. Hill.

Mons. de la Rue.—Plant 10 inches high, compact, short jointed Foliage medium size, dark green, without zone. Truss medium size, on long flower stalk. Florets double, deep rich magneta pink Values—freeness of bloom, 9 ; beauty, 10 ; for bedding, 10.

Mrs. A. Blanc.—Plant 12 inches high, spreading, long jointed. Foliage very large, dark green, distinct zone. Truss very large, on long flower stalk. Florets very large, single, deep rich salmon. Values—freeness of bloom, 7 ; beauty, 10 ; for bedding, 9.

Mrs. Cottle.—Plant 9 inches high, compact, short jointed. Foliage medium size, light green, faint zone. Truss large on long flower stalk. Florets large, single, bright rose scarlet Values—freeness of bloom, 7 ; beauty, 10 ; for bedding, 5. A seedling of Mrs. E. G. Hill, raised by Mrs. Thos. Cottle, Clinton, Ont. Has not done well outside this year, but is one of the most valuable of its color under pot culture.

Mrs. E. G. Hill.—Plant 13 inches high, compact, short jointed. Foliage very large, luxuriant dark green, distinct zone. Truss of immense size on long flower stalk. Florets very large, single dark salmon pink. Values—freeness of bloom, 10 ; beauty, 10 ; for bedding, 10 The best of its color for bedding ; excellent also for pot culture.

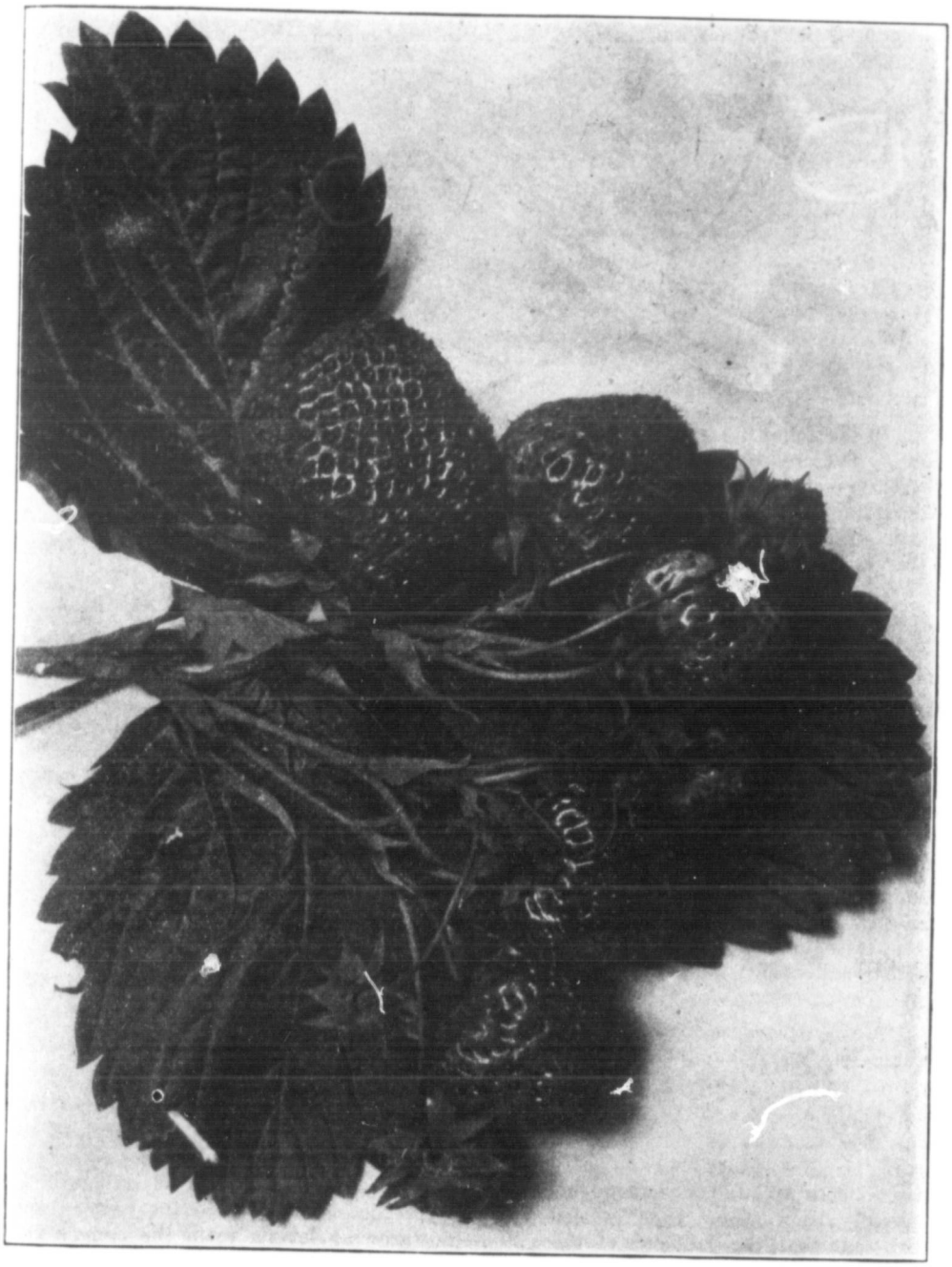
Mrs. Geo. Lorg.—Plant 11 inches high, compact, short jointed. Foliage medium size, with faint zone. Truss small on medium length of stalk. Florets double, light magneta pink with lighter colored centre. Values—freeness of bloom, 9 ; beauty, 8 ; for bedding, 7.

Mrs. J. M. Garr.—Plant 10 inches high of rather spreading habit, short jointed. Foliage medium size, not dense enough, dark green, no zone. Truss large, on very long flower stalk Florets single, pure white. Values—freeness of bloom, 10 ; beauty, 8 ; for bedding, 8.

Perle.—Plant 11 inches high, spreading, short jointed. Foliage medium in size, pale green, without zone. Truss medium size on long flower stalk. Florets single, pure white. Values—freeness of bloom, 5 ; beauty, 6 ; for bedding, 8.

Pierre Crozy.—Plant a hybrid between the Zonale and Ivy leaved Geraniums. Plant 6 inches high, spreading, short jointed. Foliage, small, light green, showing a little of the Ivy leaf. Truss, medium size, on long stalk. Florets, single, bright rose scarlet. Values—freeness of bloom, 10 ; beauty, 10 ; for bedding, 2.

Prokop Daubec.—Plant 14 inches high, compact grower, but rather long jointed. Foliage, medium size, pale green, distinct zone. Truss, large on long flower stalk. Florets, double, light rose scarlet. Values—freeness of bloom, 7 ; beauty, 10 ; for bedding, 10,



Oberholtzer No. 2.

Sam Sloan.—Plant 15 inches high, vigorous, compact, rather long jointed. Foliage, large, very dark green with faint zone. Truss very large, loose, on long flower stalk. Florets single, deep rich crimson. Values—freeness of bloom, 10; beauty, 9; for bedding, 10. A promising variety.

S. A. Nutt.—Plant 10 inches high, compact, short, jointed. Foliage, large, dark glossy green, faint zone. Truss, small, long flower stalk. Florets, double, very dark rich crimson. Values—freeness of bloom, 6; beauty, 9; for bedding, 10.

Sir Trevor Lawrence.—Plant 12 inches high, compact, short jointed. Foliage, medium size, crinkled, dark green, without zone. Truss, large, on long flower stalk. Florets, double, rosy pink. Values—freeness of bloom, 10; beauty, 10; for bedding, 8.

Van Dael.—Plant 10 inches high, weakly, spreading, short jointed. Foliage, large, dark green, no zone. Truss, large on very long flower stalk. Florets, single, light salmon rose. Values—freeness of bloom, 6; beauty, 8; for bedding, 5.

Ville de Poitiers.—Plant 13 inches high, vigorous, compact, short jointed. Foliage, large dark green, with faint zone. Truss, medium size, short flower stalk. Florets, semi double bright orange scarlet. Values—freeness of bloom, 5; beauty, 10; for bedding, 9.

White Swan.—Plant 10 inches high, compact, short jointed. Foliage, large, pale green, without zone. Truss, small, on short flower stalk. Florets, double, pure white. Values—freeness of bloom, 8; beauty, 8; for bedding, 10.

In the following list is given a few of the choicest bedding varieties in the different colors; their relative heights, an item of importance when different varieties are bedded together, may be found by reference to the foregoing list: *Scarlet*—General Grant, J. J. Harrison, Alfred Tennyson, Alfred Mame, Prokop Daubec. *Crimson*—S. A. Nutt, Sam. Sloan. *Magenta crimson*—Adrien Corret. *Pink*—Madonna, Mons. de la Rue. *Salmon*—Mrs. E. G. Hill, John Good. *White*—La Favorite, White Swan. *Bronze-leaved*—Maréchal MeçMahon. *Silver-leaved*—Mad. Saleroi *Golden-leaved*—Crystal Palace Gem.

Forest Tree Plantations.

The plantations of forest trees set out at different times here during the past twenty years have now become well established. They are not only a great ornament to the place, but they afford our students excellent opportunity for study along some of the important lines of forestry. A brief account of the present condition of one or two of these plantations may be of interest.

The oldest block of trees was set out about sixteen years ago, and is three acres in extent. It consists of maple, ash, elm, oak, hickory, butternut, walnut, basswood, mountain ash, pine, spruce, and larch. These were planted eight feet apart, on land too gravelly and rough for general field cultivation. They were cultivated as well as possible until about three years ago, when the trees had become so large that further cultivation was unnecessary. Last winter each alternate tree was cut out to give those remaining room for proper development.

A similar plantation of four acres was set out seven years ago on a rich, newly broken piece of ground on a steep hillside. These trees have made a remarkably fine growth, and have already become so large that further cultivation is unnecessary.

These plantations illustrate nicely the way in which rough and comparatively worthless lands may, with but little labor, be made to produce a crop which, in the course of a few years, will be of considerable value. There are thousands of such waste places and hillsides throughout the country which might with advantage be so planted. They would then become year by year of more value to the owners, and more than that, the influence of these numerous growing forests upon the climate and water supply of the country would be a benefit to the country at large.

The subject of forestry in many of its phases, and particularly those of preserving the forests and reforesting waste areas, is receiving yearly more and more attention at the hands of the various governments. During the past year we have commenced

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Beauty.
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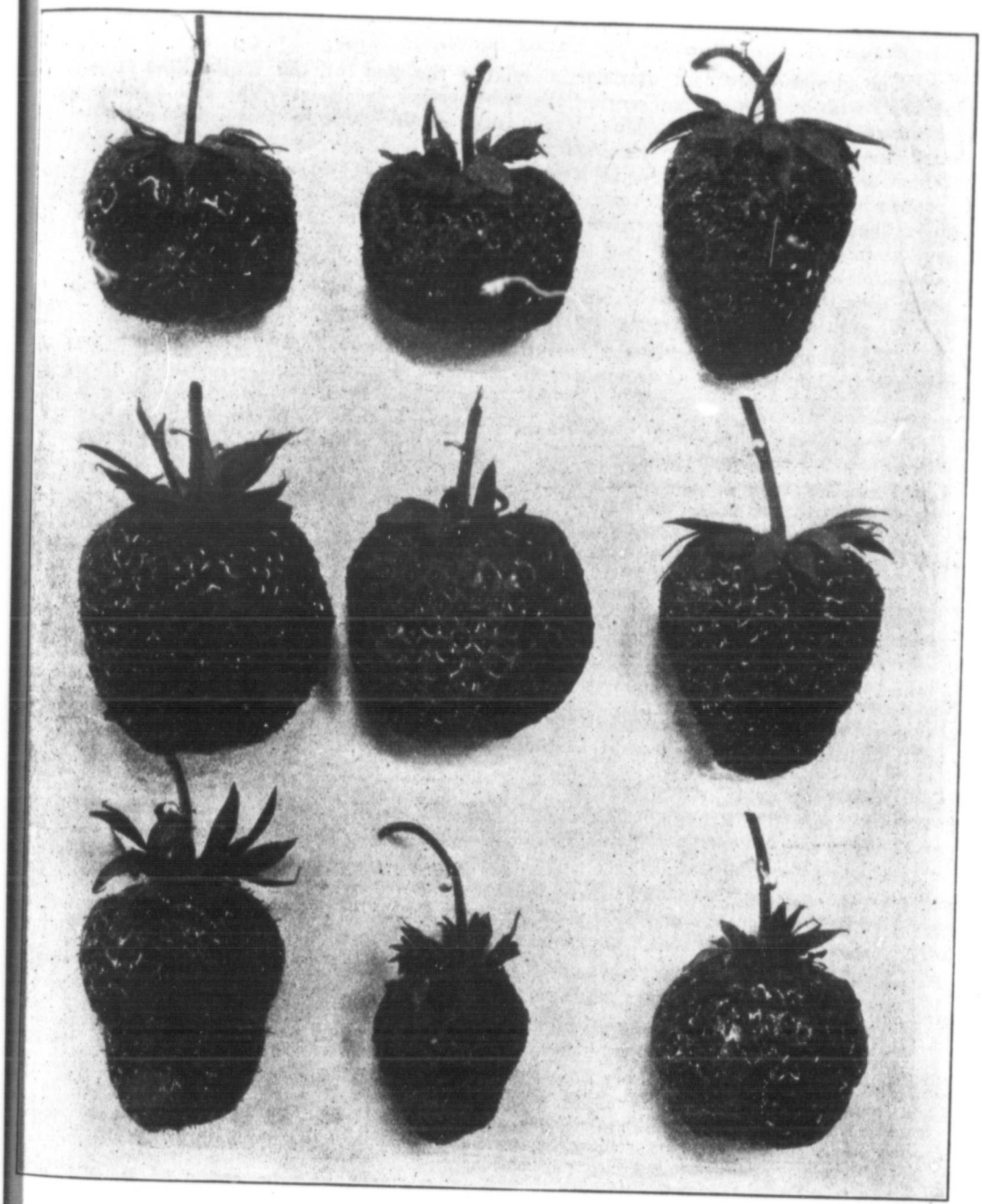


VAN DEMAN.
BEAUTY.
GERTRUDE.

SPLENDID.
BESSIE.
MICHEL'S EARLY.

ARROW.
RIO.
KOSSUTH.

two experiments along these lines—one at the request of the Clerk of Forestry for Ontario, and the other at the request of the Chief of the Division of Forestry of the Department of Agriculture for the United States.

The former experiment consists in mixing the seed of the White Pine (*Pinus strobus*) with buckwheat, and sowing the two together broadcast. The object being to ascertain the possibility of seeding large areas in this way to this valuable timber tree, the buckwheat being used as a "nurse crop" to shade the young pine seedlings, which are very susceptible to injury when exposed to the strong sunshine. Two pounds of the pine seed were mixed with a peck of buckwheat, and sown broadcast over about a quarter of an acre of ground. The land was prepared as for an ordinary grain crop, and the seed harrowed in after sowing. The results so far are not altogether satisfactory, as only a small percentage of the pine seed germinated. It may have been that the seed was too old, or that it had become too dry before sowing. At all events we hope to repeat the experiment another year.

The other experiment is a co-operative one, the nature and object of which may be best explained by giving a letter of the Acting Chief, Charles A. Keffer:

U. S. Department of Agriculture, Division of Forestry,
Washington, D.C., September 22nd, 1896.

Dear Sir,—Permit me to invite your co-operation in a simple experiment having for its object a study of the effect of locality on forest tree seedlings. As you are no doubt aware, there is a prevalent general idea that a species may grow successfully over a wide area when propagated from seeds taken within restricted limits, but that if seed grown in one part of its range be planted in a distant part the seedlings are less hardy than those of native origin.

It is desirable to know to what degree the leading economic species are thus affected by locality, and it is hoped from such a beginning other studies of equal practical bearing may be instituted.

It is proposed to gather, at each Station interested, a quantity of seed of each of the species named below. Each Station will keep a portion of each variety gathered, and send an equal quantity to all the co-operating Stations. The seeds are to be sown in nursery rows during the winter or early spring, and directions for the care, sowing and cultivation of seedlings will be sent from this office, in order that the conditions bearing upon these matters may be the same at all the Stations.

Records of growth, length of season, unusual influence (insect, fungus, meteorological, etc.) are to be kept. The following spring should show some results, and the experiment should be continued through five or more years, that the average climate may be represented.

The first year the species chosen, and the quantities to be planted at each Station, are as follows:

Negundo aceroides (Box-elder) ½ pint.
Juglans nigra (Black Walnut) 2 quarts.
Quercus macrocarpa (Bur Oak) 1 quart.
Fraxinus Americana (White Ash) ½ pint.
Fraxinus lanceolata (Green Ash) ½ pint.
Celtis occidentalis (Hackberry) ½ pint.
Gleditschia triacanthos (Honey Locust) ½ pint.

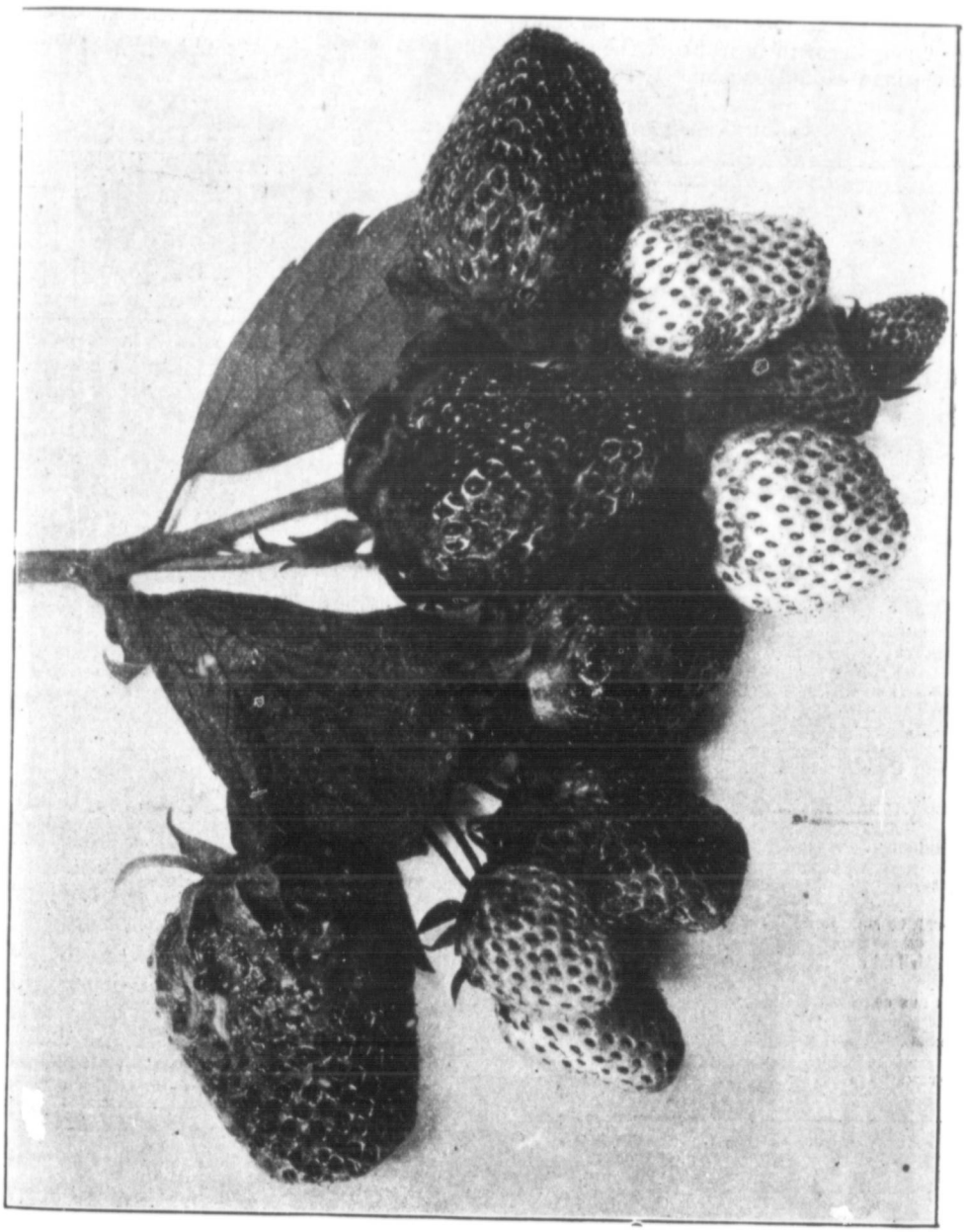
It is desirable that the following Stations should co-operate in this work, representing in general three north and south lines, and one east and west line. An East Appalachian line, consisting of the Stations in Vermont, Connecticut, New Jersey, Delaware, Maryland, Virginia, North Carolina, South Carolina, Georgia, Florida.

An East Mississippi Valley line, consisting of the Stations in Alabama, Tennessee, Kentucky, Ohio and Ontario.

A West Mississippi Valley line, consisting of the Stations in Texas, Oklahoma, Kansas, Nebraska, South Dakota and North Dakota.

An East and West line, including New Jersey, Pennsylvania, Ohio, Indiana, Illinois, Iowa, Missouri, Kansas, Nebraska, Colorado, Utah, Nevada, and California.

Respectfully,
Charles A. Keffer.



HAVERLAND.

The seeds of all of the species mentioned in the circular could not be obtained here, but those that could be obtained were gathered and sent to Washington for distribution to the other co-operating Stations.

The accompanying tabular statement shows the States from which we received seeds, the species received from each State, the amount of seed which germinated, and the average growth in inches of the seedlings the first year. As yet any very definite conclusions cannot be made.

GERMINATION AND GROWTH OF FOREST TREE SEEDLINGS.

States.	Box-elder.	White ash.	Green ash.	Black walnut.	Bur oak.	Honey locust.	Hackberry.
Alabama	.....	.....	.....	v. p.	.....	v. g.	.....
	.....	.....	.....	$8\frac{2}{5}$	.....	$5\frac{1}{5}$	.....
California	.....	.....	.....	v. p.	...	.....	.....
	.....	.....	.....	$8\frac{1}{5}$	.....	.....	.....
Colorado	v. p.	.....	g.	n.	.....	.....	.....
	$5\frac{4}{5}$	.....	$6\frac{4}{5}$	.....	.....	.....	.....
Connecticut	.....	v. p.	.....	.....	.....	.....	p.
	.....	3	.....	.....	.....	.....	$4\frac{2}{5}$
Illinois	v. g.	v. p.	v. p.	v. p.	n.	.....	.....
	$8\frac{4}{5}$	3	$6\frac{1}{5}$	2	.....	.....	.....
Iowa	g.	.....	.....	.....	.....	.....	m.
	$11\frac{3}{4}$	.....	.....	.....	.....	.....	$5\frac{1}{5}$
Kansas	m.	.....	p.	.....	.....	p.	v. p.
	$8\frac{1}{5}$	.....	$6\frac{4}{5}$	.....	.....	$4\frac{2}{5}$	$5\frac{1}{5}$
Kentucky	.....	p.	n.	v. p.	n.	m.	m.
	.....	$5\frac{2}{5}$	.....	$8\frac{2}{5}$	.....	$4\frac{2}{5}$	$5\frac{4}{5}$
Missouri	n.	...	.....	n.	.....	.....	...
	.....	.....	.....	.....	.....	.....	...
Nebraska	g.	.....	v. p.	.....	.....	.....	.....
	$8\frac{1}{2}$	.....	$5\frac{1}{5}$	.....	...	.....	...
North Carolina	.....	.....	.....	g.	.....	.....	...
	.....	.....	.....	$8\frac{2}{5}$	.....	.....	.....
Ohio	g.	.....	.....	n.	.....	p.	v. p.
	$8\frac{4}{5}$	.....	... ..	.....	.....	$3\frac{4}{5}$	$4\frac{1}{5}$
Oklohoma	v. p.	.....	.....	.....	.....	.....	v. p.
	7	.....	.....	.....	.....	.....	$3\frac{2}{5}$
Ontario	v. g.	v. p.	.....	g.	.....	v. g.	.....
	11	4	.....	$7\frac{2}{5}$	.....	$5\frac{2}{5}$	.. ..
South Carolina	.....	.....	.....	g.	... ..	.....	p.
	....	..	.....	$10\frac{4}{5}$	.....	.....	$3\frac{2}{5}$
South Dakota	p.	.....	v. g.	.....	.....	.....	.....
	$6\frac{2}{5}$	.....	6	.....	....	.....	.
Tennessee	.....	.....	... ..	v. p.	.....	.....	.....
	.....	.....	.....	10	.....	.....	.....
Texas	n.	....	v. p.	.....	.....	.....	v. p.
	.....	...	$4\frac{1}{5}$	.....	.....	.....	$3\frac{4}{5}$
Vermont	.....	.....	.....	.....	n.	....	....
	.....	.....	.....	.....	.....	...	.....

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

GREENHOUSES.

Great improvement has been made during the summer in the appearance of the interior of the greenhouses. All of the interior woodwork has been painted white, the ventilator shafting blue, and the walks gray. This gives the houses a clean, bright appearance, and affords better light for the growth of the plants.

FARM.

obtained here,
or distribution

ch we received
erminated, and
y very definite

Bur oak.	Honey locust.	Hackberry.
....	v. g. $5\frac{1}{5}$	.....
....	.....	.....
....	.....	.....
....	.....	.....
....	.....	.....
....	.....	p. $4\frac{2}{5}$
n.	.....	.....
....	.....	m. $5\frac{1}{5}$
....	.....	.....
....	p. $4\frac{2}{5}$	v. p. $5\frac{1}{5}$
n.	m. $4\frac{3}{5}$	m. $5\frac{1}{5}$
....	.....	.....
....	.....	.....
....	.....	.....
....	.....	.....
....	.....	.....
....	p. $3\frac{4}{5}$	v. p. $4\frac{1}{5}$
....	.....	v. p. $3\frac{2}{5}$
....	v. g. $5\frac{2}{5}$	.....
....	.....	p. $3\frac{2}{5}$
....	.....	.....
....	.....	.....
....	.....	.....
....	.....	v. p. $3\frac{4}{5}$
n.	.....	.....
....	.....	.....

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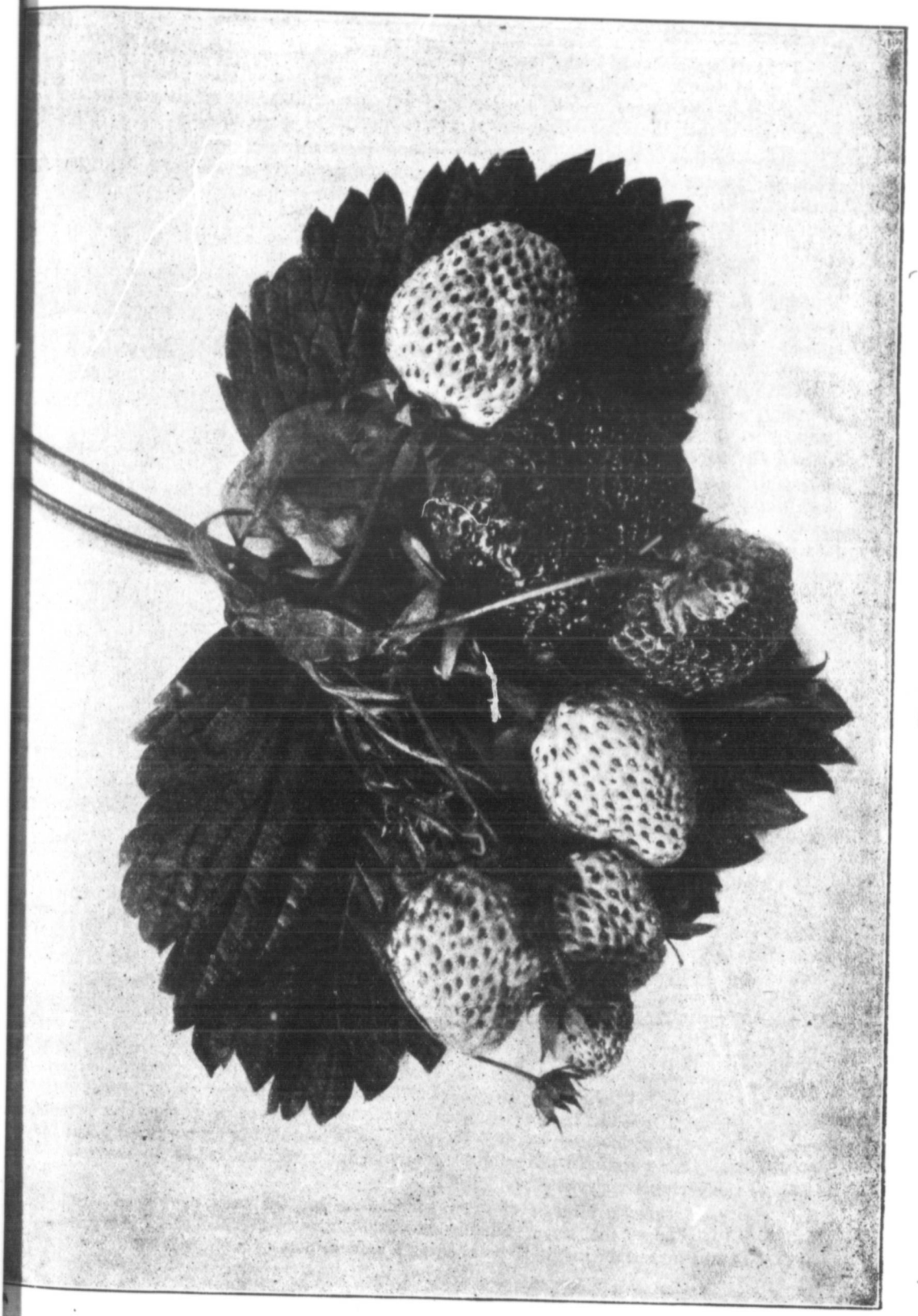


WOOLVERTON.

In the tropical house, where the constant heat and moisture so quickly rots the woodwork, all of the old decaying wooden stages were taken out and in their places were put up neat, light iron stages made of gas-pipe and angle-iron. These are not only neater and more durable than the wooden stages, but will in the end be much cheaper.

Our collection of plants has been improved and increased, until it is now one of the finest and most extensive in the country. It embraces about 220 species, and over 1,000 varieties. A complete list of the species and varieties was compiled last winter, with a view to having all of the plants re-labelled with celluloid labels.

Inspection of Fruit Experiment Stations.

One of the pleasant duties devolving upon me, as head of this department, is the inspection of the various Fruit Experiment Stations now established in different parts of the Province, under the joint control of the College and the Ontario Fruit Growers Association. As far as possible, each station was visited at the most opportune time for seeing the particular kind of fruit grown at that station. The visits were thus made at different times, from June to September, the greater number of the stations, however, being visited during September.

A full account of the inspection of these stations will be given in the Fruit Experiment Station report. I am pleased to state, however, that good work is being done, and that great progress has been made at each station. All are now fairly well stocked with the different varieties of the kind of fruit under test. In most cases this young stock is making good growth; and as it comes into bearing, some valuable results may be looked for in the reports of the experimenters.

Co-operative Fruit Testing.

For the past four years, we have been distributing, in connection with the Experimental Union, small collections of a few of the leading varieties of small fruits for co-operative testing. Some idea of the nature of the work may be obtained from the following list of varieties offered to those wishing to join in the work last spring:

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

Raspberries—Marlboro', Cuthbert, Shaffer's Colossal, and Golden Queen—six of each.

Black Raspberries—Souhegan, Greg, Palmer, and Hilborn—six of each.

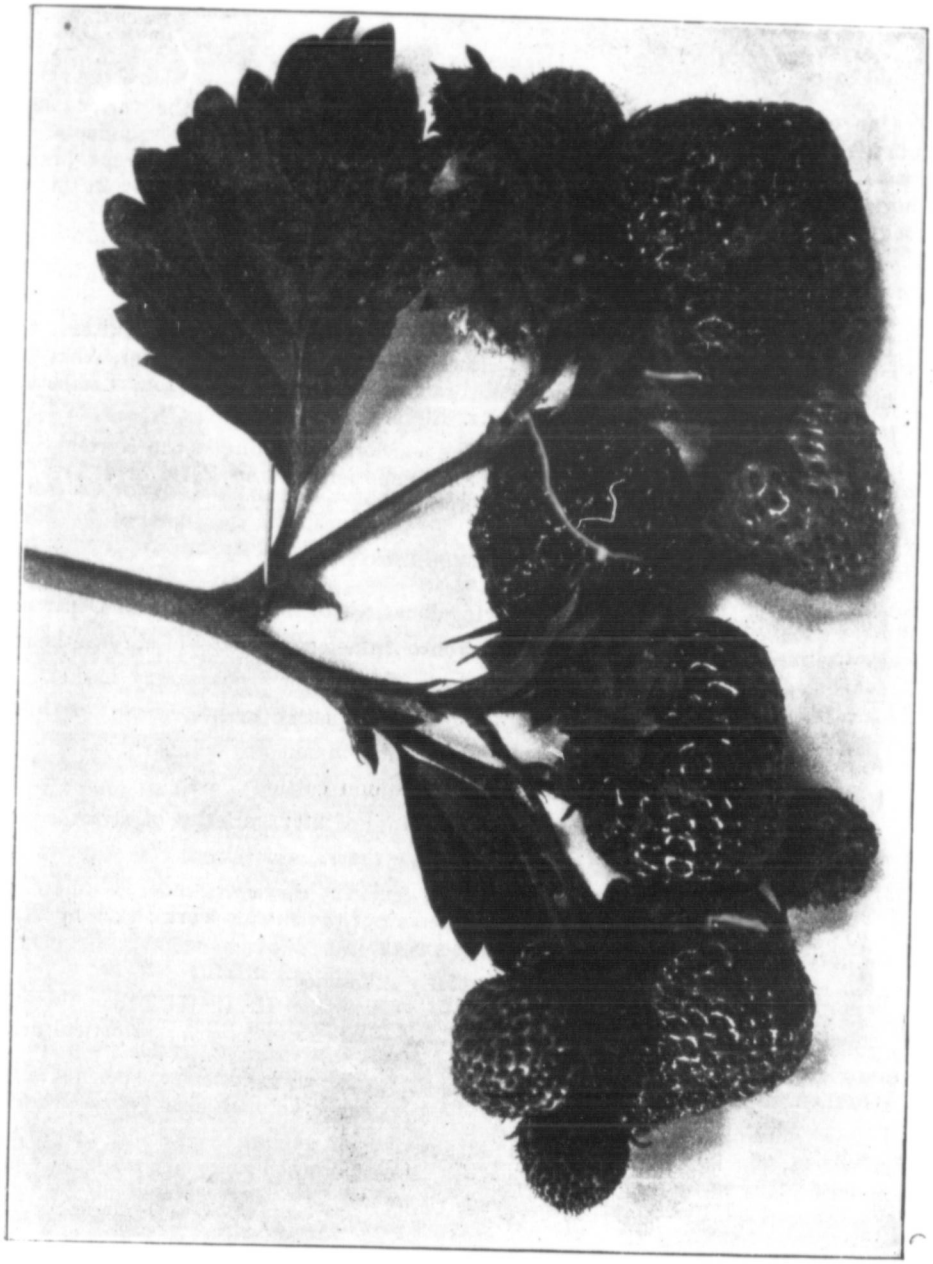
Blackberries—Kittatinny, Snyder, Taylor, and Gainor—six of each.

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

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

Each person wishing to join in the work was allowed to choose one of the experiments, and was expected to properly care for the plants, and report at the end of each season on the growth and yields obtained. The supply of plants being limited to fifty lots for the first experiment and twenty for each of the others, the plants were distributed, as far as they went, in the order in which the applications were received. The demand for plants has been increasing each year, and was this year nearly double the supply. It may be well to mention here that the plants for these experiments are not grown at the College, but that we have a small grant with which they are purchased and distributed from different nurseries, where they can be more conveniently and cheaply grown. It is evident, therefore, that the demand for plants cannot be met without an increased grant. In the past, the unsatisfactory character of the reports from the majority of experimenters has not warranted us in asking for an increased grant for this purpose, nor permitted our publishing any definite conclusions as to the relative value of the varieties under test.

This year a greater number of the reports show that the tests have been carefully made and it is hoped that some valuable conclusions may be reached. A fuller account of this may be looked for in the Experimental Union Report.



BUBACH.

One of the important features of this work is that the plants distributed are among the leading varieties, and those who receive them get a start whereby they may propagate and increase these for themselves. Then again, some get a start in growing small fruits on the farm, which they would not otherwise get if they had to purchase the plants for themselves.

Correspondence.

One of the ever-increasing duties devolving upon the heads of the various departments here is the attention required in answering the questions of correspondents. The increased number of letters received each year, bearing upon all the different branches of horticultural work, may be taken as an evidence of the increased interest in this work throughout the country.

Meetings Attended.

During the month of January, I delivered addresses on various horticultural topics at Farmers' Institute meetings at the following places: Brucefield, Exeter, Ailsa Craig, Parkhill, Arkona, Petrolia, Brigden, Mt. Bridges, Coldstream, Ilderton, Lambeth, St. Marys, Kintore, Embro, Norwich, and Mt. Elgin.

Three lectures were also given before the teachers in training at the Normal School, Toronto. Two of them on the "Nature and Functions of the Parts of a Tree," and the other on "Floriculture in the Home and School."

Acknowledgements.

I beg leave to acknowledge the following donations to the Horticultural Department:

E. Collins, Horticultural Gardens, Toronto: nineteen varieties of chrysanthemums.

E. C. Pierson, Waterloo, N. Y.: half dozen "Dominion" gooseberry bushes.

F. W. Porter, Mt. Forest, Ont. seedling red raspberry bushes.

A. Morton, Brampton, Ont.: roots of "Stoat's Mammoth" rhubarb.

R. Brooks, Fergus, Ont.: collection of geranium cuttings.

J. Craig, Experimental Farm, Ottawa: plants of fifty varieties of strawberries.

J. Terrill & Son, Picton, Ont.: two apple pickers.

I take pleasure, also, in mentioning the efficient services rendered this department by William Squirrel, gardener and foreman of the outside work; and by Arthur James, florist and foreman of the greenhouse work.

Respectfully submitted,

H. L. HUTT,
Horticulturist.

Ontario Agricultural College,
Guelph, Nov. 30th, 1897.

PART IX.

REPORT OF THE BACTERIOLOGIST.

To the President of the Ontario Agricultural College:

SIR,—I have the honor to submit to you my third annual report.

TEACHING. During the winter term, lectures and practical demonstrations in dairy bacteriology were given to the special dairy class. This course comprised lectures on the structure and form of bacteria; methods of study; bacterial contamination of milk and methods of prevention; disease-producing bacteria in milk; fermentation of milk; pasteurization; bacteria in butter and in cheese. No laboratory work was attempted with this class, except in pasteurization; but all the lectures were illustrated by diagrams, charts, and lantern slides.

The third year specialists in Agriculture and Dairying also had a course of lectures on dairy bacteriology during the winter term, accompanied by a fairly broad course in laboratory practice, including the bacteriological analysis of milk, butter and cheese; and the third year specialists in Biology and Horticulture received lectures on cryptogamic botany, with extensive laboratory work on the parasitic fungi,—their classification, mode of life, effect on the host-plant, natural and artificial infection, preventive and combative measures, symbiosis, and a systematic presentation of the pathogenic fungi and bacteria.

The third year also finished the work which they had begun the previous fall term on the structure of plant tissues and organs; and the second year started with lectures and laboratory work in practical botany. Some of this work was continued into the spring term.

During the present fall term nearly all the time has been taken up by lectures and laboratory work; two afternoons per week with specialists in Bacteriology, Biology and Horticulture; two with the third year students in Vegetable Histology; and the remainder of the time with the botany of the third year for general and special courses, which we have taken because of Professor Panton's illness; Mr. W. A. McCallum, Fellow in my department, having taken the Physiological Botany, and the remainder of the work having been done by myself.

Owing to the larger number of students in the third year, and also to the fact that the special courses offered in the circular are being taken by one or more students, the work of the coming term will be largely increased, and it will be impossible to carry on both class work and experimental work at the same time. Either is quite sufficient to engross one's whole attention; and when the attempt is made to divide up the available time between the two, one or the other is sure to be neglected.

LABORATORY WORK. In addition to the laboratory work with students, a considerable amount of special work has been done for farmers and others.

For instance: Seven samples of water were bacteriologically analysed, and the results reported to those sending them. Nine samples of milk or cream were also analysed.

Two of these were of cream that would not churn properly; three were of bad flavoured milk; and one was a sample of coloured milk, supposed to be due to a micro-organism. In the latter case, no colour-producing germ was found; but the presence of blood corpuscles was discovered in the sample. The other three samples were from milk variously affected with no specific troubles, but sent by persons who thought "something was wrong."

Other things sent for examination were fungi, foul-smelling cheese, diseased organs of animals, etc., etc.

Foul Brood. During the year, twenty-three samples of comb containing brood that was supposed to be diseased were sent to the laboratory for examination. Culture plates and microscopical examination were made and the results reported to those sending the samples.

The specimens received, came from California, Wisconsin, Minnesota, New York, Illinois, Pennsylvania, Virginia, Colorado, Ontario, New Brunswick, British Columbia and France.

In twenty-one cases, the Foul Brood germ (*Bacillus alvei*) was found, shewing the very wide distribution of this microbe. Other work in this line will be published in bulletin form at an early date.

Equipment. Owing to the large increase in the attendance of students, and the decision to manufacture tuberculin, it has been found necessary to make some alterations in our laboratory. The students' section has been enlarged by one hundred and forty-four square feet taken from the adjoining class-room, and a small room in connection with the experimental museum has been fitted up for incubators, sterilizers, and glassware; and, thanks to the liberality of the Minister of Agriculture, the equipment of the department has been considerably increased during the year. An electric Colt lantern, or stereopticon, for the projection of lantern slides on a screen, has been added; also four new Leitz microscopes, three expensive tables for the use of students, and a large amount of special apparatus for the manufacture of tuberculin.

Over 300 photographs were taken during the summer, finished in the laboratory, and lantern slides made from them. This involved a large amount of work, but it forms a nucleus of equipment which will be of much value for the illustration of lectures and the elucidation of many points which could not otherwise be made plain. We need twelve additional microscopes; and the demand for tuberculin is increasing so rapidly that it will be necessary to put in another incubator at once.

Meetings Attended. Farmers' Institutes were attended at Maberly, Balderson, Franktown, Easton's Corners, Toledo, Oxford Mills, Iroquois, North Williamsburg, and Hawkesbury. At these places, lectures were delivered from the following list of subjects:

"Bacterial Contamination of Milk," "Tuberculosis and the Tuberculin Test," "Pure Culture Starters for Butter," "The Bacteria of Leguminous Crops," "Water Supply of the Farm," "Practical Results of Bacteriology."

Also an address on "The Foul Brood of Bees," with a resumé of experiments performed during the year, was given before the Beekeepers' Association at Toronto.

Microscopic Botany. From April to October, Mr. W. A. McCallum's time was almost wholly taken up in the preparation of specimens for class-work in microscopic botany. During this time he collected and prepared material sufficient to last us for five or six years, and, as a consequence, we can now give a very thorough course of training in that branch of study.

Since the 1st of October, Mr. McCallum has assisted me in various kinds of laboratory work, and has rendered valuable service in the preparation of sections from the specimens mentioned above, for use in our daily class demonstrations. The following is a list of the different species prepared by Mr. McCallum, as stated in the first paragraph, from which sections have been made and will be made from time to time as required:

Stems.

Exogens:

Wild Cucumber, Echinocystis lobata.
Ivy, Hedera helix.
Euphorbia, Euphorbia splendens.
Dogbane, Apocynum cannabinum.
Loosestrife, Lysimachia thyrsiflora.
Egyptian Lotus, Nelumbo speciosum.
Cockle, Lychnis vespertina.
Cucumber, Cucurbita pepo.
Rhuburb, Rheum sp.
Sunflower, Helianthus annum.
Bean, Phaseolus sativum.
Nettle, Urtica gracilis.
Dodder, Cuscuta Gronovii.
Camphor, Cinnamomum Camphora.
Maple, Acer saccharinum.
Apple, Pyrus malus.
Elm, Ulmus Americana.
Pitcher Plant, Sarracenia purpurea.
Cherry, Prunus Pennsylvanica.
Wild Ginger, Asarum Canadense.
Bracted Bindweed, Calystegia sepuim.
Poplar, Populus tremuloides.
Pigweed, Amarantus retroflexus.
Viburnum, Viburnum sp.
Rubber Tree, Ficus elastica
Buckbean, Menyanthes trifoliata.
Grape Vine, Vitis vinifera.
Poppy, Bocconia sp.
Euphorbia, Euphorbia Cyparissias.
Milk Weed, Asclepias incarnata.
Water Milfoil, Myriophyllum verticillatum.
Bedstraw, Galium lanceolatum.
Buttercup, Ranunculus repens.
Primrose, Oenothera biennis.
Water Lily, Nuphar advena.

Pine, Pinus sylvestris.
Lamb's Quarters, Chelidonium album.
Horse-Chestnut, Aesculus hippocastanum.
Basswood, Tilia Americana.
Celandine, Chelidonium majus.
Moon-Seed Vine, Menispermum Canadense.
Bittersweet, Solanum Dulcamara
Birch, Betula papyracea.
Oleander, Nerium Oleandes.
Rose, Rosa rubiginosa.
Clematis, Clematis Virginiana.
Willow, Salix nigra.
Bindweed, Convolvulus arvensis.
Catalpa, Catalpa Bignonioides
Honeysuckle, Lonicera parviflora.
Broom-Rape, Epiphegus Virginiana.
Oak, Quercus alba.
Corn, Zea Mays.
Cordylina, Dracoena Cordylina.
Club Moss, Lycopodium Clavatum.
Moonwort, Botrychuim Virginica
Bracken Fern, Pteris aquilina.
Acorus, Acorus calamus.
Umbrella Plant, Cyperus alternafolia.
Solomon's Seal, Smilicina racemosa.
Banana, Musa Cavendeshii.
Date Palm, Phœnix Daetilifera.
Horse-Tail, Equisetum arvense.
Smilax, Smilax hispida.
Selaginella, Selaginella sp.
Flag, Iris versicolor
Yucca, Yucca sp.
Calla Lilly, Richardia Etheopia.
Trillium, Trillium erectum.

Roots.

Salsify, Scorgonera hispanica.
Chicory, Cichorium Intybus.
Buttercup, Ranunculus repens.
Agrimony, Agrimonia Eupatoria.
Buckbean, Menyanthes trifoliata.
Pea, Pisum sativum.
Waterleaf, Hydrophyllum Virginicum.
Spruce, Abies nigra.
Mustard, Brassica Sinapistrum.
Orchid, Vanda coerulea.

Bladder Campion, Silene inflata.
Acorus, Acorus calamus.
Willow Herb, Epilobium augustifolium.
Screw Pine, Pandanus Veitchii.
Cinque-Foil, Potentilla Canadensis.
Bindweed, Convolvulus arvensis.
Golden Rod, Solidago Canadensis.
Lamb's Quarters, Chenopodium album.
Philodendron, Philodendron sp.

Leaves.

Scotch Pine, Pinus sylvestris.
Arbor Vitæ, Thuja occidentalis.
Norway Spruce, Picea excelsa.
Yew, Taxus Canadensis.
Sedum, Sedum acre.
Rue, Ruta graveolens.
Camphor, Cinnamomum Camphora.
Sundew, Drosera rotundifolia.
Flag, Iris versicolor.
Holly, Ilex opaca.
Echineria, Echineria sp.

Oleander, Nerium Oleander.
Tradescantia, Tradescantia zebrina.
Mullein, Verbascum Thapsus.
Narcissus, Narcissus sp.
Beech, Fagus ferruginea.
Rhododendron, Rhododendron sp.
False Mitre Wort, Mitella nuda.
Pitcher Plant, Sarracenia purpurea.
Tropaelum, Tropaelum majus.
Andromeda, Andromeda palifalia.
Laurel, Kalmia glauca.

LEAVES.—*Continued.*

Blue-weed, Echium vulgare.
Bean, Phaseolus sativum.
Fig-Tree, Ficus carica.
White Pine, Pinus Strobus.
Hemlock-Spruce, Tsuga Canadensis.
Cedar, Cedrus deodaria.
Larch, Larix Americana.
Water-Lily, Nuphar advena.
St. John's Wort, Hypericum perforatum.
Rubber-Tree, Ficus elastica.
Egyptian Lotus, Nelumbo speciosum.
Vanilla, Vanilla aromatica.
Australian Flax, Phormium tenax.
Wheat, Triticum vulgare.
Sago palm, Cycas revoluta.
Labrador Tea, Ledum latifolium.
Cockle, Lychnis vespertina.
Willow, Salix nigra.
Cotyledon, Cotyledon glauca.
Pansy, Viola tricolor.
Carnation, Dianthus sp.
Gloxinia, Gloxinia sp.
Bladder Campion, Silene inflata.
Duckweed, Lemna sp.
Bearberry, Arctostaphylos Uva-urs.
Auricaria, Auricaria sp.
Olive-Tree, Olea Europaea.

FLOWER BUDS.

(*1.*) *Staminate, to illustrate the Structure of Young Stamens:*

Hemlock—Spruce, Tsuga Canadensis.
White Pine, Pinus Strobus.
Red Pine, Pinus resinosa.
Cycas, Cycas, revoluta.
Tiger Lily, Lilium sp.
Indian Cucumber Root, Madeola Virginiana.
Juniper, Juniperus communis.
Scotch Pine, Pinus sylvestris.
Black willow, Salix nigra.
Wild Lily, Lilium Canadensis.
Bermuda Lily, Lilium Harrisii.
Marsh Marigold, Caltha palustris.

(*2.*) *To illustrate the Structure of Ovules:*

Cypress, Retinospora plumosa.
Wild Lily, Lilium Canadensis.
Marsh-Marigold, Caltha palustris.
Mallow, Malva rotundifolia.
Dog-Toothed Violet, Erythronium Americanum.
Japan Quince, Pyrus Sidonica.
Yucca, Yucca sp.
Toothwort, Dentaria diphylla.
Spring Beauty, Claytonia Caroliniana.
Arbor Vitæ, Thuja occidentalis.
Poplar, Populus tremuloides.
White Pine, Pinus strobus.
Mandrake, Podophyllum peltatum.
Blood-Root, Sanguinaria Canadensis.
Willow-Herb, Epilobium augustifolium.
Dandelion, Taraxacum officinale.
Juniper, Juniperus Canadensis.
Calla Lily, Richardia Etheopia.
Pitcher Plant, Sarracenia purpurea.
Norway Spruce, Picea excelsa.
Bracted Bindweed, Calystegia sepium.
Purple Trillium, Trillium erectum.
Yellow Violet, Viola pubescens.
Neckweed, Veronica peregrina.
Zamia, Zamia sp.
Bermuda Lily, Lilium Harrisii.
Pine, Pinus austriaca.
Laurel, Kalmia glauca.
Strawberry, Fragaria vesca.
Bellwort, Uvularia grandiflora.
Barren Strawberry, Waldensteinia fragaroides.

GROWING POINTS OF SHOOTS.

Corn, Zea Mays.
Club Moss, Lycopodium clavatum.
Norway Spruce, Picea excelsa.
Artichoke, Helianthus tuberosus.
Bracken Fern, Pteris aquilina.
Loosestrife, Lysimachia thyrsiflora.
Ash-Leafed Maple, Negundo aceroides.

ROOT TIPS.

Pea, Pisum satinum.
Maple, Acer saccharinum.
Phelodendron, Philodendron sp
Corn, Zea Mays.
Bracken Fern, Pteris aquilina.
Acorus, Acorus calamus.

EMBRYOS.

Water Lily, Nuphar advena.
Flag, Iris versicolor.
Maple, Acer saccharinum
Cycas, Cycas revoluta.
Nigella, Nigella sp.
Corn, Zea Mays.
Wheat, Triticum vulgare

The Effect of Spraying Bordeaux Mixture on Foliage.

In Bulletin 86 of the Cornell Experiment Station, E. G. Lodeman makes the statement that the large number of applications of Bordeaux mixtures applied at that institution during the year 1894 seemed to have an influence upon the thickness of the foliage. "On October the 15th," he says, "leaves were taken from sprayed and unsprayed trees of three varieties of plum—*Fellemberg*, *Bradshaw* and *German Prune*,—five leaves from each lot, and in all cases from corresponding portions of the trees. In making the sections the material was uniformly cut from near the midrib, in the vicinity of the centre of the leaf, so that no error might creep in under this head. The average measurements were as follows:

Fellemberg— sprayed—10.6 micromillimetres } A gain of 1.9 per cent. from
" —unsprayed—10.4 " } spraying.

Bradshaw— sprayed—10.9 micromillimetres } A gain of 2.8 per cent. from
" —unsprayed—10.6 " } spraying.

German Prune— sprayed—12.9 micromillimetres } A gain of 10.2 per cent.
" —unsprayed—11.7 " } from spraying.

(A micromillimetre = .000039 of an inch.)

"The difference between the sprayed and unsprayed foliage, although slight in the first two cases, was, nevertheless, in favor of the sprayed foliage. This is plainly shown in the case of the German Prune. The particular cells of the plum leaves which were enlarged could not be determined with certainty, but the palisade cells appeared longer in the sprayed leaves."

These statements aroused my curiosity, and I suggested the matter to Mr. J. C. Macdonald, one of our third year students, as a line of investigation which he might pursue with interest and profit to himself and others. He commenced the work in January last, and the result of his investigation may be briefly stated as follows:

It is a well known fact among those who have sprayed with the Bordeaux mixture, that if the quantity of lime is not sufficient to neutralize the acid properties of the copper sulphate, the leaves to which it is applied will be scorched or burnt by the acid; hence, one of the objects of the experiment has been to determine the comparative effect of mixtures containing different quantities of lime.

Twelve seedlings, having an average height of twenty inches, were used for the experiment. They were potted and placed in the green houses in the first week in January, and forced into leaf. On February 10th, the first leaves had attained about half their normal size, and the first spraying was done.

The seedlings were paired as closely as possible, according to size and species; one of each pair was sprayed, and the other was left unsprayed as a check plant. The six pairs were divided into three lots of two pairs each for treatment with Bordeaux mixtures of different compositions.

Unsprayed Numbers.	*Sprayed Numbers.*		
1	2 (pear)	sprayed with	$4\frac{1}{2}$ lbs. copper sulphate. 2 lbs. lime. 40 gallons of water.
3	4 (pear)		
5	6 (peach)	sprayed with	$4\frac{1}{2}$ lbs. copper sulphate. 4 lbs. lime. 40 gallons water.
7	8 (quince)		
9	10 (pear)	sprayed with	$4\frac{1}{2}$ lbs. copper sulphate. $3\frac{1}{2}$ lbs. lime. 40 gallons water.
11	12 (pear)		

A small atomizer, such as is used for throat troubles, was used in order to ensure an even wetting of the surfaces of the leaves. Four successive applications were made on February the 10th, 16th, 23rd, and March 1st, respectively.

On March the 10th, specimens of leaves, corresponding in size, age, and position on the stem, was taken and put through the process of imbedding in paraffin, in order that sections of exactly the same thickness might be made of them. The plants were afterwards sprayed on March 16th, March 24th, and April 5th ; and leaves were again selected in the same manner and imbedded by the same methods.

Transverse sections across the central part of the leaf were cut out with a microtome: so that the sections were of the same thickness.

No noticeable changes were observed in the foliage of the plants, until the time of the fifth application, when numbers two and four, which had been treated with the mixture containing the small amount of lime, appeared somewhat crumpled, but did not turn black. A critical examination and comparison of all the plants after the last spraying, revealed a marked difference between the color of the sprayed and the unsprayed plants. Those treated with the excess-of-lime mixture were decidedly greener than the unsprayed ones, while those treated with the neutralized, or second, mixture also showed a deeper green, though not so marked as in the previous case. A microscopic examination of the leaves of Nos. two and four, which were treated with the unneutralized solution, failed to distinguish any gain in the amount of chlorophyll in the cells. So the experiment seems to prove that the increased greenness of the foliage was in direct ratio to the quantity of lime used, and an examination of sections of the leaves under the microscope bore out the observation made on the external appearance. The most noticeable feature was the increase in the number of chlorophyll granules, both in the palisade cells and in the spongy parenchyma of the sprayed leaves. Thus, the increase was in proportion to the amount of lime used. The drawing in figure B illustrates the gain of the leaves sprayed with the excess of lime, over the unsprayed leaves. The chlorophyll of the sprayed leaves was also a brighter green than that of the unsprayed.

In many places the treated leaves showed a third layer of palisade cells more or less continuous ; in the untreated leaves, nothing more than a few scattered palisade cells were seen in addition to the usual double layer.

Measurements of the thickness of the leaves were made by means of the micrometer, from six to twelve of each leaves having been taken. The results in averages were as follows :

No. 1 (plum) unsprayed, 141 micromillimetres..	}	Difference=4.2 mmms.
No. 2 " sprayed, 136.8 " ..	}	Loss from spraying=3 per cent.
No. 3 (pear), unsprayed, 177.6 " ..	}	Difference=4.2 mmms.
No. 4 " sprayed, 181.8 " ..	}	Gain from spraying=2.3 per cent.
No. 5 (peach), unsprayed, 123 " ..	}	Difference=9 mmms.
No. 6 " sprayed, 132 " ..	}	Gain from spraying=7.3 per cent.
No. 7 (quince), unsprayed, 169.3 " ..	}	Difference=1.1 mmms.
No. 8 " sprayed, 168.2 " ..	}	Loss from spraying=.6 per cent.
No. 9 (pear), unsprayed, 162.1 " ..	}	Difference=12.1 mmms.
No. 10 " sprayed, 174.2 " ..	}	Gain from spraying=7.5.
No. 11 " unsprayed, 168.2 " ..	}	Difference=18 mmms.
No. 12 " sprayed, 186.2 " ..	}	Gain from spraying=10.7 per cent.

It might be explained, that in the case of the quince, No. 7 was a much more vigorous plant than No. 8.

While the wide variations shown are somewhat unsatisfactory ; yet there is sufficient data to indicate a gain from spraying and an additional increase of thickness where an excess of lime was used.

Transverse sec
and comparative d
leaves.

Tra

Transverse sect
lbs. copper sulphate

Transverse sections of Pear leaves—A, unsprayed; B, sprayed—to show difference in width and comparative difference in the numbers of chlorophyl corpuscles in sprayed and unsprayed leaves.

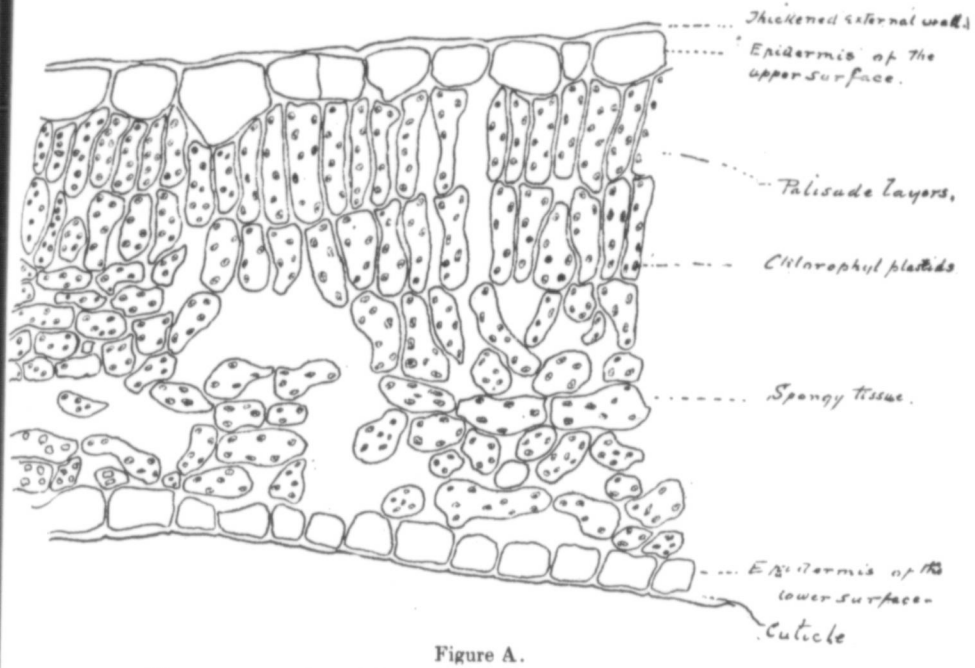


Figure A.

Transverse section of Pear leaf, enlarged 590 times. *Unsprayed.*

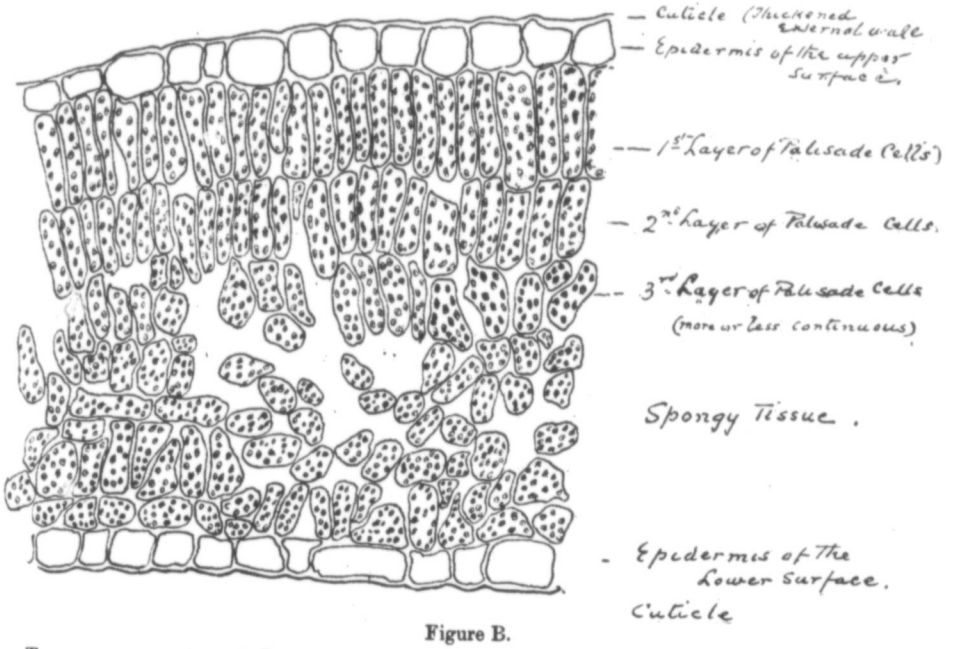


Figure B.

Transverse section of Pear leaf, enlarged 590 times. *Sprayed* with Bordeaux Mixture (4½ lbs. copper sulphate, 8 lbs. of lime and 45 galls. of water).

These experiments conducted in the greenhouses, where most of the conditions were under control, give perhaps more valuable results than if they had been carried on in the open air, as rain and other atmospheric disturbances which would affect the plants, were entirely avoided. A steady temperature; a regular supply of water, without washing the leaves; an even spraying of the leaves with an atomizer,—all went to secure uniformity of surrounding influences. On the other hand, the dews, which are deposited on outdoor plants, might have the effect of bringing into solution some of the compounds of the dried residue of the mixture adhering to the leaves.

The results, on the whole, confirm Lodeman's statements, that the increased thickness of the leaf resulted from spraying with Bordeaux mixture, and that the thickness was probably due to an increase in length of the palisade cells.

Lodeman's[1] measurements, however, are manifestly wrong, as the plum leaves examined by him are stated to be "from 10.4 to 12.9 micromillimetres in width, or about the same width as the length of a good-sized microbe." Leaves would be very flimsy structures if this were the case.

With regard to the increased greenness of the foliage, it is well known that calcium is specially abundant in the leaves of green plants,[2] and it is probable that some of the calcium of the lime in the Bordeaux mixture is absorbed by the leaves. Boussingault[3] found that if calcium sulphate be placed on the leaf of a plant it will disappear in a few hours, and sooner on the lower than the upper surface. Further, the effect of depriving plants of calcium as an ingredient of their food supply is well shown in all text-books on Physiological botany[4]. Hence, it is not improbable that the increased greenness in the leave sprayed with an excess-of-lime, is caused by the leaves absorbing an excess of calcium.

Conclusions.

Bordeaux mixture has an invigorating effect on leaves, as evidenced by the increased thickness and the marked development of chlorophyll granules in the cells.

This increased vigor is of much importance, as a strong healthy plant is always in a much better condition to withstand the attacks of fungus diseases than a weakly one.

Instances of losses from improperly made Bordeaux mixtures indicate that a lack of sufficient lime may result in injury. Crumbling of the leaf resulted in Nos. 2 and 4 from lack of sufficient lime.

An excess of lime gave better results than smaller amounts. The leaves seem able to take up some of the lime; and additional lime gives the foliage increased vigor. Hence it might be advisable to use larger amounts of lime than are generally used in the mixture.

The increased thickness of the leaf is probably due to the increased development of the palisade layers of cells.

References: 1. Lodeman, Cornell University Agricultural Experiment Station Bulletin 86, 1895; 2. Vines, Physiological Botany; 3. Boussingault, Ann. Chem. Et. Phys. Ser. V., Vol. 13; 4. Sachs, Physiological Botany; Johnson, How Plants Grow; Vines, Physiological Botany: Sorauer, Physiology for Gardeners.

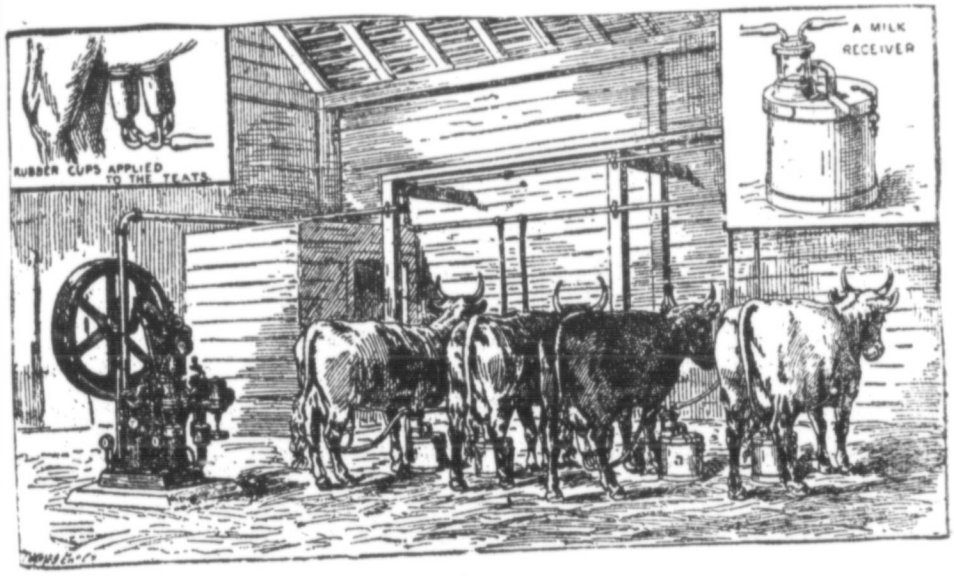
Machine-Drawn Milk *versus* Hand-Drawn Milk.—Some Bacteriological Considerations.

The Thistle milking machine was invented by Alexander Shiels, M.B. C.M., B.Sc., of Glasgow, and is now being manufactured in the same city by a company. The machine is a large air pump of special and peculiar construction. A suction pipe passes from the pump through the wall into the stable and overhead to the passage between the two rows of cows. From this main tube two smaller copper tubes are carried along on top of the stall divisions, one above the necks of each row of cows. At the side of each cow

re is an opening in this cross tube from which a short piece of smaller copper tube nts downwards, slanting toward the passage behind the cows. This smaller piece tube in each stall is controlled by a stop cock, and to it a rubber tube is attached en milking begins. This movable rubber tube extends down to a heavy, broad-ttomed tin pail on the floor, and another rubber tube connects the pail with the at-cups which are attached to the udder.

For milking each cow a pail and a set of teat-cups are used; and as it takes ss time to milk some cows than others, when a cow is milked, the man in charge uts the stop-cock, detaches the rubber tube, empties the pail into a large milk can anding close by, removes the apparatus (the rubber tube, pail and teat-cups) to another all, and places them in position to milk another cow.

As the milk pail is heavy, broad, and low, it is difficult to upset. The cover is oldered on and the milk enters through a strong glass bottle which is inserted like cork into the lid at one side, resembling a bottomless quart fruit jar, but only about alf the length. By observing the glass bottle, one can see how the milk is flowing rom the udder and know when to stop milking.



THISTLE MILKING MACHINE IN OPERATION.

Owing to the action of a reducing valve, which is used for the admission of air at regular intervals, the suction acts as a series of successive pulsations, resembling the action of the mouth of a calf in sucking, or the hand in milking, and varying in the proportion of fifteen to five. As the suction increases the teat cup contracts first at the top and then gradually downwards to the bottom, forcing the milk out of the teat; when it reaches the maximum of fifteen, air is admitted which reduces it to five, thereby partially releasing the teat and allowing it to fill with milk again. In this way the milking is done naturally, quickly, thoroughly, and without any annoyance to the cow. The machine operates more regularly than the hand.

The above is taken from a description given by Dr. Mills in 1895; and at the same time the President hazarded the opinion, "that it makes it next to impossible for any kind of dust or dirt to get into the milk during the progress of milking."

At a meeting of the Glasgow Dairymen's Association in 1895, a number of speakers expressed the opinion that the use of the machine guarded against all dirt, that the "machine milk" would be absolutely filth free, and that consequently little or no souring would occur.

So, to settle the question, I decided to investigate the matter by bacteriological methods; and I was very sanguine before I commenced the work, that the machine had struck a death blow to hand milking. The results of the following experiments, however, have conclusively proved otherwise.

During the investigation, a paragraph in *The Dairy World*, of London, England, was brought to my notice. It recorded the results of a milking machine competition for a prize of £50 offered by the Highland and Agricultural Society for the best machine. There were two entries. The Thistle Mechanical Milking Machine Co. entered two, and Mr. Murchland, of Kilmarnock, entered his machine.

With regard to the keeping qualities of the milk the judge reported as follows: "In every instance the samples of milk drawn by the Murchland milking machine were found to keep satisfactorily; after a lapse of forty-eight hours they were perfectly sweet, and in no respect inferior to the samples drawn by hand. The chief defect in the Thistle milking machine was the effect it had upon the keeping qualities of the milk. Most of the samples from it developed sourness in from twelve to fourteen hours, while samples drawn by hand from the same cows at the same time, and kept under precisely the same conditions, remained perfectly sweet for from thirty-six to fifty hours."

One of the Thistle milking machines, operated by steam power, has been in more or less constant use in our dairy stable at Guelph during the past summer.

So far as I am aware, no bacterial tests have hitherto been made of the milk from any of the machines mentioned; therefore, as opportunity presented itself, and as considerable importance is attached to the keeping qualities of milk, the subject was taken up in our laboratory and investigated at some length.

The questions that suggested themselves were as follows:

1. Is the milk from the Thistle milking machine more free from germs than milk drawn by hand?

2. What difference is there between the kinds of bacteria in machine milk and those in hand milk?

3. Is machine milk adapted for town or city supply? For butter-making? For cheese-making?

By arrangements made at the dairy stable, the machine milk was kept entirely separate from the hand milk, and samples were taken from the mixed milk of those cows milked by the machine and also from the mixed milk of those cows milked by hand. These samples were taken from the stable to the laboratory and bacteriologically analyzed, in order to ascertain the number, as well as the kinds, of germs present in the different samples. The morning's milk was never more than two hours old and the evening's milk never more than half an hour old when it was analyzed.

A large number of analyses of both machine and hand milk were made from April to August, and the results obtained are shown in the table as weekly averages. The number of analyses per week is stated in the adjoining column.

From a glance at the table, it can be seen at once that the machine milk has a far larger germ content than that milked in the usual manner; and, as it has been time and again proven, the number of germs in milk is dependent on its cleanliness—the more dirt, the larger the number of germs. Making a direct comparison between the number of germs in machine milk and the number of germs in hand milk, we note that the proportion varies greatly, from three to twenty times as many bacteria being found in the machine milk as in the hand milk.

There is considerable weekly variation, due partly to difference in feed, surroundings and temperature.

The large number of bacteria found in the machine milk may be attributed to three causes:

1. When the rubber teat-cups are fastened on the cow, a small portion of the hairy coat of the udder is included in the cup, and no matter how clean the animal is, germs are

to be present on this coat in considerable numbers, depending on the cleanness of the der.

These germs come chiefly from the bedding and dried manure, and in various ways d lodgment on the hairy coat of the animal. Experimental proof of this can be ily made. Take a single hair from an animal, lay it on some medium suitable for cterial growth, and a surprisingly large number of germs will develop from it. (See g. C). For further information on this point, see page 109 of the Ontario Agricultural llege Report for 1896.

When the suction of the machine is applied, the force exerted naturally draws y loose or dry particles that may be on the teats and that portion of the udder within e cups, down into the milk. In this way, the myriads of germs on these particles gain cess to the milk and find in it suitable conditions for their growth and multiplication. he infection from this cause might, we think, be in a large measure prevented by horoughly wiping the teats and udder with a well damped cloth or sponge immediately efore milking.

A hair from the udder of a cow. Figure C. A hair from the body of a cow.

In these illustrations, each white spot represents a colony of bacteria that has developed from a single germ. Each colony is made up of myriads of individuals.

NOTE.—The gelatine was *liquefied* along the hair, in right hand figure, showing the presence of putrefactive germs.

2. The teat-cups and the connecting tubes to the milk pail are made of rubber and consequently cannot be scalded or steamed, as scalding or steam would crack and spoil the rubber; hence it is impossible to cleanse them thoroughly from germ life. They may *look* clean after being rinsed in warm water and kept in cold water; but they are certainly not bacteriologically clean, *i. e.*, free from germs; and in the process of milking many of the germs on the inside of the rubber and in the crevices of the tubing are washed down into the milk. Conclusive evidence of this is afforded by the fact that, time and again, germs that were constantly present in the pure water in which the rubber tubing was kept between milkings, were also found in the milk.

3. In detaching the cups from one cow and putting them on another, attendants sometimes let them fall upon the floor of the stable, and in this way germ-loaded particles of dust and dirt get into the teat-cups, and find their way into the pail as soon as the milking of the next cow begins. Of course, this may be put down to carelessness on the part of the attendants; but, in our experience, no matter how carefully the transfer was made from one cow to another, instances of the cups falling occured from time

to time, and each time undoubtedly made a larger addition to the germ contents of the milk.

It will be seen from table below that the average number of germs per cubic centimetre in the morning's milk from the machine for sixteen weeks was 141,595, while the average in the hand milk for fourteen weeks was 10,619,—a result largely in favor of the hand-milk. The average for the evening's machine-milk was 165,033 and for the hand-milk, 12,890,—a result almost as much in favor of the hand-milk.

Quantitative analysis of milk drawn by the Thistle milking machine and milk drawn by hand :

Week ending.	Machine milk.				Hand milk.			
	No. of analyses.	Number of germs in cubic centimetre of morning's milk.	No. of analyses.	Number of germs in cubic centimetre of evening's milk.	No. of analyses.	Number of germs in cubic centimetres of morning's milk.	No. of analyses.	Number of germs in cubic centimetre of evening's milk.
April 10	4	71,124	4	89,204				
" 17	20	127,978	12	180,480	4	2,560	.....	.....
" 24	20	141,420	12	176,310	5	2,736	.....	.....
May 1	15	143,327	11	395,726	4	9,576	3	8,520
" 8	18	198,000	6	170,240	12	23,829	9	17,637
" 15	10	105,814	4	112,320	7	63,422	4	12,513
" 22	9	84,012	17	76,658	6	2,700	.....	.....
" 29	18	99,000	8	119,295	7	13,472	.....	.....
June 5	5	131,250	.....	.....	6	7,626	.....	.....
" 12	9	163,602	.....	.....	6	3,330	.....	.....
" 19	6	114,538	.....	.....	6	3,520	.....	.....
" 26	5	121,075	.....	.....	4	4,220	.....	All grass-fed
July 3	6	137,213	.....	.....	2	645	.....	after May
August 7	4	189,833	.....	.....	.....	.....	.....	the 29th.
" 14	6	146,767	.....	.....	5	10,124	.....	
" 21	6	190,830	.....	.....	4	906	.....	
Total	161	2,265,533	74	1,320,269	78	148,666	16	38,670
Average	.....	141,595	.....	165,033	.....	10,619	.....	12,890

Let us consider next the kinds of germs present in the milk. A considerable variety was found in the machine milk, over 25 species being separated by the usual bacteriological methods, and all grown in pure culture in sterilized milk. Their behaviour in this medium was as follows :

7 curdled the milk to a solid curd, with little or no whey separating from it.

7 curdled the milk with much whey separating, and finally digested all the curd to a whey-like fluid.

2 coloured the milk without further change.

7 made no apparent change.

3 changed the milk to a watery-like fluid, without coagulation of the casein.

12 of the above liquefied gelatine—a process nearly allied to putrefaction, and 14 were found to be non-liquefiers.

The germs in the hand-milk were generally speaking, of the same kinds as were found in the machine milk, but in the machine milk the putrefactive species (those that liquefy gelatine) were very much more numerous and varied.

Effect of the Germs Isolated from Machine Milk on the Flavor and other Qualities of Butter. By F. C. Harrison and M. N. Ross.

The germs isolated from the milk by the usual bacteriological methods were transferred to agarjelly, and when sufficient growth had developed a loopful was transferred to 100 cubic centimetres (about three and one-half ounces) of sterilized, germ-free milk. Another portion of the growth was placed in thirty-five cubic centimetres of sterilized milk, in order to study the changes that might occur in the milk after prolonged growth of the germ in it. The single species of microbe in the 100 cubic centimetres of sterilized milk (called a pure culture) was used as a starter and kept for twenty-four hours at a temperature ranging between 20-25° C. (68-77° F.), and at the end of the twenty-four hours this starter was added to one litre (about thirty-five ounces) of cream which had been previously pasteurized at 158° F. for twenty minutes on two successive days. In a few cases the starter was kept for a longer period than twenty-four hours, and in these cases the results were generally more pronounced.

The cream was ripened at a temperature between 20-25° C. (68-77° F.). The ripening continued for twenty to twenty-four hours, and the cream was then cooled and churned in a small tin, worked in an oil-test churn. This method was adverse to the production of a butter with a fine texture, as the rather rapid movement of the churn and the thinness of the tin in a warm atmosphere caused the cream to rise several degrees in temperature during the churning.

No control cream was used, because several different germs were put into each lot of cream, and the relative results were practically correct. A bacteriological examination of each lot of cream was made after pasteurization and before adding the starter, and this analysis revealed the fact that two spore-forming germs which were present on all occasions except two, but in such very small numbers that their presence did not interfere materially with the results, and from experimental churnings of cream made with starters seeded with these spore-forming germs, it was found that they made no appreciable difference in the results. It is also evident that the experimental germs introduced into the cream with the starter would be in such overwhelming majority that they would overcome completely the growth of the few germs present in the pasteurized cream.

In several cases, pasteurized cream kept for twenty-four hours without showing any increase of acid; one sample kept for seven days before becoming ripe enough to churn (six per cent. of acid.)

All the butter was washed twice, and this, no doubt, caused a loss of flavour in some samples which were adjudged "not bad" or "flavorless;" but it was desirabl to wash it, as part of the experiment was to ascertain the keeping qualities of the butter

One-half ounce of salt was added to the pound, as in the opinion of the judges the flavor of the butter was more definitely brought out by the use of at least a little salt. The butter was judged by Mr. W. J. Palmer, of the Kensington Dairy, Toronto, and Professor Dean, and a portion by T. C. Rogers, the College butter-maker, first when fresh and again when from three to four weeks old. The butter during this time was stored in the dairy refrigerator.

The judges' opinions differ somewhat, and of course it is difficult to eliminate altogether the personal equation, but they agree as to whether the flavor and aroma were desirable or not. Each judge also stated that every sample had a distinctly different flavor, not two lots having been described as alike by any judge.

Before discussing further results, it might be well, for the sake of clearness and explicitness, to explain the meaning we attach to the terms *acid*, *flavor* and *aroma*.

By *acid* we mean the decomposition of milk sugar into lactic acid, giving rise to what is termed the souring of milk. The one species of germ may develop both acid and a pleasant flavor; but the production of the flavor probably comes, not from the decomposition of the milk sugar, but from the decomposition of the fats or albuminoids

present in the cream. Another species of germ may develop acid and a bad flavo and this is proof that we have two kinds of decomposition taking place.

Flavor in butter is that quality which appeals to the sense of taste. It may developed, as stated above, by a germ that also produces acid, but a good flavor ma also be developed in cream by alkali-producing germs independent of acid production.

Aroma in butter is that quality which appeals to the sense of smell, and is especiall noticeable in freshly made butter. It is the most difficult quality to obtain and retain and it disappears as the butter ages. The fine quality of June butter is due largely t the aroma. Hence we say the aroma is very volatile, and probably is derived from th decomposition of the albuminoids.

Effect of the Germs. The effect of the germs on the butter was quite marked in mos cases, and was distinct and characteristic. In grouping them we find that,

4	germs	gave a flavor	which was	pronounced good.
4	"	"	"	passable.
7	"	"	"	neutral.
11	"	"	"	bad.

The "passable" flavour was present in the butter only while fresh; when kept for some time it went "off" in flavor.

The ripening temperature was found to have the greatest influence on the action of the germs; and no doubt different results would have been obtained if the cream had been ripened at other temperatures.

Acid Production. The most important and most noticeable difference was in the production of acid.

Sartori states that the most desirable amount of acid for the production of a good flavour is .6 to .7 per cent.; and his quantity has been found to give the best results in our college dairy. Of the germs tested,

18 gave .6 per cent. and upwards of acid.
7 gave less than 6 per cent of acid.
11 gave a neutral, or alkaline, reaction.

It should be borne in mind that the results apply only to the particular temperature and length of time at which the cream was ripened. Fleischman states that "to obtain ripeness in a longer or shorter time than eighteen to twenty-four hours has been shown to be risky, since under such conditions uniform ripeness can scarcely be expected to take place throughout the entire mass." With regard to this point, it is of interest to note that some cream that had been left for three days without stirring, tested 1.37 per cent. of acid at the bottom and only .67 per cent. at the top.

The amount of acid produced is shown to have a distinct effect on the amount of butter obtained from the cream; germs producing a larger amount of acid than others in the same amount of cream, invariably gave more butter. This fact supports Babcock's theory, that the ripening of the cream dissolves the fibrin present, and so permits the fat globules to collect more easily. When acid is not produced in sufficient quantity a large number of the fat globules are lost in the butter-milk.

Fleischman also remarks that, "If the liquid has not quite gained a sufficient degree of ripeness before churning, the result is that less butter is obtained; and if the degree of ripeness be exceeded, the nature and keeping quality of the butter will be injured."

Several of our experiments seem to indicate that with the same lot of cream, one portion having more acid in it than the other, the one with the greater acidity will churn slightly sooner than the other, but the time does not vary exactly in proportion to the difference of acid.

Flavor and Aroma. In several cases most noticeable differences existed between the flavor and aroma. For instance, the butter ripened with germ No. 9 had a most unpleasant flavor, but whilst fresh had a splendid aroma; that ripened with germ No. 26 also had a good aroma and an unpleasant flavor. Some germs when used singly produced little or no aroma, but when mixed together produced a decidedly pleasant aroma; this was true of germs Nos. 2 and 25. It seems possible that, in such cases, the substances resulting from the action of one germ is acted upon either by another germ or by the products of another germ.

Some of the mixtures furnished good examples of the power possessed by many of the desirable germs of neutralizing and, to some extent, overcoming the actions of others that give poor results; but in some cases the influence of the latter was stronger than that of the former, and in no case was the bad flavour entirely eliminated. A rather remarkable fact occurred in cases in which the cream before churning and the butter-milk had a strong unpleasant smell, which was not transferred to the butter.

The best butter was produced by a mixture of germs obtained from the milk of a neighboring farmer's cow. There were isolated from this milk three germs and a mould; and the latter had the power of coagulating milk in thirty hours. Hueppe's lactic acid germ was found, and the remaining two were acid producers.

Only one germ isolated from the machine milk produced gas in glucose bouillon; but No. 6 produced gas very plentifully in cream. A few germs were obtained which gave no acid reaction, but coagulated the starter. These belonged to the rennet producing class mentioned by Conn and others. The putrefactive germs, which curdled and then digested the precipitated casein, were also present; and, in a few cases, the action of these germs brought about a decided difference in the colour of the butter; for instance, No. 6 invariably produced a light coloured butter.

These experiments have shown that the number of undesirable germs in the "machine" milk far exceeds that of those which are desirable. Taking Conn's results as normal for hand milk and ordinary conditions we notice considerable difference.

Conn found 18 out of 68, or 26 per cent., to have injurious effects upon butter.

Harrison and Ross found 11 out of 26; 42 per cent.

Conn found 10 out of 68 to have beneficial effect; 29 per cent.

Harrison and Ross found 4 out of 26; 15 per cent.

Briefly, the germs isolated from the machine milk were 16 per cent. more injurious than those isolated by Conn (his conditions being taken as normal).

The only practicable method of overcoming these bad effects is by thorough pasteurization of the cream and the addition of a good starter, produced from pasteurized milk to which has been added either good buttermilk from an excellent flavored butter, or, failing this, a culture obtained from some recognized source and which is known to be good. There are now several of these on the market, and there is no doubt that their introduction has been productive of much good.

Tabulated Data of Species.

(Note.—All germs from machine milk unless otherwise specified.)

1. A motile bacillus; liquefies gelatine; curdles milk after four days; subsequently digests the curd. The starter made from it was not uniformly curdled, although shaken at the usual times. The cream was lumpy at the bottom and contained 78 per cent. of acid. The butter had no flavor and was slightly sour.

8. Actively motile bacillus; liquefies gelatine rapidly; gives off a smell of sulphuretted hydrogen; coagulates milk; subsequently digests the curd and coagulates the cream. Cream churned slowly. Butter was off flavor.

5. Actively motile bacillus; liquefies gelatine; turns milk watery whilst a few flakes appear on the surface. and thickens the cream. There was no curdling of cream. Butter was flat and flavorless, with rancid aroma.

(*Continued on page 140.*)

Tabulated data of butter made from cream inoculated

Germ added to steri ized milk to make starter.	Description of starter, the amount in every case being 100 c. c. (about 4 ozs.)	Per cent. of fat in the cream.	Acidity of raw cream.	Number of germs in pasteurized cream.	Range of temperature of cream during ripening.	Time taken in ripening the cream.	Acidity of cream when ripe.	Temperature of cream before churning.	Description of cream before churning.	Time occupied in churning.	Weight of granular butter.	Weight of worked butter.	Temperature of buttermilk.
					Centigrade.	hrs.		Centigrade.			grs.	grs.	Centigrade.
1	Thick sediment..	24	.41	80	18 to 26	24	.78	17	Thin but lumpy at the bottom.	20	310	275	18
8	Very much curdled, whey separated.	24	.33	80	18 to 21	24	.54	18	Cream smelt badly.	30	230	220	20
5	Not curdled, bad smell.	$23\frac{1}{10}$	.52	600	18 to 21	22	.81	17	Very thick	25	335	310	18
2	Unchanged.....	$23\frac{1}{10}$	.60	600	18 to 21	20	.49	17	No smell, no flavor.	35	210	200	19
3	Unchanged	$23\frac{1}{10}$	.54	600	18 to 21	22	.52	16	Cream lumpy...	30	220	205	19
4	Unchanged.....	$25\frac{2}{10}$	.33	480	20 to 24	24	1.56	16	Cream very thick and sour.	25	295	280	20
6	Unchanged.....	$25\frac{2}{10}$	.33	480	20 to 24	23	.03	16	Cream thin, contains gas bubbles.	25	200	190	20
7	Unchanged.....	$23\frac{4}{10}$	.49	260	20 to 24	22	1.25	17	Cream very thick and acid.	30	340	320	21
10	Unchanged.....	$23\frac{4}{10}$	.51	260	20 to 24	23	.49	21	A little thickened.	40	335	305	21
9	Unchanged.....	$23\frac{4}{10}$	.54	260	20 to 24	23	1.03	15	Very thick and acid, peculiar smell.	5	345	325	20
11	Unchanged.....	....	.41	400	20 to 35	22	.41	12	Bad smell, especially whilst churning.	50	225	215	18
12	Putrid smell.....	....	.26	400	19 to 26	20	.31	12	Bad smell	65	345	340	15
13	Unchanged	....	.26	400	19 to 26	22	.49	7	Exceedingly thick and lumpy.	65	265	250	13
14	Unchanged.....	....	.27	....	21 to 28	22	.60	12	Very thick and curdled.	40	265	230	15
15	Unchanged.....	....	.27	....	21 to 28	23	.91	13	So thick water had to be added before churning.	30	365	350	15
16	Very curdled, whey not separated.	....	.30	....	25 to 28	24	.39	15	No change	70	250	230	19
17	Unchanged.....	....	.31	....	22 to 28	24	.55	15	.....	40	325	265	20
18	Curdled	....	.51	....	22 to 28	24	1.03	12	.....	55	295	280	19
5 & 10	Unchanged.....	....	.51	....	22 to 28	24	.35	12	....	60	290	260	15
19	Unchanged...	....	.20	....	21 to 25	24	.49	12	Very sweet, like sugar.	30	375	350	15
19	Very bad smell, unchanged.	...	.22	20	15 to 21	48	.72	12	Coagulated, whey separated, bad smell.	80	210	190	20
2 & 24	Coagulated, 48 hours old.	....	.23	....	18 to 25	22	1.10	14	Thickened	20	340	300	16
29	Not coagulated ..	....	.28	....	18 to 25	20	.75	14	Thick, lumpy...	65	255	225	18
11, 24, & 2	Coagulated, 48 hours old.	....	.23	....	18 to 25	22	1.40	14	Thick, good condition.	30	270	250	16

with germs, isolated from machine-drawn milk.

Mr. T. C. Rogers' score.			Mr. W. J. Palmer's score.		Prof. Dean's score. Old butter.		
Flavor. Max. 45.	Color. Max. 15.	General description.	Fresh.	Four weeks old.	Flavor. Max. 45.	Color. Max. 15.	General description.
35	14	Not good	No butter flavor, slightly sour.	Rancid	....	....	All very rotten.
41	14	Mild	Off in flavor	Rancid, bad	....	....	All very rotten.
41	13	Poor flavor	Flat and flavorless, rancid aroma.	Cheesy	....	....	All very rotten.
32	14	....	Rich buttery flavor, mild.	....	....	....	All very rotten.
....	....	Butter soft	Quite cheesy	....	....	....	All very rotten.
32	12	Bread flavor	Peculiar medicinal flavor, aroma like choke cherries.	Rotten	....	....	All very rotten.
41	13	Mild, but sweet	Sweet but lacks flavor	....	....	....	All very rotten.
30	13	Undesirable	Slightly cheesy, strong bad smell.	Rancid, sour	....	....	All very rotten.
30	14	Not good	Slightly rancid	Rancid	....	....	All very rotten.
35	14	Bad flavor	Rancid and bitter, aroma good.	Rancid	....	....	All very rotten.
20	14	4 weeks old, rancid	Full butter flavor, good	....	36	11	Cheesy.
20	10	....	Very flat, no flavor	Flat, aged, kept very well.	38	13	Fair.
22	10	Cheesy, rancid	Off, rank	Cheesy, bad	38	12	Cheesy.
....	....	....	Rancid	Rank	25	10	Cheesy.
....	....	....	Off, very tasteless	Stinks	35	12	Tallowy.
....	....	....	Off, tasteless, aged	Cheesy	25	12	Very rotten.
35	....	4 weeks, no good	Dish-rag flavor	Bad, like Stilton cheese.	....	....	....
15	12	4 weeks, sour	Fine and mild but lacks flavor.	....	38	13	Poor.
....	....	....	No flavor, perfectly flat	....	37	12	Cheesy.
38	15	Not very aged	Flavor like roots, bad smell.	Bad	30	13	Very bad.
....	....	....	Flavor bad	....	35	12	No flavor.
....	....	....	Good but mild, no aroma.	....	35	11	Very cheesy.
....	....	....	Aroma good, poor flavor.	....	20	13	....
....	....	....	Good mild flavor, no aroma.	....	36	11	Cheesy.

Tabulated data of butter made from cream inoculated

Germ added to sterilized milk to make starter.	Description of starter, the amount in every case being 100 c. c. (about 4 ozs.).	Per cent of fat in the cream.	Acidity of raw cream.	Number of germs in pasteurized cream.	Range of temperature of cream during ripening.	Time taken in ripening the cream.	Acidity of cream when ripe.	Temperature of cream before churning.	Description of cream before churning.	Time occupied in churning.	Weight of granular butter.	Weight of worked butter.	Temperature of buttermilk.
					Centigrade.	hrs.		Centigrade.			grs.	grs.	Centigrade.
14	Unchanged in 12 hours.	....	.27	....	20 to 24	24	.30	15	Unchanged, smells of sulphuretted hydrogen.	40	275	260	17
15	Unchanged in 12 hours.	....	.27	....	20 to 24	24	.34	15	.....	35	240	225	18
3	Unchanged in 12 hours.	....	.27	....	20 to 24	24	.27	14	.....	30	230	225	17
4	Unchanged in 12 hours.	....	.27	....	20 to 28	20	.32	14	Cream too thick to run.	45	280	265	17
25	Very coagulated	....	.27	....	20 to 28	20	1.17	14	Cream thickened.	30	335	295	16
6	Unchanged	....	.27	....	20 to 28	20	.49	14	Bubbles of gas in cream.	50	300	275	17
26	Unchanged	....	.22	....	18 to 25	20	.54	14	Thickened	30	240	215	16
26	Unchanged	....	.20	....	16 to 20	20	1.16	15	Thickened	40	255	175	16
21	Unchanged	....	.37	80	26 to 26	20	.45	14	.....	30	190	175	18
22	Unchanged	....	.45	80	26 to 26	23	.45	14	.....	35	195	165	16
24	Very much coagulated.	....	.37	80	26 to 26	22	1.15	15	Very thick and acid.	30	245	230	18
Starter from dairy.	Pleasant smell	....	.45	200	25 to 26	24	1.53	13	Very thick	40	245	215	15
Cream left standing.	No starter used	....	.45	200	25 to 25	20	1.56	14	Very thick	30	250	215	16
6	Unchanged	....	.27	180	15 to 27	24	.27	16	.....	40	155	140	19
16	Casein partly digested.	....	.27	180	13 to 27	22	.29	16	Curdled	30	155	135	19
21	Unchanged	....	.28	10	15 to 21	48	.36	14	Bad smell in churn.	50	235	175	16
2 & 25	Coagulated	....	.28	10	15 to 21	48	.47	14	Very thick	35	285	260	16
20	Unchanged	....	.20	....	21 to 25	24	.49	10	Very thin	55	365	340	15
21	Unchanged	....	.32	80	24 to 25	24	.36	12	Sweet, smells like raw meat.	25	280	260	15
6	Unchanged	....	.32	80	25 to 25	24	.67	13	Bad smell	35	325	300	16
8 & 11	Unchanged	....	.13	140	23 to 25	22	.29	12	Unchanged	80	310	280	14
9 & 10	Bad smell	....	.13	140	23 to 25	24	.29	12	Objectionable smell.	30	330	320	15
21	Unchanged	....	.34	120	25 to 25	23	.40	13	Bad taste, not thickened.	25	325	300	16
23	Coagulated, whey separated.	....	.35	120	25 to 25	20	1.19	13	Very thick and acid.	35	375	340	15
2 & 25	Coagulated	....	.31	140	20 to 25	20	1.06	12	Very thick, rich flavor.	35	375	345	15
2 & 18 & 25	Coagulated	....	.31	140	20 to 25	20	1.12	13	Very thick	25	400	370	15

with germs, isolated from machine drawn milk.—*Concluded.*

Mr. T. C. Rogers' score.			Mr. W. J. Palmer's score.		Prof. Dean's score. Old butter.		
Flavor. Max. 45.	Color. Max. 15.	General description	Fresh.	Four weeks old.	Flavor. Max. 45.	Color. Max. 15.	General description.
			Off, woody		42	13	Fair butter flavor.
			Cowy		32	13	Bad.
			Fine clean flavor		35	13	Disagreeable.
			Full pronounced flavor		35	13	Bad.
			Flat and tallowy, no aroma.		40	13	Passable, not good.
			Fine full flavor		20	10	Old cheese aroma, sweet flavor.
			Aroma good, flavor unpleasant and bad.		40	13	
			Cheesy and sour		38	12	Poor.
			Flat, off	Strong buttermilk flavor.	30	10	Rancid.
			Flavor good but mild		37	12	Cheesy.
			Flavor and aroma cheesy.				
			Very good flavor, good aroma.		35	11	Fairly good.
			Flavor unpleasant		30	13	Bitter.
			Mild, no aroma		38	14	Fair.
			Flat	Distinctly cheesy.	32	13	Very poor.
			Flat	Cheesy	30	12	Tallowy.
			Fair				
			Rich but too mild	Rancid, acid	37	14	Not very bad.
			Flavor hardly discernible, no aroma.	Fine clear flavor.	32	14	Off.
25	13	Starter flavor	No aroma, flat	Off, slightly sweet	32	14	Bad.
35	14	Passably good		Cheesy	30	13	Cheesy.
25	13	Peculiar flavor	Bitter, bad	Rancid	10	10	Very rank.
			No flavor	Cheesy	32	14	Bad.
			Mild and pleasant	Old and rancid	32	13	Rancid.
			Too mild, aroma good	Rancid, slightly acid.	36	13	Bad.
30	14	Mild	Too mild, aroma good		30	13	Off

2. Sluggishly motile bacillus; liquefies gelatine; makes milk watery, and has an alkaline reaction. It produced less butter from same amount of cream than No. 5. Butter was of better quality and flavor.

3. Non-motile bacillus; liquefies gelatine; gives alkaline reaction but does not affect milk. Gave less butter than No. 5, and of a cheesy flavor.

6. Non-motile torula (a kind of yeast); does not liquefy gelatine; gives alkaline reaction, and produces gas in cream, but does not change milk. Loss of butter very marked (compare with No. 4, of same lot of cream). Butter had a yeasty flavor.

In the first experiment, an alkaline reaction was given; in the second, an acid; in the third, a neutral; in the fourth, all acid. The difference was evidently caused by the effect of the temperature at which the cream was ripened. At the lower temperature, no acid was formed; at the higher temperature, acid was formed. In each experiment, this germ produced less butter than other germs with the same cream. The butter had pleasant flavor when fresh, but a yeasty taste when aged.

4. Small motile bacillus; does not liquefy gelatine; does not change milk, but produces a yellow growth on the surface; gives the butter a very peculiar "medicinal" flavor and an aroma like choke-cherries.

7. Small non-motile bacillus; does not liquefy gelatine; gives a cheesy flavor and a bad aroma to butter.

10. Non-motile coccus; does not liquefy gelatine; does not change milk. Butter made from this germ seemed always to be of a much lighter color than the other lots of butter,—in one case it was almost white.

9. Large bacillus, actively motile; liquefies gelatine; changes milk to a watery fluid. The flavor of butter from this was distinctly rancid when a few days old. The aroma was uncommonly good, and from some unaccountable circumstance, in the first experiment with this germ, the cream churned in five minutes.

12. A non-motile bacillus; liquefies gelatine; produces no effect on milk, but gives a very bad smell to cream. The butter was flavorless.

11. An actively motile bacillus; does not liquefy gelatine; does not change milk; does not effect acidity of cream, but gives it a bad smell. The flavor of the butter was good.

13. A non-motile bacillus; liquefies gelatine; curdles and digests the casein of the milk. Butter had a rank flavor.

14. A non-motile bacillus; does not liquefy gelatine; does not change milk. The butter had a rancid flavor.

15. A non-motile bacillus; liquefies gelatine after eight or nine days; produces no acid, but causes the cream to become very thick. Butter had no noticeable flavor.

16. A non-motile coccus; liquefies gelatine; precipitates the casein of milk, leaving a clear whey. Butter was tasteless.

17. A non-motile bacillus; does not liquefy gelatine; gives a bad smell to milk. Butter had a bad flavor.

18. A motile bacillus; liquefies gelatine; curdles milk; digests the casein and gives off a putrid smell. The butter lacked flavor.

19. A motile bacillus; when grown on potatoes gives a strong mousey smell; does not liquify gelatine. Butter had a bad aroma and a root-like flavor.

20. A motile bacillus; liquefies gelatine; curdles and digests the casein of milk. Butter had a mild flavor.

21. A motile bacillus; a non-liquefier; curdles milk in four days. Butter was flavorless.

22. A motile coccus; found in pasteurized cream; a non-liquefier. The casein was gradually digested without coagulation. The butter was mild both in flavor and aroma.

23. A non-motile coccus; a non-liquefier; coagulates milk. Butter had a mild, pleasant flavor.

24. A mould—a species of Oidium—growing freely on the surface of the milk. This mould corresponds to the description of Oidium lactis, with the exception that the mould found in this case coagulates the milk and forms much acid. Butter was "cheesy" in aroma and flavor.

25. A non-motile bacillus (*Bacillus acidi latici* of *Hueppe*); coagulates milk. Butter had no aroma and was "flat" in taste.

Machine-Drawn Milk for Cheese-Making.

No bacteriological analyses were made of cheese from machine milk, consequently I cannot say for certain that the germs found in the milk were also in the cheese; but the evidence from a practical standpoint strongly pointed that way.

Two small cheeses were made from machine milk by Mr. Stratton at the college dairy on July the 26th, 1897. One vat contained aerated milk and the other contained unaerated milk. No starter was added; the curd was gassy; there was great loss of fat at salting (three pounds of fat lost in drippings); and the curd had a very bad flavor.

Both the cheeses were judged a month later by Mr. G. J. Brill, when the flavor was scored 20 and 26 respectively out of 35.

Summary and Conclusions *re* Machine-Drawn Milk *versus* Hand Milk.

Bacteriological experiments and practical observations conclusively prove that milk drawn by the Thistle milking machine contains a considerably greater number of germs than ordinary hand milk.

Machine milk sours much more quickly than hand milk, there being 10 to 30 hours difference in favor of the latter.

There are large numbers of undesirable bacteria (putrefactive germs, etc.) in machine milk. These deleterious forms destroy the keeping quality of the milk, spoil the flavor of the butter made therefrom, cause great loss of fat in the making of cheese, and produce bad flavor in the cheese.

The college butter maker, Mr. Rogers, was unable to make first-class butter from the milk; and Harrison and Ross's experiments show a large number of germs which produce bad flavor in butter.

As stated above, the infection of the milk arises from:

1. Germs on the hairy portion of the udder, drawn into the pail by the pulsation of the teat-cups, etc.

2. Inability to cleanse thoroughly the cups and rubber connections.

3. The occasional falling of cups upon the stable floor, and constant contamination from material full of germ life.

The infection under 1 and 3 may, we think, be largely prevented by due care on the part of milkers; and it is possible that the makers of the machine will devise some means of overcoming the difficulty about cleaning and disinfecting the udder cups and tubes.

Bad Flavor in Cheese caused by Undesirable Bacteria in Water used in Factory.

During the past two years, I have made a large number of analyses of Canadian Cheddar cheese, and one of the samples sent this year by Mr. Publow, instructor in cheese-making for Eastern Ontario, had very bad flavor. Mr. Publow writing to me on August the 1st, 1897, says: "I send you by this mail a sample of cheese from the Ashton Union factory. I find all their cheese has a bad flavor, and in testing the milk it all appeared to be of very good flavor. The cheese-maker is a good maker, and has his factory in first-class condition. Every thing is very clean, but the water he is using stinks, and I think is the cause of the bad flavor. I am having them send you a bottle of the water."

Later, I received more cheese together with Mr. Publow's report on the factory, which reads as follows:

"Factory visited on 31st July, 1897. The condition of the factory, milk vats, presses, sinks, and utensils, was clean and satisfactory. The making room's appearance

and condition were clean and tidy. The curing room's appearance and condition were clean and tidy. The drainage good. General appearance first class."

Report on the Cheese. "Number of cheese made each day, 10; flavor, not clean, off flavor; body, close and firm; texture, fine; color, bright and uniform; appearance and finish, neat, well finished. Remarks and recommendations: The cheese are all well made and have a fine appearance, but off flavor."

The water from the Ashton Union factory was received in a large Winchester bottle, in good condition, but it was not packed in ice, and as a considerable interval had elapsed between the collection of the sample and its examination, the number of bacteria present when collected must have undergone extensive multiplication; for example, Kruger* found that the bacteria in samples of water examined by him and kept for 20 hours ar 52° F. increased 5.3 times. This fact may account in part for the very large number of germs present in the sample sent from the Ashton factory, viz., an average of 271,000 per cubic centimetre.

There were five different species of germs present; each was grown in pure culture and sterilized milk was inoculated with each species.

The chemical analysis of the water showed that it was below second class and consequently should be regarded as suspicious.

The bacteriological analysis of the cheese was as follows:

Average total number of germs, 11,404,800 per gram (1/29 of an ounce); species present. 4; per centage of lactic acid germ present, 94; per centage of other germs present, 6.

The germs isolated from the milk and cheese were compared, and two of the species found in the water were discovered to be identical with two of the species in the cheese. One kind was, however, in such small numbers in the cheese that its presence was disregarded altogether; and the biological characters of the remaining germ were carefully studied, in order to be sure that the species found in the water and that found in the cheese were identical.

The biological characteristics of the germ were as follows:

Occurrence: In water and cheese from Ashton Union factory.

General character: Shape and arrangement, a bacillus, with rounded ends, occurs singly and in long threads; size, about four times as long as wide; mobility, very slowly motile; spore formation, none observed; relation to temperature, grows best at about 30° Centigrade, at 15° grows very slowly; relation to air, a facultative anaërobe, grows in hydrogen gas; relation to gelatin, does not liquefy gelatin; color, a dirty ochreous growth on potatoes; stain, stains readily with all the analine stains.

Gelatin: Stick culture, growth all along the track of the needle, does not spread on the surface of the gelatin, white growth not at all characteristic; plate culture, colony about the size of a large pin head, white and perfectly round, edge of the colony sharp and well defined with ⅔ objective, appears slightly granular and brown in color, edges entire.

Agar: Streak culture, moist, round, semi-transparent colonies appear on the surface of agar, these fuse together at the centre of the needle track, and appear as a moist, flat and semi-transparent growth. The growth is not sticky, but very moist.

Milk: Coagulated into a soft mushy curd, is rendered slightly acid, and gives off a bad odor; no whey separates.

Potato: A waxy, pale, ochreous color, abundant growth.

Smith tube: A little gas is produced in glucose bouillon, growth occurs in both arms of the tube, and a fine sediment settles at the bottom, leaving the media quite clear.

Bouillon: Bouillon slightly turbid, sediment present.

A starter made from a culture of this germ in milk (pasteurized for twenty minutes on two consecutive days) was used in a vat of milk for making cheese at the College

* Kruger-Leitschrift für Hygieni, vol. VII., page 90.

dairy on August the 13th. The following are the particulars of making, as reported by Mr. Stratton, the College cheesemaker :

Pounds milk	200.
Condition of milk	Normal, good.
Per cent. of fat in milk	3.2.
Amount coloring used	2 drachms.
Rennet test for ripeness	22 seconds.
Temperature set	88° F.—2° higher than usual.
Time set	11.55 a.m.
Amount of rennet used	3½ oz. per 1,000 lbs. of milk.
Time cut	12.28 p.m.
Minutes in curdling	33 minutes.
Temperature for cooking	98°.
Hot iron test when dipped	No acid ; acid in whey, .198%.
Time dipped	3 p.m.
Time from setting to dipping	3 hours 5 minutes.
Per cent. fat in whey	.35%.
Hot iron test when milled	No acid (per cent. acid, .333).
Time milled	5.10 p.m.
Time salted	6 a.m., August the 14th.
Hours from dipping to salting	15 hours.
Amount of salt used	2½ lbs. per 100 lbs. curd.
Temperature put in press	82° F.
Weight of green cheese	18.25 lbs.
Weight of cured cheese	17.0 lbs.

Milk was about three hours ripening from time of adding starter. The flavour was rank ; curd the same. Have had lots of curd with more gas, but this one was so harsh and stiff at 8.30 p.m. that I decided to leave it over night before salting. Left two pails of hot water in vat and covered well.

In the morning, water was at 96°, curd 83° ; more gassy than on the night before. Milled at 5.15 a.m. and aired until salted. It was so dry that no drippings would run from it after milling a second time. Squeezed enough from curd cloth for an alkaline test, which gave .765 per cent. of acid.

The cheese was allowed to ripen for two weeks and was then analyzed ; and the germ previously found in the cheese and water from the Ashton Union Factory was discovered in large numbers. The cheese had a bad flavour and was pronounced 'poor by two expert judges, Mr. T. C. Bell, of Tavistock, and Mr. G. J. Brill, of Guelph. Three and a-half months later the cheese was re-examined, and still found off in flavour ; and from a sample recently taken, I have again succeeded in isolating the original germ.

The results of the analysis of the water, etc., were briefly communicated to Mr. Publow, who condemned the well. The cheesemaker at once stopped using this water, and thereafter obtained what he required from another well.

In a letter dated August 30th, 1897, Mr. Publow writes : "The cheese is all right since they stopped using the water."

This completes the chain of evidence ; and from it cheesemakers and others will see the importance of using pure water.

The germs may have got into the cheese in two ways :—

1. From the setting of the vats. The rennet was, as usual, mixed with half-a-pailful or more of water and stirred into the milk.

2. Thorough infection of the vats by the contaminated water. Perhaps germs from the water used in washing found lodgment in the crevices and cracks of the vats, or even on the surface ; and, the momentary application of hot water or steam not being sufficient to destroy their life, they multiplied very rapidly when the milk was added. Further, it may be that the floors, etc., washed with the contaminated water dried, and microbes rising in the currents of air were carried about and brought into contact with the milk in the vats ; for germs are so small that very many find lodgment on the dust particles that we see when sunlight strikes through a semi-darkened room.

In this case, however, the infection was probably due chiefly to setting of the vats.

Another factor that should be mentioned was the high average temperature of the curing room, which was 72° F. This temperature gave more favorable conditions to the growth of the noxious germ, and less favorable conditions for the growth of those germs whose presence in cheese is necessary for the production of the finest flavour and quality. A temperature of 65° F. is more favorable to the latter.

Summary. The cheese from the Ashton Union Factory was said to be "off flavor" and "not clean," an abnormal condition arising from the presence in the cheese of a noxious germ. This harmful germ was found in the well water, and the water was used in setting the vats, thus innoculating the milk with the germ. In other words, the water acted as a starter.

Currents of air or dust arising from dry surfaces which were washed with the contaminated water may have contributed something towards the seeding of the cheese with the undesirable germ, but it is likely that the trouble arose chiefly from the use of the water in washing the vats and in setting.

The high average temperature of the curing room (72° F.) favoured the growth of the undesirable germ in the cheese.

A change in the water supply caused an immediate difference in the flavour of the cheese. Since the change there has been no trouble.

Hence we may repeat what has often been said, viz., that factory men should pay very close attention to the water supply in their factories, to see that it is clear, pure and good. Bad smelling water should never be used for setting vats. In all doubtful cases, the water should be boiled and then cooled to the required temperature.

Tuberculin.

On account of the new quarantine regulations between Canada and the United States, animals entering the latter country have to pass the tuberculin test. Hence, the Minister of Agriculture for Ontario decided that a supply of tuberculin for the Province should be manufactured by and sent out from this laboratory.

On the 7th of May of this year the first lot of tuberculin was sent out. At first the demand was small; but on the publication of a special bulletin by the Department of Agriculture on Tuberculosis, at the end of July, in which it is stated that "The tuberculin will be supplied free of cost to any cattle owners who desire it, by making application to the Agricultural College, Guelph; but only in limited quantity and for the sole purpose of testing their own herds, and under such regulations as the Minister may enact," many availed themselves of the opportunity, and up to the end of November we sent out 840 doses, worth $240, at 25 cents a dose, which is the retail price, charged by the Pasteur Vaccine Co., of Chicago.

All the tuberculin manufactured at the College has given good reactions, and the lymph has in all cases been clear and has remained so, even when diluted. I have examined tuberculin from other places; and in some cases, after adding 1 per cent. of carbolic acid to the concentrated extract, have found the lymph to be quite turbid.

On comparison with the German tuberculin, I have found our own manufacture to be equally good. No complaint has been raised as to its value; in fact, several veterinary surgeons who have used the lymph, have expressed their satisfaction with it. One wrote as follows: "It works well, as well as any I have ever used, and far better than the most of it."

The tuberculin has been sent out in homœpathic phials, holding from 6 to 18 doses of concentrated tuberculin. The phials are sealed, labelled and sent out with the following directions:

Directions for Use. The febrile reaction in tuberculous cattle following the subcutaneous injection of tuberculin, begins from four to ten hours after the injection.

reaches the maximum in twelve to twenty hours after the injection, and returns to normal eighteen to twenty-six hours after the injection.

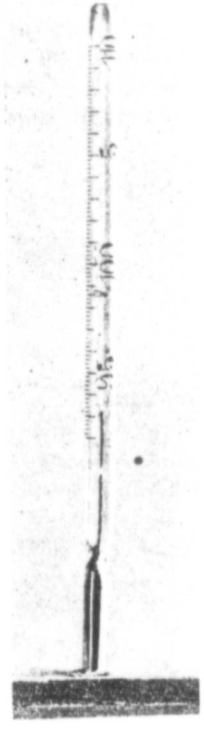
In conducting the test, the following course is recommended to those who wish to obtain the most accurate results :

1. Begin to take rectal temperature at 6 a.m. and take it every hour thereafter till midnight.

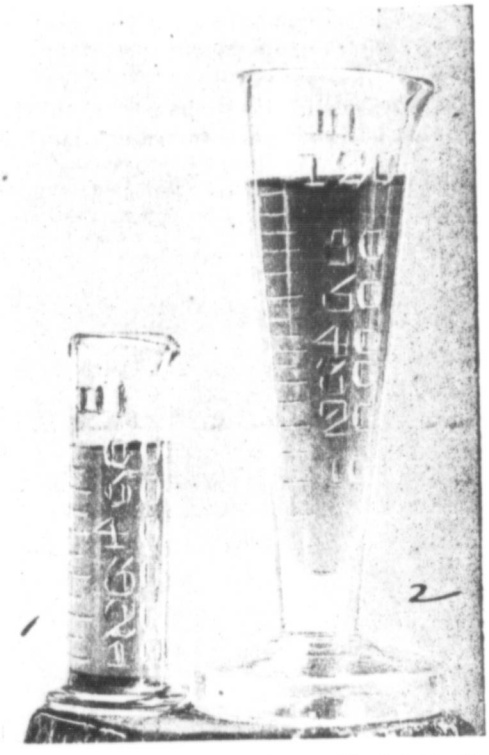
2. Make the injection at midnight.

3. Begin to take the temperature next morning at 6 a.m. and continue as on preceding day.

A.—Hypodermic Syringe with needle affixed. The syringe is standing on the piston, which is partially drawn out. To the right is an extra needle.



B.—Clinical Thermometer. The long marks are degrees; the short marks fifths of a degree.



C.—Two graduates, actual size. No. 1 holds 60 minims or drops; No. 2 holds 120 minims or drops.

To those who have large herds to examine, or who are unable to give the time required by the above directions, the following shortened course is recommended :

1. Begin to take the temperature at 8 a.m., and continue every two hours until 10 p.m. (Omitting at 8 p.m., if more convenient.)

2. Make the injection at 10 p.m.

3. Take the temperature next morning at 6 or 8 a.m., and every two hours thereafter until 6 or 8 p.m.

The amount to be injected into each adult animal is $\frac{1}{2}$ cubic centimetre (about 8 minims) of the tuberculin, diluted to 5 cubic centimetres (about 85 minims), with one per cent. carbolic acid. For yearlings and two-year olds, two-thirds of above dose; and for bulls and very large animals, one-third more than the usual dose.

The injection is made beneath the skin of the neck or shoulder; and in healthy animals, it is rarely followed by any constitutional or local disturbance, beyond, in some cases, a very slight rise in temperature. In diseased animals it is followed by a rise in temperature; in some cases, by trembling or uneasiness and fits of shivering. In diseased cows, there is sometimes a decrease in the secretion of milk or impaired appetite, and, rarely, a tendency in pregnant animals to abort.

A rise in temperature, on the day following the injection, of two or more degrees Fahrenheit above the maximum observed on the previous day, is regarded as an indication of tuberculosis. For any considerable rise less than this, a repetition of the injection after two or three weeks is desirable.

The tuberculin test is *not infallible*. In rare cases, the temperature may rise in the absence of any disease, or it may fail to rise when tuberculosis is present, but in the latter case diagnosis may often be made by clinical symptoms.

It is desirable to take note of the time of feeding and watering. During the test, animals should not be turned out, but fed and watered in the stable.

D.—How and where to inject the tuberculin.

Syringes should be *thoroughly sterilized* with five per cent. solution of carbolic acid immediately before use, and also the seat of injection with the same solution.

Accompanying these directions, is a schedule for recording the results of the test—one side of the schedule bearing the following headings:

No. of animal; breed; age; weight; amount injected; date and time of injection; temperature before injection (8, 10 a.m., 12 n., 2, 6, 10 p.m., 12 m; temperatures after injection (6, 7, 8, 9, 10, 11 a.m., 12 n., 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 p.m., 12 m.; local lesion;—with forty blank lines (sufficient for recording the results from forty head of cattle), while on the other side is printed a form with the following headings:

No. of animal; retropharyngeal glands; mesenteric glands; portal glands; liver; peritoneum; uterus; lungs; bronchial glands; posterior mediastinal glands; udder; pleura; glands of muscles; remarks; local congestion;—for use in those cases in which the animals are slaughtered.

A letter is also sent asking for an acknowledgment of the receipt of the tuberculin and stating the conditions on which it is sent free.

Applications are coming in very fast, and the prospects are that, as its use becomes better known, the demand will proportionately increase. Hence my request for another incubator.

We intend at an early date to send our tuberculin out either concentrated or diluted; and those applying should state whether they require the "concentrated," which possesses good keeping qualities, or the "diluted," which does not keep so well, but is ready for immediate use.

For full directions (including a description of the instruments used; where they can be obtained and their price; how to inject the tuberculin; directions for taking the temperature; reaction, etc., etc.) see special bulletin on "Tuberculosis in Cattle," published in July, 1897, by the Department of Agriculture, Toronto.

The following table is a summarized report of the results of the test sent in by those who have used our tuberculin:

Breed.	Number of healthy animals.	Number of diseased animals.
Shorthorn, pure bred	42	6
Shorthorn, grade	132	21
Jersey, pure bred	51	24
Jersey, grade	58	10
Ayrshire, pure bred	14	..
Ayrshire, grade	7	32
Holstein, pure bred	3	1
Holstein, grade	6	..
Hereford, pure bred	14	1
Sussex, pure bred	2	..
Common grade	173	65
Total	502	160

The bad record under some of the above heads, is due, not to a general prevalence of the disease among animals of that breed, but to certain herds which were very seriously infected.

Milk from Tuberculous Cows.

Carmichael, in 1810, wrote in an "Essay on the Nature of Scrofula, with Evidence of its Origin from Disorder of the Digestive Organs," that infants at the time of weaning are, from the change of diet, particularly subject to bowel complaints, too often followed by disease of the mesenteric and lymphatic glands.

Caspar, in 1822, also suggested the possibility of the transmission of the disease to man by means of milk from tuberculous animals. He says "that La Billardiere declares that the majority of the milch cows of Paris perish from nodular consumption, and that

their milk contains seven time more of phosphate of lime than common. Is it possible that there is a connection between this phenomenon and the many tuberculous diseases among the children of Paris? In the hospitals for foundlings and children the effects of scrofula can be seen in astonishing numbers."

In 1846, Klencke called attention to the fact that some cows' milk contained poison which produced scrofula in children, and asserted that there was a connection between the milk of scrofulous or tuberculous cows and the development of scrofula in bottle fed children. He also demonstrated that the scrofulous lesions which sometimes develop in the cow are the same as those found in the human subject.

Later investigators also pointed out the danger of tuberculous milk. Johne reports a case in which a post mortem examination of a cow revealed extensive tubercular deposits. The milk of this cow, on account of its supposed good condition, had been selected by the farm steward for his inrant son; but the boy, not being well was examined by his physician and reported as suffering from "emaciation and pulmonary catarrh"; and a short time afterwards he died of tuberculosis. There was no hereditary predisposition, and the other children in the family were perfectly healthy.

Hermsdorf, Leonhard, Demme, Sonntag, Meyerhoff, Stang, Schonger, and Uffelmann report other cases, which go to show the danger of using milk from tuberculous animals.

So, from the results of the investigations mentioned, and many others, it is evident that the milk of tuberculous cows is highly dangerous, but there are still some doubts as to the infectiousness of the milk of diseased cows when the udder is not directly affected by the disease,—that is, when there are no tubercular deposits in the udder.

Bang, Ernst, Woodhead, Bollinger and others, demonstrated the presence of the tuberculosis germ in milk of animals in which the udder was not diseased; but Martin and Nocard found that the milk was infected only when the disease was in the udder ieself. Theobald Smith, Ernst, Bang, May, Stein, and Hirschberger, on the contrary, have found that milk from tuberculous cows, even when not suffering irom disease of the udder, contained the bacillus tuberculosis. I shall state briefly the results of a few experiments which were made during the past year.

Case 1.—Large grade cow—tested with tuberculin. Highest normal temperature 106°F. Amount tuberculin used, $\frac{1}{2}$ C. C. Highest temperature after injection, 105°F. This animal, therefore gave no reaction; but, because of clinical symptoms, she was condemned and killed. The post mortem revealed general infection with tuberculosis. The udder appeared normal, and the tissue was found to be normal. Portions were taken, imbedded and sectioned, but the bacillus tuberculosis was not found.

Previous to the slaughter of the animal, a sample of milk from each quarter of the udder was centrifuged and two cubic centimetres (thirty-two drops) inoculated subcutaneously into each of two guinea pigs. These pigs died in eight and nine weeks afterwards with general tuberculosis.

The results of this experiment, therefore, show that the milk of this cow, though her udder was not affected, was infectious and contained the bacillus tuberculosis.

Case 2. Jersey, pure bred, tested with tuberculin: Highest normal temperature, 102° F. Quantity of tuberculin used, $\frac{1}{3}$ c.c. Highest temperature after injection 104.6° F. Reaction, 2.6°. Clinical examination did not reveal any lesions of the udder. Milk taken from each quarter of the udder was centrifuged and injected into each of two guinea pigs. The pigs were killed ten weeks after, and were found to have tuberculosis. This cow was not killed, and as she was not on the college farm I am unable to say what became of her.

The evidence in this case is not quite so positive as in case Case 1, inasmuch as the amount of disease present was not known, and the udder was not dissected or examind microscopically. The veterinary surgeon, however, reported that the cow shewed no external evidences of any tuberculous lesions of the udder.

The result shows that the milk of this cow was infective and contained the bacillus tuberculosis.

Case 3. Jersey cow, two year's old, tested with tuberculin: Highest normal temperature, 102.6° F. Quantity of tuberculin used, $\frac{1}{3}$ c.c. Highest temperature after injection, 105.2° F. Reaction, 2.6°. No evidence of any lesion of the udder. The cow was not killed, but 2 c. c. of her milk was centrifuged and inoculated into a guinea pig. The pig was killed at the end of ten weeks and the organs, etc., were found to be perfectly healthy.

The result of this experiment fails to show that the milk of this cow was infectious.

In these cases we note that, clinically, there was no evidence of lesions of the udder, and the one examined microscopically gave negative results. The one examined was suffering from general tuberculosis; but the conditions of the other two were unknown, except in so far as the tuberculin test indicated disease, and the milk was infectious in two out of three cases. It may be urged that the udder was diseased in Case 1, and that normal portions happened to be selected for microscopical examinations; but in reply I may say great care was taken in the examination of the udder; several small pieces were taken from different parts, and the germ was not found anywhere in the tissues.

It would no doubt have been better to have fed the milk to guinea pigs; but as the owners at once disposed of the cattle it was impossible to get a supply long enough to conduct experiments in this way.

Library.

The library is growing slowly, but as the appropriation granted barely enables us to keep pace with the ever increasing number of periodicals and books, no money is left to expend on complete sets of periodic literature.

In scientific subjects especially the reader meets with many references which he wishes to verify; and, on enquiry at the library, he finds that we do not possess the books referred to. Again, an investigator who decides to undertake work on a certain subject, cannot tell whether the experiment or experiments which he wishes to perform have already been made or not unless he has good library facilities.

In certain new departments of the institution this lack of contemporary literature is a crying want; and I trust that "the powers that be" will endeavor to remedy this lack, so far as may be possible. Complete sets of the *Journal of the Royal Agricultural Society*, *Journal of the Highland Agricultural Society*, and the *Journal of the Bath and West of England Agricultural Society* have been acquired as a first step towards obtaining the best periodic literature in agriculture. We should like very much to extend this list and obtain complete sets of all books and periodicals on the subjects covered by our extensive course of study.

In addition to the following, we would also record our appreciation of all other exchanges, notably those from the United States Department of Agriculture, the various State Experiment stations, and the publications of many of the Departments of Agriculture throughout the British colonies.

Religious papers: Presbyterian Review, Westminster, Congregationalist, Christian Guardian, Evangelical Churchman, Northern Messenger, Canadian Baptist, Choir Leader.

Weeklies: The Weekly Times (Melbourne, Victoria), Montreal Witness, Montreal Star, Acton Free Press, Weekly Sun.

Dairy: American Cheesemaker, Hoard's Dairyman, Chicage Produce, Dairy World (Chicago), Dairy World (London, England), The Dairy, Molkerei-Zeitung, Milch-Zeitung, La Laiterie, Holstein-Friesian Register, Creamery Gazette, Jersey Bulletin, Elgin Dairy Report, Jersey Downs.

Agricultural: Swine Breeders' Journal, American Swineherd, Farm Students' Review, Farm Journal, O. A. C. Review, Practical Farmer, Co-operative Farmer and Maritime Dairy, Journal of Agriculture, Farmers' Gazette, American Cultivator, Farmers' Home,

Livestock Report, American Agriculturist, American Horsebreeder, Country Gentleman, Wool Record, Farm Stock and Home, Skordemannen, North Western Agriculturist, Nor' West Farmer, American Sheep Breeder, Farmers' Review, American Fertilizer, Agricultural Gazette (New South Wales), Queensland Agricultural Journal, Connecticut Farmer, Prairie Farmer, Ohio Farmer, Western Rural, Nebraska Farmer, Wisconsin Agriculturist, Dakota Field and Farm, Oregon Agriculturist, Farm, Field and Fireside, Journal of the Jamaica Agricultural Society, Horseman, Canadian Entomologist, Canadian Bee Journal, Bulletin des Seances de la Societe Nationale d' Agriculture de France, Farming, Canadian Horticulturist.

Following are particular books added during the year (to the end of November):

Agriculture	84	Forestry	3
Apiculture	13	Geology	9
Bacteriology	27	Herd books	10
Biology	8	History	1
Biography	1	Horticulture	12
Botany	19	Literature (general)	16
Chemistry	15	Mathematics	1
Dairying	7	Reports	29
Economics	3	Session papers	4
Entomology	7	Travels	3
History	26		

Dictionaries: Two copies, "Standard," and two volumes, French-English.

Volume of Papers, etc., Bound During the Past Year.

Bulletins	61	Journal Pathology	2
Experimental Station Record	6	N. S. W. Gazette	5
Insect Life	4	Agricultural Journals	27
Botanical Gazette	9	Other papers	4
Cent. für Bakteriologie	16		

Total number of volumes added during year 427

Total number of volumes, exclusive of bound papers, etc. 300

The following papers are provided by the College for the use of the students in the reading room:

Daily Globe, Daily Mail and Empire, Guelph Daily Mercury, Guelph Daily Herald, Farmers' Advocate, Journal of Veterinary Archives, Gardening, American Gardening, Florists' Exchange, Review of Reviews, Scientific American, Nature, American Naturalist, and the Canadian Magazine.

The majority of Ontario farmers cannot attend our College, and for that reason it becomes our duty to assist them in every way possible, as we are endeavoring to do by our work at farmers' institutes, correspondence on various matters, and the preparation of bulletins and reports; and, with that object in view, I venture to submit brief notes on a few of the latest works on agriculture in one or other of its various branches or departments. This is done in the hope that some farmers may thereby be induced to read more widely and with greater advantage to themselves in the important work in which they are engaged.

I may add that we shall be pleased to recommend other simple works along such lines as stock raising, horticulture, floriculture, dairying, domestic economy, etc., if so desired.

"*The Fertility of the Land.*"—By I. P. Roberts. 415 pages, illustrated, price $1.00. Published by Macmillan & Co., New York.

This little work is the last published book of the Rural Science Series, edited by Professor L. H. Bailey of Cornell University. It sets forth Professor Roberts' philosophy of the means of maintaining the productivity of the land, and explains in a simple, clear and practical manner, the underlying reasons for the common things which the farmer does. It contains valuable chapters on the food required by plants; the development of the plow; the results of plowing; surface tillage; conservation of moisture; irrigation and drainage; farm manures—their care, preservation and application; commercial fertilizers; green manures; fallows and rotations. Every chapter is practical and up to date.

"*Heavy Horses; Breeds and Management.*"—By Biddell, Douglas and others. 219 pages, illustrated, price 3s. 6d., published by Vinton & Co., London, England.

The second edition of this work will be valued by all horse breeders. A description of each breed is written by its own specialist; and interesting details of the noted horses and of the foundation and history of the three breeds—Clydesdale, Shire and Suffolk—are given, together with chapters on the farm management of heavy horses, and the diseases and injuries to which these horses are subject. The book is illustrated by many full-page cuts and reproductions from photographs, well executed and printed on good paper.

"*Milk and its Products.*"—By H. H. Wing. 1897. 280 pages, illustrated, price $1.00. Published by Macmillan & Co., New York.

This forms another volume of the Rural Science Series, edited by Prof. L. H. Bailey, of Cornell University. The author's idea is to give to the dairymen, in simple, concise form, the principles underlying modern dairy practice. There are chapters on the secretion, composition, testing, ferments and fermentation of milk; the separation, ripening and churning of cream; the finishing and marketing of butter; milk for cheese; Cheddar cheesemaking; varieties of cheese; by-products of the dairy; butter and cheese factories, with an appendix of useful rules, tests and standards for dairy practice.

"*Soils and Crops of the Farm.*"—By G. E. Morrow and T. F. Hunt, 1895. 303 pages, illustrated, price $1.00. Published by Howard and Wilton Publishing Co., New York, U.S.A.

This volume has been recommended by the Pennsylvania Farmers' Reading Circle. Soils are treated as to their classification, composition, origin, uses, physical properties, improvement by manuring, drainage, irrigation, tillage and rotation of crops. Eighteen chapters are devoted to farm crops, especially the cereals, legumes and grasses. These are considered under the headings—history, production, uses, structure, composition, relations to climate, soils, manures, varieties, culture, harvest and diseases.

"*First Principles of Agriculture.*"—By E. B. Voorhees, 1896. 212 pages, price $1.00. Published by Silver, Burdett & Co., Boston, U.S.A.

The author in this work confines himself chiefly to two main subjects, viz., manures natural and artificial; the scientific feeding of stock.

A few chapters treat of soils, crops, principles of breeding, dairy products.

An appendix contains tables showing composition of fertilizers, fodders, feeds; also the co-efficients of digestibility of various feeding stuffs.

"*Economic Entomology.*"—By J. B. Smith. 1896. 481 pages, illustrated, price $2.00. Published by P. B. Lippincott Company, Philadelphia, U.S.A.

As the author states in his preface, he has tried to give an outline of the characteristics of insects generally; of those features that distinguish them from all other animals, and of those peculiarities upon which we must base our hope of conquering them. Part I., devoted to structure and classification, deals briefly with the various parts of the insect body, external and internal; with the digestive, circulatory, respiratory, nervous and reproductive systems, and finally with their growth and metamorphosis. Part II., comprising the bulk of the book, considers all the different orders in such a way that an intelligent reader may recognize at least the group to which an insect belongs and in most cases decide as to whether or not an injurious species is in hand. Part III., des-

cribes in a clear and concise manner the various insecticides, preventives and machinery now in general use. The author has kept in mind throughout his work, the direct needs of the agriculturist.

This book has been adopted as a text-book for our third year work in entomology.

"*Agriculture in some of its Relations with Chemistry.*"—By F. H. Storer, 1897. 3 volumes, price, $4.25. Published by Charles Scribner's Sons, New York, U.S.A.

This, the seventh edition of Storer's Agriculture should be welcomed by all agricultural students. The work has been revised and enlarged, and also put in a very neat and compact form.

"*The Book of the Dairy.*"—By W. Fleischman. Translated from the German by C. M. Aikman, 1896. 344 pages, illustrated, price $3.50. Published by Blackie and Son, London, England.

This work, although along the same line as Prof. Wing's "Milk and its Products," is more comprehensive, forming a very complete treatise on modern dairying in all its branches. For instance, in the chapter on the secretion, properties and composition of milk, the structure of the udder and teats is very fully described and illustrated, while the chemistry of the constituents of milk also receives some attention. Other chapters treat upon the extraction, immediate sale and testing of milk; milk in its relation to micro-organisms, dairying and bacteriology; the manufacture of butter; cheese and cheese making; preparation of keeping milk, fermented milk and the by-products of milk; and, lastly, the economic aspect of dairying.

"*Thomas Bates and the Kirklevington Shorthorns.*"—By C. P. Bates, 1897. 513 pages, illustrated, price $2.50. Published by Robert Redpath, Newcastle-upon-Tyne.

To breeders of Shorthorns or Durhams this work should be of great interest, containing, as it does, a complete history from 1400 to 1897 of this famous breed. The greater portion of the history is obtained from the papers and correspondence of the celebrated breeder, Thomas Bates of Kirklevington. Collings, Watson, Appleby and others receive their share of praise for the part which each took in the improvement of the shorthorn. The last chapter gives a full account of the dispersion of the Bates' herd, and of some of the great sales which took place during the last forty years, both in England and America.

The following list of books can be obtained in Ontario for the prices named, including postage:

First Principles of Agriculture, by E. B. Voorhees	$1 00
Soils and Crops of the Farm, by Morrow & Hunt	90
Economic Entomology, by J. B. Smith	2 25
Milk and Its Products, by H. H. Wing	90
Book of the Dairy, by Fleischman & Aikman	2 50
Heavy Horses; Breeds and Management, by Biddell, Douglas and others	90
Fertility of the Land, by Roberts	1 10
The Soil, by King	65

Respectfully submitted,

F. C. HARRISON,
Bacteriologist.

ONTARIO AGRICULTURAL COLLEGE,
GUELPH, December 1st, 1897.

PART X.

REPORT OF THE EXPERIMENTALIST.

To the President of the Ontario Agricultural College:

SIR,—I have the honor of herewith submitting for your consideration the report of the Experimental Department for the year 1897.

The work of this department during the part season has been very satisfactory. We submit the results of the various experiments with much confidence in their reliability and in their real practical value. That they will be appreciated by the farmers of Ontario, we have good reason to believe. While personally conducting about twelve thousand farmers through our experimental grounds the past summer, I do not remember hearing a complaint from any one of them regarding our experiments. We have tried to do good work, and we sincerely hope that the results will do good to others.

THE WEATHER. During the summer of 1897, the weather was most favorable to our field experiments. The lowest and the highest temperatures, and the total amount of rainfall for each month from May to October inclusive, will be found in the following table.

Months.	Minimum Temperatures.	Maximum Temperatures.	Total amount of Rainfall.
May	31.2 degrees	75.8 degrees	1.58 inches
June	34.5 "	82.0 "	1.96 "
July	49.4 "	93.2 "	4.80 "
August	40.4 "	84.0 "	3.43 "
September	28.0 "	90.0 "	.41 "
October	26.2 "	84.0 "	2.09 "

It will be seen from the foregoing table that there were only three months in the summer in which the thermometer did not reach the freezing point, namely the months of

June, July and August. In five of the six months above mentioned, the temperatures reached over 80 degrees above zero, the month of July showing the highest record, namely, 93.2 degrees. There were 14.27 inches of rainfall during the six months here reported. It will be noticed that the rainfall during the months of July and August was very heavy, as more than 50 per cent of the whole amount for the half year came during those two months. September shows a very light rainfall, there being less than ½ inch on the level for the thirty days. These records were made in connection with the experimental department.

Experimental Grounds. The experimental grounds consist of about fifty acres located at the rear of the main college building. The soil in these grounds may be called an average clay loam. The plots vary in size from 1/8 to 1/160 of an acre, and the majority of them are uniform in size and shape, being ten links wide by one hundred links long, thus forming an area of 1/100 of an acre. The plots which number upwards of two thousand are separated by paths and roads, there being upwards of five miles of roads in these grounds.

About one-third of the whole number of plots used for experiments in 1897 were devoted to grain tests. These included experiments with varieties, dates of seeding, methods of cultivation, selection of seed, application of fertilizers, etc. In all instances, the grain plots were of a rectangular form and a stake was driven at each of the four corners of every plot. In most instances the grain was sown broadcast. A line was drawn around the separate plots, and the packages of grain, which had been previously weighed out were sown upon their respective plots inside the enclosure made by the line. After the crops reached the height of about two inches, a line was again placed around each plot, and the plants outside the plot limits were destroyed, thus the areas devoted to the different crops were made exactly uniform.

All necessary notes regarding the various characteristics presented by the different crops from time to time were taken throughout the entire season. Cutting was done with the cradle when each crop reached its proper stage of maturity. In order to have the results exactly uniform, nearly all the plots were cut by one person. As soon as the grain became sufficiently dry, it was hauled to the experimental barn in a wagon with a tight rack made specially for the purpose. The whole crop was immediately weighed and thrashed, great care being taken that no grain was lost and that no mixing occurred.

In order to find out the best kinds of grain for cultivation in Ontario, all the varieties obtainable throughout the Dominion of Canada have been secured, and also the leading ones from France, Germany, Italy, Sweden, Russia, England, Switzerland, Scotland, Hungary, Greece, Austria, Egypt, Japan, New Zealand, Australia, and the United States The most of these varieties have been carefully tested in the experimental department for several years in succession. All varieties are grown for a period of at least five years, unless they show themselves quite inferior within a shorter time. The ones which give the most satisfactory results are continued for a much longer period. We are pleased to state that we have been successful in obtaining a few very excellent foreign varieties which have given better all around results than the best varieties which we have secured in Ontario. These leading varieties will be referred to when considering the results of the various experiments here presented.

Barley.

Test of varieties. In 1897, forty-six varieties of barley were grown in the experimental department. Of this number, fifteen were six-rowed, and nineteen two-rowed ; and twelve were hulless varieties. Some of the varieties have been grown for nine, some for eight, some for seven and some for six years in succession, while the others have been grown for five years or less. The barley was all sown broadcast at the rate of one hundred pounds of seed per acre on plots exactly 1-100 of an acre in size. Equal amounts were sown on the different plots, and the seeding took place on the 28th of April

for the present year. The soil was comparatively new, this being the third crop taken from the land. No manure or fertilizers of any kind were applied to any of the crops.

Varieties.	No. of rows per head.	Results for 1897.			Average results for number of years grown.		
		Weight per measured bushel.	Yield per acre.		Weight per measured bushel.	Yield per acre.	
			Straw.	Grain.		Straw.	Grain.
Grown for nine years.		lb.	tons.	bus.	lb.	tons.	bus.
1. Mandscheuri	6	50.13	1.11	42.13	50.65	1.79	**63.61**
2. Oderbrucker	6	51.31	1.08	41.38	53.27	1.60	**55.92**
3. Scotch Improved	6	51.81	1.07	38.67	52.01	1.47	**53.65**
4. French Chevalier	2	50.81	1.59	33.90	52.12	1.89	**53.58**
5. Common Six-Rowed	6	50.75	1.17	43.92	52.37	1.40	**52.27**
6. Empress	2	48.75	1.32	28.46	52.15	1.68	**51.91**
7. Two-Rowed Italian	2	50.00	1.56	25.75	52.68	1.90	**47.40**
8. Kinna Kulla	2	50.25	1.14	31.54	51.71	1.62	**46.86**
Grown for eight years.							
9. New Zealand Chevalier	2	49.19	1.57	34.60	52.45	1.95	**53.07**
10. Early Minting	2	49.81	1.57	39.65	52.29	1.82	**51.13**
11. Mensury	6	50.00	1.20	37.60	51.48	1.36	**50.93**
12. Cape	6	44.13	1.03	36.46	46.91	1.35	**50.76**
13. Australian	2	50.94	1.37	33.46	52.89	1.74	**48.97**
14. Italian	2	49.69	1.32	39.98	53.51	1.71	**45.93**
Grown for seven years.							
15. California Brewing	6	45.63	1.21	41.44	46.22	1.44	**56.55**
16. Imperial Six-Rowed	6	49.00	.95	32.39	51.83	1.42	**56.48**
17. Six-Rowed Baxter's Improved	6	48.56	1.23	36.13	51.71	1.49	**51.53**
18. California Chevalier	2	50.50	1.67	42.88	52.04	1.96	**51.45**
19. Highland Chief	2	49.88	1.50	40.63	52.36	1.64	**49.56**
20. Salzer's California Prolific	2	49.88	1.00	31.31	52.20	1.51	**46.50**
21. Duckbill	2	49.69	1.09	33.56	52.15	1.54	**46.29**
22. Carter's Goldthorpe	2	50.63	1.89	41.21	51.86	1.80	**46.29**
Grown for six years.							
23. Gold Foil Hansfords	2	50.00	1.80	52.08	52.41	1.85	**51.56**
24. Two-Rowed Canadian	2	49.06	1.80	56.06	51.89	1.60	**46.42**
25. Selected Canadian Thorpe	2	50.69	1.49	45.02	51.50	1.55	**43.20**
Grown for five years.							
26. Four-Rowed	6	48.69	1.52	47.17	51.22	1.27	**54.55**
27. Vermont Champion	2	50.75	1.47	47.15	53.39	1.65	**49.75**
28. Jarman's Selected Beardless	2	51.88	1.52	48.21	52.36	1.66	**48.30**
29. Jarman's Golden Champion	2	50.63	1.85	32.17	51.02	1.61	**37.09**
Grown for four years.							
30. Scotch	6	49.56	.98	38.15	50.12	1.36	**49.70**
31. North Western	6	49.25	1.11	38.31	50.17	1.40	**48.38**
32. Success	6	40.56	.93	27.02	46.19	1.16	**31.42**
Grown for two years.							
33. Silver King	6	49.38	1.10	38.35	49.97	1.13	**41.10**
34. Manitoba Six-Rowed	6	51.13	1.14	34.77	50.88	1.11	**38.39**

The average yield of barley per acre for the year 1897, as determined from our experimental plots, was 38.6 bushels. This is 11.4 bushels per acre less than the average yield for 1896, and about 19 bushels per acre less than the average yield for 1895. Although

the average yield of barley per acre is less than usual, still the comparative yield of the varieties one with another is not necessarily affected, as it requires a variety of seasons to determine the relative value of the various kinds of grain, even when grown side by side. The weight of grain per measured bushel in 1897 is also below the standard of the last nine years, the average for this year being 49.5 pounds, while that for the last nine years is about two pounds more per measured bushel.

It will be observed from the second column of figures, that in weight per measured bushel there were only three varieties that came under the standard of 48 pounds, these being the Cape, California Brewing and Success. It will also be observed by examining the fifth column of figures that these varieties are usually very low in weight of grain per measured bushel, the Cape weighing only 46.9 pounds in the average of eight years, the California Brewing 46.2 in the average of seven years, and the Success 46.2 in the average of four years. The best quality of barley grown in 1897, as determined by the average weight per measured bushel, was produced by the Oderbrucker, 51.3 lbs.; Scotch Improved, 51.8; Jarman's Selected Beardless, 51.9 pounds; and the Manitoba Six-rowed, 51.1 pounds. Three of these were six-rowed varieties and the other was a two-rowed variety. It will also be observed, by examining the column giving the weight per measured bushel in the average results, that the Oderbrucker weighs very heavily, giving upwards of 53¼ lbs. per measured bushel in the average of nine years. One of the most important column of figures is the one at the right hand side of the table, which gives the average yield of grain per acre for the number of years in which the different varieties have been under experiment at the Agricultural College. It will be seen from this column that the Mandscheuri has given decidedly the largest average yield, the average being 63.6 bushels for the nine years' experiments. The Oderbrucker, which is also a six-rowed barley, and stands second in the list in yield of grain per acre, has given an average of nearly eight bushels per acre less than the Mandscheuri; but, at the same time, it will be observed that the weight of grain per measured bushel is nearly 2½ pounds greater than that of the Mandscheuri in the average of nine years' experiments.

The average yield per acre of the two-rowed varieties in 1897 was 38.8 bushels and that of the six-rowed varieties 38.3 bushels. This shows an average of ½ bushel per acre in favor of the two-rowed as compared with the six-rowed varieties. If we examine the column which shows the average results for a number of years, we find that some of the two-rowed varieties have given very good results, but on the whole the six-rowed varieties have taken the lead in yield of grain per acre.

There was not very much trouble from rust on the barley during the past season. The only varieties which were entirely free from lodging were Kinna Kulla, Salzer's California Prolific, Duckbill, Selected Canadian Thorpe, Vermont Champion and Jarman's Selected Beardless. Some of the other varieties, however, such as the Mandscheuri, Two-rowed Italian, Australian, Six-rowed Baxter's Improved, North-western and Silver King stood up exceedingly well.

Hulless Barley.

Test of varieties. Of the twelve varieties of hulless barley tested in 1897, five have been grown for eight years in succession, three for five years, one for four years, and one for two years, and two of the varieties were grown this season for the first time. As in the case of the two-rowed and six rowed varieties, the seeding took place on the 25th of April on plots of exactly the same shape and size as those used for the two rowed and six-rowed varieties.

As the grain of the hulless varieties of barley closely resembles those of wheat or rye, we have taken sixty pounds as the standard weight per measured bushel in calculating the yield. In examining the results for 1897, it will be seen that there was only one variety which came up to the standard of sixty pounds per measured bushel, this variety being the

Purple. In the average results for the number of years grown, however, four varieties, namely, Black Hulless, Three-rowed, Guymalaya and purple have each given grain weighing more than sixty pounds per measured bushel.

Varieties.	No. of rows per head.	Results for 1897.			Average results for number of years grown.		
		Weight per measured bushel.	Yield per acre.		Weight per measured bushel.	Yield per acre.	
			Straw.	Grain.		Straw.	Grain.
Grown for eight years:		lb.	tons.	bus.	lb.	tons.	bus.
1. Black Hulless	6	59.94	1.17	27.00	62.93	1.47	**38.17**
2. Guymalaya	6	55.94	1.29	24.43	58.01	1.38	**37.53**
3. Hungarian	6	56.75	1.24	27.17	58.96	1.49	**37.46**
4. Large Skinned	2	53.81	1.30	23.38	59.24	1.49	**32.33**
5. Three-rowed	6	54.56	1.14	15.22	60.24	1.25	**26.72**
Grown for five years:							
6. Guy Mayle	6	57.75	1.09	28.75	60.92	1.32	**43.53**
7. Purple	6	60.13	1.10	25.70	62.68	1.60	**40.29**
8. Smooth Hulless	6	52.13	1.03	11.62	59.73	1.51	**32.06**
Grown for four years:							
9. Winnipeg No. 2	6	56.25	1.40	20.70	59.33	1.65	**36.84**
Grown for two years:							
10. New White Hulless	6	54.13	1.22	15.27	57.13	1.29	**23.08**
Grown for one year:							
11. Hog		56.50	1.78	32.47	56.50	1.78	**32.47**
12. Dakota Silver Beardless		45.38	1.16	27.88	45.38	1.16	**27.88**

The average yield per acre of the twelve varieties grown in 1897 was 23.3 bushels per acre, which is about 12 bushels per acre less than the average yield in 1896. The Black Hulless, which stands at the head of the list in the yield of grain per acre, produces a large yield of grain which weighs well per measured bushel. This variety, however, is very weak in the straw, and in some soils it is almost sure to lodge very badly. The Hungarian, New White Hulless, and Smooth Hulless varieties possessed the stiffest straw among those tested in 1897.

Barley—Broadcasting and Drilling on Six Different Dates.

For three years in succession, an experiment has been conducted by sowing barley on six different dates, commencing on April 18th and closing on May 26th. In the experiments of 1896 and 1897, the grain was sown broadcast and with a grain drill on each of the six dates. In each of these years the plots were all similar in size, and the same quantity of seed was used in all cases. The land upon which the experiment was conducted in 1897 produced a crop of roots in 1896. Farmyard manure at the rate of twenty tons per acre was applied to the land in preparation for the root crop. The crop on each plot was harvested when it reached its proper stage of maturity. The following table gives the results of the experiment conducted in 1897, and also the average results of the experiment conducted for three years in succession.

It will be observed from the above table that there is a marked difference in yield of grain per acre produced from the seed sown at different dates. The largest yield in 1897 was produced from sowing the grain with a grain drill on the 19th of April: and

the lowest yield was produced by sowing the grain with a grain drill on the 26th of May. We find by averaging the results from the broadcast seeding and also those from the drilled seeding that the drilled grain gave a little more than two bushels per acre over that sown broadcast.

Date of Seeding.	Average results from different methods of seeding.		Average results from different dates of seeding.			
	Broadcasted or drilled.	Yield of grain per acre. Average 2 yrs. 1896-97.	Weight per measured bushel.		Yield of grain per acre.	
			1897.	Average 3 yrs. 1895-7.	1897.	Average 3 yrs. 1895-7.
		bus.	lbs.	lbs.	bus.	bus.
April 18-19	Broadcasted	49.78	49.79	50.72	47.39	**49.48**
	Drilled	52.01				
April 22	Broadcasted	51.53	50 57	51.09	42.07	**49.28**
	Drilled	49.54				
May 1-4	Broadcasted	36.76	49.85	49.34	37.70	**40.61**
	Drilled	42.34				
May 9-10	Broadcasted	30.66	50.01	46.56	43.01	**35.80**
	Drilled	38.60				
May 18	Broadcasted	21.44	46.26	45.41	24.03	**25.76**
	Drilled	22.74				
May 25-29	Broadcasted	12.19	41.75	41.68	10.56	**15.52**
	Drilled	9.54				

The results of this experiment, which has been conducted for three years in succession in sowing grain at different dates, shows the advantage of early seeding in the case of barley. As there were only some three or four days difference between the first two dates of seeding, the results for these dates are not widely different. It will be seen that the seed which was sown in the first week in May gave a crop which yielded nearly nine bushels per acre less than that sown on April 22nd. The decrease in yield per acre is very marked dur. g the advancing periods of the season. The average yield produced on May 25th and 26 h is less than one-third of that produced on April 22nd.

Peas.

Test of varieties. There were forty-seven varieties of peas tested in the experimental department in 1887. Thirty-eight of these varieties have been grown from five, six, and seven years in succession, and the other nine varieties have been grown for less than five years. In 1897, three varieties have been grown for the first time. The land had received similar treatment previous to the sowing of peas as that described for the different varieties of barley. Seed of all the varieties was sown on the 29th of April upon plots exactly 1-100 of an acre in size. The grain was sown with a grain drill, which contained ten tubes, the tubes being on link (7.92 inches) apart. The quantity of grain sown varied from 2 to 4½ bushels per acre, according to the size of the grain and the manner of growth of the various kinds. The yields per acre have been calculated from the actual yield of the plots.

It will be seen from the following table that the yield of peas per acre was rather light in 1897, the highest among the forty-seven varieties being 33.1 bushels, and the lowest 14 55. In weight per measured bushel, the results of the past season are perhaps a little below the average. Twenty-six of the varieties, however, weighed heavier than the standard of 60 pounds per measured bushel, the highest weight being 65 38.

Varieties.	Results for 1887.				Average results for number of years grown.			
	Percentage of peas injured by weevil.	Weight per measured bushel.	Straw per acre.	Grain per acre	Number of days from time of seeding until maturity.	Weight per measured bushel.	Straw per acre	Grain per acre.
Grown for Seven Years:		lbs.	tons.	bus.		lbs.	tons.	bus.
1 White Wonder (New Zealand)	27	60.88	.63	20.65	97	63.47	1.11	**38.04**
2 Early Britain	34	56.75	.54	18.52	98	60.07	1.22	**37.51**
3 Field (New Zealand)	34	57.88	.61	22.13	93	62.02	1.26	**36.76**
4 Mummy	15	65.13	.73	23.15	101	64.12	1.48	**36.44**
5 Brown (New Zealand)	34	57.63	.94	25.22	100	59.64	1.47	**35.71**
6 Blue (New Zealand)	31	59.75	.62	22.53	100	62.57	1.13	**33.36**
7 Prussian Blue	30	60.75	1.52	22.68	106	62.19	1.55	**33.29**
8 Princess Royal	24	58.38	.69	19.58	98	60.35	1.17	**33.17**
9 Glory	36	58.88	.72	22.68	96	61.38	1.23	**32.78**
10 White Eyed Marrowfat	26	61.88	.82	21.72	102	62.25	1.41	**32.01**
11 Black Eyed Marrowfat	37	60.00	.77	17.00	102	61.61	1.33	**31.01**
12 Early Race Horse	32	57.38	.63	18.97	95	61.67	1.18	**31.01**
13 Multipliers	28	61.13	1.02	21.12	107	62.01	1.56	**29.28**
Grown for Six Years:								
14 Tall White Marrowfat	27	61.25	.97	23.38	100	61.93	1.56	**35.74**
15 New Canadian Beauty	31	61.63	.93	22.45	100	62.27	1.36	**31.77**
16 Canada Cluster	17	63.88	.95	24.30	99	63.15	1.47	**31.73**
17 Centennial White	27	60.88	.84	23.72	104	61.66	1.29	**30.87**
18 Golden Vine	25	60.50	.98	24.17	101	62.23	1.35	**30.46**
19 Royal Dwarf Marrowfat	26	61.25	.97	24.50	101	61.58	1.39	**30.36**
20 Potter	29	61.75	1.13	32.50	99	61.62	1.26	**30.05**
21 Cleveland's Advancer	29	61.13	.90	23.43	103	61.34	1.64	**29.61**
22 Scotchman	26	62.13	1.57	22.65	109	62.60	1.80	**29.44**
23 McLean's Advancer	33	51.63	.81	20.38	98	55.66	1.01	**29.39**
24 Sword	17	61.63	.96	29.72	103	62.06	1.38	**29.23**
25 Prince Albert	30	61.75	1.43	22.22	111	62.13	1.55	**28.39**
26 Canada Field	20	61.63	1.25	28.30	108	61.60	1.35	**27.68**
27 Striped Wisconsin Blue	14	63.00	1.76	29.63	109	62.77	1.54	**25.58**
28 Oakshott Field	12	57.88	1.52	20.08	114	54.51	1.63	**23.63**
29 Pride of the North	31	56.63	.56	14.55	96	59.76	1.00	**21.39**
Grown for Five Years:								
30 Chancellor	18	58.25	.80	21.75	90	63.32	1.30	**34.54**
31 William the First	32	55.88	.50	15.15	92	58.99	1.05	**33.93**
32 Nimble Taylor	42	57.88	.90	21.77	100	59.33	1.32	**33.91**
33 Common Grey	18	59.25	.94	25.42	101	58.79	1.39	**33.24**
34 Nine Pod	23	59.88	.75	22.37	101	59.58	1.37	**33.23**
35 D'Auvergne	20	60.13	.72	21.85	93	62.07	1.12	**31.44**
36 Early June	20	61.75	.90	24.25	101	62.30	1.34	**30.36**
37 Tall Turkish	33	59.13	.80	20.05	94	60.97	1.18	**29.77**
38 White Imperial	15	61.50	.87	20.15	100	61.32	1.30	**29.43**
Grown for Four Years:								
39 Improved Grey	45	56.63	.75	20.93	99	59.54	1.07	**33.43**
40 Crown	42	57.00	.70	20.05	98	60.08	1.25	**30.52**
41 Coffee	17	59.13	.94	17.68	104	60.11	1.42	**24.30**
Grown for Three Years:								
42 White Hundredfold	33	60.50	.86	25.45	98	62.01	1.44	**38.09**
Grown for Two Years:								
43 Lindsay	40	54.38	.85	20.75	94	55.83	1.04	**24.83**
44 Waterloo	47	53.38	.84	18.60	96	55.25	.91	**20.45**
Grown for One Year:								
45 Harriston Glory	12	63.50	1.11	33.10	91	63.50	1.11	**33.10**
46 Elephant Imperial Blue	18	63.50	.80	27.50	95	63.50	.80	**27.50**
47 Oddfellow	5	65.38	.97	16.98	107	65.38	.97	**16.98**

In order to get the material for the first column of figures in the foregoing table, the peas were all split and closely examined regarding the presence or absence of the pea

weevil (*Brucus pisi*). The percentage mentioned gives the full number of peas which were infested with the pea weevil. From general appearance the peas would not indicate nearly so much injury done as is recorded in the foregoing table, as in many instances the weevil was still located in the central part of the peas, owing to the peas having been treated with carbon bisulphide as soon as possible after harvest and before the weevil had done much damage. It will be observed that the Waterloo, Improved Gr-y, Crown, Nimble Taylor, and the Lindsay varieties of peas were the most affected; and the Oddfellow, Harrison Glory, and the Oakshott Field varieties of peas were the least affected this year. We hope to give this special feature of the work a considerable amount of attention in the future by examining the peas year after year, in order to find out which varieties are the least subject to the ravages of the pea weevil throughout several years. Our crop of peas in the experimental department has been treated for two years in succession as soon as possible after the crops were harvested in the autumn, carbon bisulphide being used for this purpose. As the result has proven very satisfactory indeed, and as a number of our readers may not have seen any bulletin treating on this subject, I give a very concise summary of the treatment of the weevily peas, which is simple in method and effectual in results. The treatment which we would recommend from our two years' experience is as follows: The peas containing the weevils should be placed in a comparatively air-tight box, barrel, bin, or room, either in bulk or in cloth bags. Flat dishes should then be placed on top of the grain, and after the carbon bisulphide is poured into them, the compartment containing the peas should be closed and allowed to remain undisturbed for forty-eight hours, in order that the vapors, which are two-and-a-half times heavier than air, may penetrate every portion of the receptable and do effective work. The weevils can be destroyed at any stage of their growth; but the treatment should not be attempted when the thermometer stands lower than ten degrees above zero, as it is claimed that the liquid would not vaporize sufficiently to work satisfactorily. I would strongly recommend treating the peas immediately after they are harvested and threshed in the autumn, and thus destroying the weevils, when they are still small and entirely enclosed in the peas. The vapors of the carbon bisulphide will penetrate the skins of the peas, and will thus destroy the weevil, before they have completed their work of destruction and have made their escape. Peas which are not treated in the autumn should be treated in the warm days of the winter or in the spring to check the spread of this troublesome insect.

Carbon bisulphide is a clear liquid which volatilizes very rapidly, and, as the vapors are very inflammable, great care should be taken to keep fire away from them. Carbon bisulphide can be purchased in small quantities from most druggists, or in large quantities from the manufacturers. It has been estimated that one-and-a-half pounds of the liquid is sufficient for each ton of the grain to be treated, if used to the best advantage possible.

If peas are badly infested with the pea weevil in the spring of the year, it is usually advisable to get them ground and purchase sound grain for seed. We have conducted an experiment for four years in succession, in which we have used sound peas, and peas that have been injured with the weevil for seed. The results show that only about one-third of the injured peas will germinate, and that the peas produced by them are usually much weaker and smaller than those produced by sound seed.

Special attention is directed in the foregoing table to the average number of days from the time of sowing the different varieties until their maturity. It will be seen that there is a great variation in the length of time required for the varieties to ripen. Among the forty-seven varieties under experiment, the Chancellor is the first and the Oakshott Field pea is the last to mature, there being a difference of twenty-four days in the ripening period of these two varieties. The Golden Vine variety, which is one of the best known peas throughout Ontario, occupies an intermediate position in the length of time required from seeding till harvesting.

It will be observed that the White Wonder variety of peas, which was obtained from New Zealand in 1889, occupies first place in average yield of grain per acre among thirteen varieties grown in the experimental grounds for seven years in succession. It

was distributed this year in small quantities for the first time. The White Wonder variety is suited to comparatively rich land, as the straw is not so long as that of many other varieties. The Early Britain pea, which stands second on the list in yield of grain per acre among the varieties grown for seven years, was imported from England, and has given very good satisfaction in the comparative results. It was distributed throughout Ontario in 1896 for the first time, along with three other varieties, and, in the average results of successfully conducted experiments carried on upon seventy-three different farms throughout Ontario, it occupied the highest place among the four varieties tested. It was again distributed for co-operative experimental work in the spring of 1897. The Chancellor pea, which has now been grown in our plots for five years in succession, has given an average of 34 5 bushels per acre, and an average weight per measured bushel of 63.3 pounds. This is the earliest among the forty-seven varieties under experiment, as it has matured in an average of ninety days from the time the seed was sown. The Chancellor pea, which is a small white variety, gave the best results in the co operative tests in 1896, coming next to the Early Britain in the experiments over Ontario and even surpassing the Prussian Blue variety. Of all the varieties of early peas that have been tested, the Chancellor has given the best all round satisfaction up to the present time. The Egyptian and the grass varieties of peas are much different in character and growth from those reported in the foregoing table. The grass pea is a variety more suitable for fodder purposes than for the production of grain. The Egyptian variety, however, is a good producer of grain, but possesses a straw of inferior quality. These varieties have both been tested for four years in the experimental department. As they are both late in reaching maturity, the crops were unavoidably injured in 1897, and are therefore not mentioned in the foregoing table. In the average of four years' experiments, the Egyptian gave 36.2 bushels per acre, the grain weighing 61½ pounds per measured bushel; and in the average of three years' experiments, the grass pea gave an average of 15.3 bushels of grain per acre, which weighed 63½ per measured bushel. Both of these varieties are free from the ravages of the pea weevil.

Broadcasting and Drilling on Different Dates. Twelve plots were used in 1897 for an experiment in which peas were sown broadcast and with a grain drill at six different dates, commencing on April 19th and closing on May 26th. The plots were all 1/100 of an acre in size, and equal quantities of seed were used for the various plots. The drilling was done with an ordinary grain drill and the broadcasting was done by hand. The ground was harrowed after the seeding.

Dates of seeding.	Results from different methods of seeding.		Results from different dates of seeding			
	Methods of seeding.	Yield of grain per acre. Average for two years.	Weight per measured bushel.		Yield of grain per acre.	
			1897.	Average for three years.	1897.	Average for three years.
		bush.	lbs.	lbs.	bush.	bush.
April 18-19.	Broadcasted	27.35	51.63	58.07	23.65	**29.62**
	Drilled	28.90				
April 22	Broadcasted	31.28	52.07	58.11	26.13	**32.72**
	Drilled	31.20				
May 1-4	Broadcasted	23.73	55.26	59.30	17.93	**30.00**
	Drilled	24.31				
May 9-10.	Broadcasted	19.45	55.69	59.48	16.38	**28.49**
	Drilled	22.33				
*May 18	Broadcasted	11.07	55.63	58.63	11.36	**25.02**
	Drilled	11.66				
*May 25-26	Broadcasted	10.15	59.01	60.35	9.68	**23.59**
	Drilled	9.20				

* The average results from the seeding of May 18th and May 25th and 26th, are for one year less than those from the seeding of the first four days.

It will be observed from the above table that, in the average of two years' experiments, grain sown with the drill has given better all round satisfaction, although on two dates the broadcast seeding gave a slight increase over the drilling.

When the results from seeding on different dates are taken into consideration, it will be seen that, on the whole, late seeding produced grain of very good quality, the highest weight of all resulting from the seeding of May 26th. In yield of per acre, however, it will be noticed that there is a gradual decrease from the second to the sixth seeding, the highest average yield being produced on April 22nd, and the lowest on May 26th. In some instances, however, it is found that even better results are obtained from sowing peas about the first of May as compared with any earlier date; but in 1897 the earliest date of seeding in the case of peas, gave the best results in yield of grain per

Spring Wheat.

Test of Varieties. In 1897, forty-eight varieties of spring wheat were under test in the experimental grounds. These include all the varieties introduced since the spring of 1893, and the leading varieties among all those introduced from 1888 to 1893. The plots for the spring wheat were similar to those used for the barley previously mentioned. The seeding took place on April 22nd. The grain was sown broadcast, and in nearly all cases at the rate of two bushels per acre. The large coarse varieties, as Bart Tremenia, Wild Goose, Medeah, Sorentino, Ontario, and Algiers, were sown at the rate of two and one-half bushels per acre.

The average yield per acre of the forty-eight varieties of spring wheat grown in 1897 was 16 bushels per acre. Although this is not a high yield, still it is 6.3 bushels per acre more than the average yield in 1896. It is, however, 10.7 bushels less per acre than the average yield of 1895, and only about one-half the yield of 1894. When it is considered, however, that our experiments extend over a period of several years, the average results of the different varieties for the full number of years which they have been grown in the experiments should indicate very well the comparative value of the different varieties for general cultivation. Some varieties do well in favorable years, while others, and especially strong growing sorts, are likely to give the best satisfaction in seasons in which the weather and other conditions are less favorable. Those kinds of spring wheat which will give the best satisfaction under varied conditions, as secured through experiments of several years, are varieties from which we may hope to receive the most satisfactory results in general use.

In yield of grain per acre, the Bart Tremenia, Wild Goose, Medeah, Sorentina and Algiers gave the largest yields among the coarse grained wheats; and the Herison Bearded, Saxonka, Konisburg, Red Fern, Red Fife, Colorado, Rio Grande, Washington. Wellman Fife and the Blue Democrat among the small grained varieties. Special attention is drawn to the Herison Bearded variety of spring wheat which was imported from France in the spring of 1889. This variety has given an average of over 26.5 bushels per acre in nine years' trials on the small plots of the experimental department. The weight per measured bushel of this variety has averaged 62½ lbs. It possesses a good strong straw, which is usually troubled but little with rust. Among fifty-seven varieties of spring wheat which were submitted to the Millers' Association, the Herison Bearded was selected as one of the nine first-class milling wheats. In the co-operative experiments, conducted over Ontario each year with four or five of the leading varieties of spring wheat, the Herison Bearded has made an excellent record. This variety is now grown in the large fields at this institution to the exclusion of all other varieties.

The Preston, Stanley and Percy varieties of spring wheat, which were furnished us through the kindness of Dr. Wm. Saunders, of the Central Experimental Farm, Ottawa, in the spring of 1896, gave better yields in 1897 than they did the first season. The tests with these, as with all other new varieties, will be continued for at least five years, in order that we may thoroughly study the capabilities of the different varieties under the varying conditions of several seasons.

	Varieties.	Nature of head.	Results for 1897.			Average results for number of years grown on plots.		
			Weight per measured bushel.	Yield of straw per acre.	Yield of grain per acre.	Weight per measured bushel.	Yield of straw per acre.	Yield of grain per acre.
	Grown for Nine Years:		lbs.	tons.	bush.	lbs.	tons.	bush.
1	Bart Tremenia	bearded	60.13	1.50	24.27	62.16	1.70	**27.97**
2	Herison Bearded	"	59.25	1.46	22.92	62.36	1.78	**26.57**
3	Pringle's Champion	"	58.00	.87	16.15	59.78	1.66	**24.06**
4	Saxonka	"	58.38	1.13	20.52	60.20	1.64	**23.76**
5	Konisburg	"	58.82	1.34	22.13	60.99	1.54	**23.53**
6	Holben's Improved	bald	54.19	.89	12.97	57.99	1.64	**21.73**
	Grown for Eight Years:							
7	Wild Goose	bearded	62.63	1.36	23.07	61.12	1.91	**32.36**
8	Red Fern	"	58.63	1.43	23.13	60.41	1.89	**29.29**
9	Medeah	"	58.50	1.51	24.63	60.40	1.70	**28.17**
10	White Russian	bald	54.75	1.15	14.90	57.91	1.76	**27.07**
11	Sorentino	bearded	57.82	1.65	25.10	59.24	1.82	**26.82**
12	Red Fife	bald	56.06	1.53	20.73	60.02	1.78	**25.93**
13	Algiers	bearded	56.44	1.69	26.98	57.47	1.80	**25.86**
14	White Fife	bald	55.19	1.24	15.32	59.85	1.56	**23.79**
15	Colorado	bearded	54.38	1.45	20.15	58.71	1.60	**22.51**
	Grown for Seven Years:							
16	Rio Grande	bearded	58.00	1.57	21.98	59.03	1.77	**24.82**
17	Mo. Carlin	"	57.13	1.27	19.27	58.62	1.82	**24.52**
18	Manitoulin	bald	54.06	1.03	14.17	58.30	1.52	**23.20**
19	Okanagan Valley Velvet Chaff	"	52.25	1.05	13.43	54.55	1.62	**22.53**
20	Washington	bearded	58.25	1.63	21.57	58.96	1.55	**22.52**
21	Saskatchewan Red Fife	bald	55.13	1.05	14.95	58.11	1.47	**21.43**
22	Salzer's Assiniboia Fife	"	54.38	1.10	15.15	57.95	1.34	**21.07**
	Grown for Six Years:							
23	Wellman Fife	bald	56.06	1.55	21.62	58.10	1.76	**25.35**
24	Lost Nation	"	54.50	1.01	13.07	57.68	1.64	**23.36**
25	Velvet Chaff Blue Stem	"	51.75	.96	10.63	56.13	1.59	**22.40**
26	New York	bearded	54.25	1.37	15.10	57.10	1.53	**20.68**
27	Manitoba Red	bald	54.00	1.27	15.22	58.00	1.53	**20.23**
28	Hayne's Blue Stem	"	51.00	1.20	11.62	55.45	1.59	**19.78**
29	Dakota Marvel	"	52.38	1.39	16.20	55.84	1.58	**19.70**
30	Campbell's White Chaff	"	51.06	1.31	14.58	53.74	1.26	**14.39**
	Grown for Five Years:							
31	Blue Democrat	bearded	57.31	1.65	21.62	58.75	1.78	**23.65**
32	Champion Bearded	"	57.82	1.28	17.35	58.52	1.58	**20.10**
33	Amethyst	bald	54.19	1.14	14.53	57.64	1.36	**19.31**
34	French Imperial	"	54.88	1.38	15.78	57.75	1.33	**18.65**
35	Ontario	bearded	56.25	1.47	9.22	56.81	1.73	**18.12**
36	Early Scotch Bearded	"	53.00	1.25	12.45	56.73	1.45	**16.66**
37	Scotch Fife	bald	54.00	1.08	12.45	57.33	1.12	**15.06**
38	Canadian Club	"	51.75	.95	12.65	55.33	.....	**14.31**
39	Niagara	"	51.00	.79	7.13	53.28	1.09	**11.67**
40	White Australian	"	49.00	.62	4.43	49.00	1.44	**8.54**
	Grown for Four Years:							
41	Salzer's Marvel	bald	52.50	1.03	12.30	55.74	1.19	**17.22**
42	Red North Dakota	"	55.13	1.03	12.30	57.19	1.11	**16.75**
43	May's Early Wonder	"	54.88	.99	12.08	54.88	1.06	**15.56**
	Grown for Three Years:							
44	Manitoba Hard	bald	54.25	.84	10.47	56.02	.80	**11.20**
	Grown for Two Years:							
45	Preston	bearded	55.25	.82	12.77	54.47	.64	**9.10**
46	Stanley	bald	53.88	.70	10.00	54.38	.63	**7.74**
47	Percy	"	53.38	.80	9.85	53.76	.70	**7.56**
48	Seven Headed	"	49.75	1.01	6.47	49.75	1.02	**4.46**

Broadcasting and Drilliag on Different Dates. In the spring of 1897, as in the spring of 1896, spring wheat was sown with an ordinary grain drill and broadcasted by hand. The plots used for this experiment were 1-100 of an acre in size, and the soil had received twenty tons of farmyard manure per acre in the spring of 1896, after which a crop of roots was grown on the land. The seed was sown at the rate of two bushels per acre in every instance.

Dates of seeding.	Methods of seeding.	Yield of grain per acre.		Average results for different dates of seeding.			
				Weight per measured bushel.		Yield of grain per acre.	
		1897.	Average for two years.	1897.	Three years.	1897.	Three years.
		bus.	bus.	lb.	lb.	bus.	bus.
April 18-19	Broadcasted	20.00	.....	55.91	59.96	18.86	**21.39**
	Drilled	17.72	20.37				
April 22	Broadcasted	14.22	16.60	55.25	58.26	13.83	**16.86**
	Drilled	13.43	16.93				
May 1-4	Broadcasted	11.93	12.19	55.06	57.95	13.60	**14.90**
	Drilled	15.27	15.79				
May 10	Broadcasted	9.12	9.54	54.56	57.51	8.78	**11.41**
	Drilled	8.43	9.01				
May 18	Broadcasted	2.55	3.57	47.07	52.36	2.37	**6.31**
	Drilled	2.18	3.23				
May 25-26	Broadcasted	1.62	2.11	44.00	51.75	1.62	**6.08**
	Drilled	1.62	1.65				

A very important feature of this experiment is the great advantage of early seeding. Experiments in sowing grain at different dates have been conducted in the experimental department for several years, and they have shown that while it is important to get oats and barley sown early in the spring, it is of still greater importance to have the spring wheat in the ground at the earliest possible moment after the ground is in a suitable condition for cultivation. In the experiments for 1897, we notice that there were four bushels per acre more from the grain which was sown on the 19th of April than that which was sown only three days later. As the time of seeding advanced, the grain crop decreased in both quantity and quality. In fact, it will be seen that there was less than two bushels per acre produced from the plots which were sown on the 26th of May. In weight of grain per measured bushel, there was a decrease from 59.9 pounds per measured bushel from the first date of seeding to 44.0 pounds per measured bushel from the last date of seeding.

Winter Wheat.

Test of Varieties. One hundred and eighty-nine plots were devoted to winter wheat experiments in 1897. The experiments conducted will be taken up under several different heads. In the variety experiment there were ninety-one kinds tested in the past season. Seed was sown at the rate of two bushels per acre on September 2nd, 1896, on plots 1/100 of an acre in size. The land upon which the wheat was grown had produced one crop since it was last manured, and the soil was worked as a bare fallow in the summer of 1896. The varieties ripened between the 21st and the 31st of July. Owing to the late harvest and the exceedingly wet season, no winter wheat bulletin was issued this year. A concise article, however, giving the summary results was sent to 352 newspapers.

CHARACTERISTICS AND YIELDS OF NINETY-ONE VARIETIES OF WINTER WHEAT.

Varieties—Arranged according to the last column of this table, which gives the average yield of grain per acre for the number of years grown.	Heads bearded or bald.	Color of grain.	Results for 1897.		Average results for number of years reported upon.						
			Weight of grain per measured bushel.	Yield of grain per acre (bush. 60 lbs.)	Date of maturity.	Height of crop.	Per cent. of straw lodged.	Percentage of rust.	Weight per measured bushel.	Yield per acre. Straw.	Yield per acre. Grain (bush. 60 lbs.)
Grown for six years:			lbs.	bus.	July.	ins.			lbs.	tons.	
1. Dawson's Golden Chaff	Ba.	W.	54.81	53.48	19	45.9	2	42	58.97	3.0	**50.50**
2. Golden Drop	Ba.	R.	59.44	57.60	20	46.5	41	28	61.16	3.3	**48.35**
3. Early Red Clawson	Ba.	R.	57.50	58.43	20	46.6	39	31	58.50	3.2	**48.24**
4. Egyptian	Be.	R.	57.25	52.30	21	48.0	53	22	60.13	3.2	**47.82**
5. Reliable	Be.	R.	58.06	50.12	20	48.1	26	16	61.09	3.2	**46.10**
6. Russian Amber	Be.	R.	56.88	48.07	21	46.4	31	17	60.73	3.0	**44.68**
7. American Bronze	Ba.	R.	55.88	43.90	21	48.3	2	45	58.73	3.1	**42.98**
8. Bulgarian	Be.	W.	56.06	43.07	22	48.9	20	24	60.26	2.7	**42.26**
9. Golden Cross or Volunteer.	Be.	R.	56.38	45.42	22	48.4	26	35	59.48	3.1	**41.24**
10. Red Velvet Chaff	Ba.	R.	52.06	36.35	21	48.5	33	29	57.34	3.3	**40.64**
11. Standard	Ba.	W.	53.13	38.75	22	46.4	15	33	57.61	2.7	**39.29**
12. Surprise	Ba.	W.	53.88	37.92	21	46.6	23	26	57.56	2.7	**39.0**
13. Bonnell or Landreth	Ba.	W.	53.13	37.30	22	49.3	24	24	57.86	2.9	**38.97**
14. Longberry Red	Be.	R.	57.94	42.35	21	46.2	51	20	60.49	3.0	**38.23**
15. Jones' Winter Fife	Ba.	R.	54.88	37.00	21	47.3	24	26	58.48	2.5	**38.17**
16. Velvet Chaff	Be.	R.	59.13	39.27	19	42.8	6	28	62.19	2.3	**35.63**
Grown for five years:											
17. Stewart's Champion	Ba.	R.	55.88	47.45	20	50.5	7	28	58.06	2.9	**39.25**
18. Soules	Ba.	W.	52.75	45.37	18	47.4	9	30	56.47	2.5	**36.03**
19. White Star	Be.	R.	57.19	48.70	19	47.7	12	27	59.28	2.4	**35.98**
20. Early White Leader	Ba.	W.	50.25	31.47	21	46.3	6	36	55.25	2.0	**33.33**
21. Treadwell	Be.	W.	57.00	44.17	20	48.7	8	23	59.00	2.3	**32.19**
Grown for four years:											
22. Early Genesee Giant	Be.	W.	54.88	56.98	20	48.9	12	30	59.40	3.3	**50.10**
23. Imperial Amber	Be.	R.	57.13	56.15	19	48.6	40	7	59.06	3.8	**48.76**
24. Tasmania Red	Be.	R.	59.00	45.83	18	45.0	54	12	61.10	3.3	**45.73**
25. Poole	Ba.	R.	58.06	48.02	19	46.4	31	13	60.22	3.2	**44.86**
26. Egyptian Amber	Be.	R.	57.94	46.88	18	47.9	42	8	60.76	3.6	**44.65**
27. Early Ripe	Ba.	R.	57.94	41.88	19	47.4	31	18	60.76	3.3	**44.22**
28. Siberian	Ba.	R.	58.00	43.90	20	47.4	37	16	61.23	3.1	**42.20**
29 Tuscan Island	Be.	R.	58.75	53.02	18	48.2	46	23	59.84	3.1	**42.06**
30 Emporium	Ba.	R.	57.56	49.73	20	49.9	38	6	58.87	3.5	**41.83**
31 Geneva	Be.	R.	60.13	46.25	17	45.5	42	10	61.91	3.2	**41.79**
32 Red May	Ba.	R.	59.00	45.42	17	46.4	32	11	61.48	3.0	**41.66**
33 Rudy	Be.	R	57.38	49.58	17	46.2	47	19	59.87	2.8	**41.65**
34 Arnold's Hybrid	Ba.	R.	59.00	46.93	17	46.9	29	13	61.03	3.1	**41.58**
35 Bissell	Be.	R.	58.75	46.72	17	45.3	49	7	60.81	3.0	**41.16**
36 Pride of Genesee	Be.	R.	54.44	41.58	19	48.6	37	13	59.81	2.8	**41.15**
37 New Columbia	Ba.	R.	55.38	38.48	18	45.4	23	16	58.25	3.0	**41.90**
38 McPherson	Ba.	R.	60.25	47.65	17	46.5	31	13	61.26	3.0	**49.89**
39 Zimmerman	Ba.	R.	57.94	45.65	19	45.8	23	13	60.69	2.7	**39.76**
40 Golden Tankard	Be.	R.	58.32	46.77	17	48.8	44	21	59.96	3.7	**39.14**
41 Andrew's No. 4	Be.	R.	55.69	46.88	21	49.5	28	23	58.92	3.2	**38.72**
42 Kentucky Giant	Be.	R.	59.25	48.90	20	47.7	37	15	59.29	2.8	**38.18**
43 Simcoe Red	Be.	R.	55.44	38.07	17	48.7	19	19	58.26	2.8	**36.37**
44 Penquit's Velvet Chaff	Be.	R.	59.38	45.52	18	45.5	17	28	60.90	2.5	**35.83**
45 Hindostan	Be.	R.	59.19	48.65	20	48.1	37	29	60.32	2.9	**35.79**
46 Turkish Red	Be.	R.	56.94	35.92	18	41.3	44	8	60.74	2.3	**35.08**
47 Currell	Ba.	R.	59.13	41.52	18	46.7	36	20	60.53	2.9	**34.23**
48 Jones' Square Head	Ba.	W.	53.19	27.50	19	46.1	7	28	57.17	2.1	**32.23**
49 Bullard's Velvet Chaff	Ba.	R.	58.38	46.67	22	47.6	12	25	59.97	2.3	**30.42**

CHARACTERISTICS AND YIELDS OF NINETY-ONE VARIETIES OF WINTER WHEAT.—*Concluded.*

Varieties—Arranged according to the last column of this table, which gives the average yield of grain per acre for the number of years grown.	Heads bearded or bald.	Color of grain.	Results for 1897.		Average results for number of years reported upon.						
			Weight of grain per measured bushel.	Yield of grain per acre (bush. 60 lbs.)	Date of maturity.	Height of crop.	Per cent. of straw lodged.	Percentage of rust.	Weight per measured bushel.	Yield per acre. Straw.	Yield per acre. Grain (bush. 60 lbs.)
Grown for three years:			lbs.	bus.	July.	ins.			lbs.	tons.	
50 Michigan Amber	Be.	R.	55.50	47.18	19	46.8	34	20	59.50	3.3	**46.53**
51 Giant Sqare Head	Be.	W.	50.00	47.03	20	48.0	27	42	56.93	3.3	**46.48**
52 Hunter's Wheat	Be.	R.	54.50	46.77	20	45.0	30	17	59.37	3.0	**42.32**
53 Pride of Illinois	Ba.	R.	55.25	39.80	17	43.9	40	23	59.48	2.7	**37.93**
54 White Bearded	Be.	W	49.50	37.23	20	42.5	10	30	56.17	2.2	**35.94**
55 German Emperor	Ba.	R.	53.38	40.47	19	46.2	51	18	58.46	3.1	**35.56**
56 Kalina	Be.	R.	53.75	38.75	21	37.7	32	45	58.05	2.5	**31.52**
57 Amherst Isle	Be.	R.	54.50	39.95	20	44.0	61	8	58.10	1.8	**31.45**
58 Mealy	Ba.	R.	55.00	39.90	19	46.9	34	28	59.07	2.2	**30.77**
59 Nonpareil	Be.	W.	52.00	38.02	22	46.9	26	38	57.60	2.2	**30.61**
60 Silver Star	Ba.	W.	48.50	29.07	22	44.3	14	47	56.97	2.3	**30.02**
61 Long Amber	Ba.	W.	44.94	26.22	24	54.7	15	50	52.58	1.9	**21.47**
Grown for two years:											
62 Queen Meg	Be.	W.	55.68	41.82	21	54.7	43	53	55.68	4.0	**49.26**
63 Murray's Hybrid	Be.	W.	51.13	36.35	20	52.7	48	45	55.27	3.1	**35.13**
64 Beattie's Victor	Be.	W.	51.25	31.43	21	54.7	21	53	55.43	3.0	**33.12**
65 Bailey	Ba.	W.	53.45	24.02	19	48.5	13	58	53.45	2.6	**32.31**
Grown for one year:											
66 Russian	Be.	R.	56.25	49.58	23	52.0	99	10	56.25	4.2	**46.58**
67 Buda Pesth	Be.	R.	56.63	49.17	28	50.0	98	35	56.63	3.9	**49.17**
68 World's Fair	Ba.	R.	55.38	48.75	24	62.0	75	50	55.38	4.4	**48.75**
69 Mac. Garvin	....	R.	54.88	48.33	26	56.0	50	70	54.88	3.6	**48.33**
70 Reliable	Be.	R.	58.44	47.35	28	52.0	95	40	58.44	4.7	**47.35**
71 Prize Taker	Ba.	W.	51.00	41.62	26	56.5	25	80	51.00	3.9	**41.62**
72 Diamond Grit	Be.	R.	54.63	40.10	26	62.0	35	60	54.63	4.3	**40.10**
73 White Golden Cross	Be.	W.	52.75	39.27	30	57.0	90	70	52.75	4.4	**39.27**
74 Roberts	Be.	R.	56.06	39.12	26	61.0	90	45	56.06	3.9	**39.12**
75 Bearded Winter Fife	Be.	R.	51.13	38.70	26	54.5	80	40	51.13	3.6	**38.70**
76 Eastman	Be.	W.	54.75	38.23	29	59.0	80	60	54.75	3.9	**38.23**
77 Wisconsin Triumph	Be.	R.	55.25	38.13	29	59.0	90	50	55.25	4.5	**38.13**
78 French Hero	Be.	R.	55.63	37.92	26	58.0	95	70	55.63	4.0	**37.92**
79 Red Cross	Ba.	R.	53.56	37.60	28	59.0	50	70	53.56	4.3	**37.60**
80 White Clawson	Ba.	W	49.88	37.13	26	61.0	35	70	49.88	3.9	**37.13**
81 Turkish Red Winter	Be.	R.	55.13	35.88	29	50.0	90	50	51.13	2.8	**35.88**
82 Bearded White Fife	Be.	W.	50.00	35.32	23	54.0	15	40	50.00	2.5	**35.32**
83 Johnson	Be.	W.	48.13	34.80	29	57.0	80	70	48.13	4.2	**34.80**
84 Gold Coin	Ba.	W.	52.06	34.53	28	57.5	75	100	52.06	4.0	**34.53**
85 Canadian Hybrid	Ba.	R.	54.00	34.48	29	54.0	80	50	54.00	3.4	**34 48**
86 Pedigreed Genesee Giant	Be.	W.	48.88	32.03	27	56.0	90	80	48.88	3.9	**32.03**
87 Long Amber	Ba.	W.	46.75	31.30	29	61.5	20	80	46.75	3.3	**31.30**
88 Ohio State	Ba.	W.	54.63	30.05	29	56.0	85	70	54.63	3.5	**30.05**
89 Early Oatka Chief	Be.	W.	57.38	29.53	28	54.0	95	50	57.38	4.3	**29.53**
90 Early Arcadian	Ba.	W.	48.38	29.02	26	59.5	75	100	48.38	4.3	**29.02**
91 Zerena	Ba.	W.	50.25	26.82	29	55.0	75	60	50.25	3.4	**26.82**

In this experiment with ninety-one varieties of winter wheat grown under similar conditions in 1897, it is found that the seven varieties which stand highest in yield of grain per acre are the same seven varieties which have given the largest average yield of

grain per acre among eighty-six varieties grown on the experimental plots for four years in succession. Although the comparative order of the yields of these seven varieties is not the same in 1897 as in the average of four years, still the fact that they gave the largest yield in both cases among all the varieties tested, is a very important feature in the experiment.

I wish to draw special attention to Dawson's Golden Chaff, which gave a yield of 50.50 bushels per acre in the average of six years' trials. It will be observed that this variety has given an average of over two bushels per acre more than the variety which stands next to it in yield of grain. In weight per measured bushel, however, the Dawson's Golden Chaff gave only an average of practically 59.0 pounds, while three of the other varieties among those which have been grown for six years in succession have given an average of over 61 pounds.

The Dawson's Golden Chaff winter wheat has been sent out over Ontario with several other varieties during each of the past five years. In these co-operative experiments, also, it has made an excellent record. The following are some of the conclusions regarding the different varieties of winter wheat tested on the farms throughout Ontario, including the year 1897: 1. "In average yield of winter wheat per acre, the Dawson's Golden Chaff stood highest among eleven varieties tested over Ontario in 1893, nine varieties in 1894, nine varieties in 1895, nine varieties in 1896, and seven varieties in 1897." 2. "The Dawson's Golden Chaff was the most popular variety with the experimenters in each of the past four years."

The Golden Drop, which stands second in average yield of grain per acre for six years, is a red grained variety. Special notice should be taken of this point, as there is also a white grained variety in circulation under a similar name, but which does not appear to be so good a variety as the one standing second in the above list.

The Early Genesee Giant variety has now been grown for four years in succession and has given satisfactory results. The straw grows about three inches higher than that of Dawson's Golden Chaff. It is a variety which seems to be well suited for comparatively poor land; but on rich soil it is apt to produce straw of a very coarse nature, and is not likely to fill so well as though the straw had not grown so abundantly.

Different Dates of Seeding. Two or more varieties of winter wheat have been sown at three different dates in the month of September in each of the past five years. The following table gives the average results for each date of seeding in 1897, and also for the five years in which these experiments have been conducted.

Date of seeding.	Yield of straw per acre.		Weight per measured bushel.		Yield of grain per acre.	
	1897.	Average 5 years.	1897.	Average 5 years.	1897.	Average 5 years.
	tons.	tons.	lbs.	lbs.	bush.	bush.
September 2-3	3.09	2.84	52.03	57.32	34.66	**38.40**
" 7-9	3.22	2.88	52.53	57.46	35.97	**37.67**
" 17-20	3.17	2.21	50.77	55.68	34.28	**30.95**

Although the results from the second date of seeding are slightly better than those from the first date of seeding in 1897, still the results for the five years' experiments show an average of about one bushel per acre in favor of the first date of seeding. The results from the seeding of September 17th to 20th show an average of two pounds per measured bushel, and a yield of seven bushels per acre less than those produced from the seeding of September 7th to 9th in the average results for five years. In consideration of the results of these experiments, and some other experiments which have been conducted in sowing winter wheat at different dates, it is found that the returns are not usually very satisfactory from sowing winter wheat later than the 9th of September at this institution.

Methods of Seeding. An experiment in sowing winter wheat broadcast and with a grain drill has been conducted in duplicate in each of the past four years. Uniform quantities of seed were used in this experiment throughout. The following table gives the average results for each method of seeding in 1897, and also those for four years in which this experiment has been conducted :

Method of seeding.	Weight per measured bushel.		Yield per acre.			
			Straw.		Grain.	
	1897.	Average 4 years.	1897.	Average 4 years.	1897.	Average 4 years.
	lbs.	lbs.	tons.	tons.	bush.	bush.
Drilled	55.29	58.62	4.10	2.68	36.69	**42.42**
Broadcasted	55.01	58.30	4.04	2.66	36.93	**42.40**

The average results from the sowing by the two methods are very similar, there being a very slight advance in those from the drilled crop. It should be understood, however, that the land was in excellent state of cultivation for both methods of seeding. Had the land been poorly worked, the results might have been much more marked in regard to the methods of seeding.

Different Quantities of Seed. In 1894, 1895, 1896, and 1897, two varieties of winter wheat were sown broadcast on similar plots at the rates of 1, 1½, and 2 bushels per acre. The treatment of the plots was the same in every respect, the only difference being in the amount of seed used. The following table gives the average results from each quantity used in 1897, and also for the four years in which this experiment has been conducted :

Quantity of seed sown.	Weight per measured bushel.		Yield per acre.			
			Straw.		Grain.	
	1897.	Average 4 years.	1897.	Average 4 years.	1897.	Average 4 years.
	lbs.	lbs.	tons.	tons.	bus.	bus.
1 bushel per acre	53.53	57.72	4.02	2.72	36.05	**38.56**
1½ bushels per acre	53.97	57.94	4.15	2.94	36.83	**42.52**
2 bushels per acre	54.91	58.38	4.45	3.18	38.28	**44.48**

It will be observed that in yield of straw and of grain the largest amounts were produced from the thickest seeding. Also in weight per measured bushel, the thickest seeding gave the most satisfactory results. The heaviest grain per measured bushel produced from the thickest seeding in 1895, 1896 and 1897. It must be remembered that this experiment was conducted on small plots. For wheat growers to determine the proper quantity of winter wheat to sow per acre in order to get the best results upon their respective farms, it will be advisable for them to observe and experiment for themselves, as very much depends upon the fertility of the soil and upon other conditions.

Selection of Seed. An experiment was conducted in 1897 in sowing large plump, small plump, shrunken, and cracked winter wheat seed of the Dawson's Golden Chaff and the Early Genesee Giant variety. The plots were exactly the same size in every instance, being 1/100 of an acre. Large plump seed was sown at the rate of two bushels to the acre. Exactly the same number of seeds of each of the other selections was used, as in the case

of the large plump seed. For the selection of cracked seed broken grain was picked from the two varieties of winter wheat which had been threshed with the separator, and in which there was more or less broken grain, as is frequently the case as a result of threshing. It was necessary, of course, to use exactly twice as many broken grains as whole grains in making the selection for this experiment. The following table gives the average results from each of the selections for 1897 :

Selections.	Weight per measured bushel.	Yield of straw per acre.	Yield of grain per acre.
	lbs.	tons.	bus.
Large plump seed	57.00	4.22	**63.60**
Small plump seed	56.75	3.80	**59.93**
Shrunken seed	57.47	3.45	**56.77**
Cracked seed	53.66	1.05	**20.92**

Large plump seeds produced $3\frac{2}{3}$ bushels per acre more than the small plump seed ; $6\frac{4}{5}$ bushels per acre more than the shrunken, and $42\frac{2}{3}$ bushels per acre more than the seed which had been broken with the machine in threshing. It seems rather strange that the shrunken seed produced grain which weighed slightly heavier per measured bushel than that produced from the large plump seed. As, however, the yield of shrunken seed was about seven bushels per acre less than that produced from the large plump seed, there was a better opportunity for the smaller crop to become more fully developed. It must be remembered that these results are simply for one year. It is our intention to continue this experiment for several years.

Sprouted Grain for Seed. As 4.8 inches of rain fell at the Agricultural College during the month of July, and as the heavy rains were quite general throughout the Province of Ontario, the farmers generally had much difficulty in getting their winter wheat harvest properly cured. As a result of the wet weather, the wheat was very badly sprouted in manylocalities. It became a burning question among the farmers as to the advisability of sowing sprouted seed this autumn. In order to glean some information in regard to the value of sprouted wheat for seed, an experiment was conducted in the month of August by placing different selections of seed in boxes where the percentage of germination and the character of growth could be closely watched. Fifty sound grains were planted in No 1 box ; fifty grains, which were slightly sprouted, in No. 2 box ; fifty grains, considerably sprouted, in No. 3 box ; and fifty grains, badly sprouted, in No. 4 box. In about two weeks after the grains were planted, the crop in No. 1 box showed 88 per cent. germination, and the plants an average of $3\frac{1}{2}$ inches in height ; in No. 2 box 66 per cent. of the seeds germinated, and the plants averaged $2\frac{3}{4}$ inches in height ; in No. 3 box, 16 per cent. of the seeds germinated, and the plants averaged $1\frac{1}{2}$ inches in height ; and in No. 4 box, 10 per cent of the seeds germinated, and the plants averaged $1\frac{1}{4}$ inches in height. Several other experiments were also conducted, each showing results very similar to those here given. All of the experiments conducted showed that wheat which is even slightly sprouted lacks in germinating power, and is apt to produce an uneven crop, as there was a great difference in the sizes of the plants from the sprouted seed.

Treatment of Soil During the Four Months Previous to Sowing. In the spring of 1896 twelve plots, each one rod wide by six rods long, were staked off for an experiment in different treatments of soil, preparatory to the growing of winter wheat. The experiment was conducted in duplicate, there being six plots in each set. The land had been plowed in the autumn of 1895 and received surface cultivation in the spring of 1896. Four plots in each were sown in the latter part of May with crops

to be plowed under later in the season. These crops were peas, buckwheat, rape, and crimson clover. The other two plots in each set were worked as a bare summer fallow throughout the season. About the first of August each of the green crops was plowed under and the land was then worked on the surface during the month of August. Farmyard manure, at the rate of twenty tons per acre, was applied to one of the bare summer fallow plots in each set. On August 25th the Pride of Genesee variety of winter wheat was sown on one of the sets, and the Bearded Winter Fife on the other.

Soil preparation in 1896.	Height of plants.	Weight per measured bushel.	Yield per acre.	
			Straw.	Grain.
	inches.	lbs.	tons.	bush.
Bare summer fallow and farmyard manure at 20 tons per acre	52.8	58.54	2.79	43.29
Green peas plowed under	52.3	58.63	2.37	39.43
Bare summer fallow	52.1	58.19	2.10	37.18
Green rape plowed under	49.6	57.44	1.73	31.66
* Green crimson clover plowed under	48.3	57.79	1.56	28.20
Green buckwheat plowed under	48.5	57.54	1.32	26 27

* The crimson clover for this experiment made a very poor growth.

It will be observed from the foregoing table, that land which was treated as a bare summer fallow throughout the summer and manured at the rate of twenty tons of farmyard manure per acre previous to the sowing of winter wheat, gave the largest yield of grain per acre. It should, however, be remembered that this was the most expensive of the six different treatments. Land upon which peas were used as a green manure produced a considerably larger yield of winter wheat per acre than similar land upon which rape or buckwheat had been used as a green manure or which had been worked as a bare summer fallow. Owing to the amount of work required for a bare summer fallow, this method of preparation is more expensive than any of the others except the bare fallow, which was also manured. Where green crops were plowed under there was the expense of the seed used. The amounts of seed used for the green manure crops were as follows: peas 2½ bushels per acre, rape 4 pounds, buckwheat 1 bushel, and crimson clover 12 pounds. This experiment, it must be remembered, has been conducted for only one year.

Treatment of Smut. An experiment in treating seed wheat for the prevention of smut has been conducted for two years with quite satisfactory results. Infected seed wheat not treated for smut produced a crop containing an average of 2,146 smut balls per bushel of grain; while that treated with potassium sulphide produced an average of 109 balls of smut; that treated with copper sulphate, twelve balls of smut; and that treated with hot water, nine balls of smut per bushel of grain. The hot water treatment, which is one of the cheapest and most effectual remedies, consists in immersing seed wheat for fifteen minutes in hot water at a temperature of 132 degrees F. The water should not go below 130 degrees and not above 135 degrees. Not only is the hot water treatment very effectual in killing the smut spores, but it frequently improves the productive power of the seed, as shown by the increased yield of grain per acre. Every farmer in smut-infected districts should treat sufficient seed to insure the harvesting of clean grain for seed for the following year.

Effect of Cutting at Different Stages of Maturity. Five plots each of Dawson's Golden Chaff and the Early Genesee Giant varieties of winter wheat were sown on the same day in 1893, 1894, 1895 and 1896. The plots were 1/100 of an acre in size in every case. The seeding was done by hand at the rate of two bushels per acre.

Each of the varieties reached the stage of maturity at which winter wheat is usually cut in Ontario on the 19th of July in 1894, 18th of July in 1895, 11th of July in 1896, and the 20th of July in 1897. The two varieties were cut at five different periods in each of the four years commencing on July 4th in 1894 and in 1895, on June 30th in 1896, and on July 6th, 1897. The period between the cuttings were one week in length. The average dates of cutting, taking the four years into consideration, are as follows: First cutting, July 4th; second cutting, July 11th; third cutting, July 18th; fourth cutting, July 25th; fifth cutting, August 1st. The following table gives the results from each cutting in 1897, and also in the average of four years:

Date of cutting. (Average four years.)	Weight per measured bushel.		Yield per acre.			
			Straw.		Grain.	
	1897.	Average 4 years.	1897.	Average 4 years.	1897.	Average 4 years.
	lbs.	lbs.	tons.	tons.	bus.	bus.
July 4th	38.38	51.61	5.46	3.75	14.53	**31.99**
" 11th	53.32	58.91	5.31	3.54	47.89	**49.54**
" 18th	55.13	59.45	4.80	3.32	57.55	**51.64**
" 25th	53.07	57.58	4.29	3.16	55.28	**52.25**
August 1st	52.00	56.44	4.41	3.18	48.82	**46 30**

In each of the four years the greatest yield of straw was obtained from the first cutting, and the heaviest weight of grain per measured bushel from either the second or third cutting. The yields of grain per acre were best from the last cuttings in 1894 and in 1896, from the second last in 1895, and from the third last in 1897. The lowest results in yield of grain per acre, and in weight per measured bushel, were obtained from the first cutting of each variety in each year. The quality of the straw was the best from the first two cuttings and was the poorest from the last two cuttings.

Value of Grain for Seed as Affected by Cutting. For three years in succession an experiment has been conducted in sowing seed from two different varieties of wheat which had been harvested at five different dates, with a period of one week between each two dates. The first cutting took place when the wheat was in the milk condition, and the third when the wheat was in the condition usually harvested in Ontario, while in the case of the last cutting the wheat was very ripe. As this experiment is rather complicated, and as it is to be continued for several years to come, simply a reference is made to it in this report. We look upon this as a very important line of investigation, and hope to obtain some valuable conclusions by the time the experiment has been conducted for a period of five years or more. In the average results of experiments for the last three years, it is found that the heaviest weight per measured bushel, and the largest yields of grain and of straw per acre, were produced from the ripest seed.

Oats.

Test of Varieties. Although the number 103 represents the varieties of oats tested in the experimental department in 1897, still it does not by any means include the full number of varieties of oats that have been tested here within the past ten years. After varieties have been grown and the results carefully determined for five years in succession, the unworthy varieties are then dropped from our list and only the most valuable ones retained for further experiment and comparison. The seventeen varieties of oats which were grown in the experimental department in 1897, for the ninth year in succession, were selected as the best among eighty-one varieties which were grown on the

plots from the years 1889 to 1893 inclusive. The varieties grown during the past season for the seventh and sixth year, are also the leading varieties among the new kinds which were tested for the first time in 1891 and 1892 respectively.

	Varieties.	Nature of head.	Color of grain.	Results for 1897.			Average results for number of years grown.		
				Weight per measured bushel.	Yield of straw per acre.	Yield of grain per acre.	Weight per measured bushel.	Yield of straw per acre.	Yield of grain per acre.
	Grown for nine Years:			lbs.	tons.	bus.	lbs.	tons.	bush.
1	Joanette	Spreading	Black	33.25	2.48	62.82	35.57	2.77	**86.08**
2	Siberian	"	White	30.75	1.80	53.12	34.58	2.69	**79.91**
3	Oderbrucker	"	"	27.00	1.70	56.21	31.27	2.54	**79.29**
4	Waterloo	"	"	28.88	1.66	49.68	31.30	2.54	**77.60**
5	Probsteier	"	"	26.63	1.72	51.79	32.13	2.46	**77.59**
6	Danebrog	"	"	28.75	1.56	46.71	32.54	2.44	**75.61**
7	Bavarian	"	"	30.63	1.71	46.38	31.37	2.71	**74.95**
8	Improved Besthorne	"	Yellow	28.13	1.86	55.24	32.49	2.17	**74.71**
9	Poland White	"	White	33.63	2.03	39.71	36.80	2.50	**72.70**
10	Georgian	"	"	32.00	2.00	44.44	32.55	2.70	**70.57**
11	Yellow Gigantic	Main	Yellow	27.00	2.21	40.85	28.83	2.66	**69.81**
12	Egyptian	"	White	33.50	2.46	46.65	35.07	2.77	**69.39**
13	Black Poland	"	Black	24.00	2.36	32.00	29.19	2.81	**65.64**
14	Rosedale	"	White	34.75	1.82	45.74	34,44	2.74	**64.87**
15	Victoria White	Spreading	"	36.13	1.40	41.00	39.00	2.50	**64.64**
16	Black Champion	Main	Black	25.25	1.76	32.00	28.98	2.52	**64.39**
17	Black Tartarian	"	"	23.13	1 71	27.62	30.49	2.65	**62.59**
	Grown for seven Years:								
18	White Schonen	Spreading	White	27.75	1.47	48.91	31.81	2.26	**79.96**
19	Vick's American Banner	"	"	26.50	1.57	48.68	30.67	2.28	**79.12**
20	Danish	"	"	26.00	1.52	46.06	24.51	2.22	**77.01**
21	Wide Awake	"	"	27.38	1.62	45.82	32.94	2 26	**76.85**
22	White Mane	"	"	26.50	1.52	48.62	31.46	2.56	**76.55**
23	Holstein Prolific	"	"	27.00	1.62	48.59	31.72	2.14	**76.21**
24	Magnet	"	"	27.88	1.58	42.24	30.53	2.53	**75.45**
25	Early Calder	"	"	28.00	1.40	47.24	31.88	2.32	**73.60**
26	Golden Giant	Main	Yellow	24.75	1.94	40.59	28.04	2.43	**73.35**
27	Giant Swedish	"	"	24.25	1.79	42.06	28.47	2.46	**72.14**
28	Early Gothland	"	White	33.50	1.77	42.88	35.53	2.35	**65.68**
29	Clydesdale	Spreading	"	35.00	1.41	34.82	37.80	2.44	**64.47**
30	White Belgium	"	"	34.75	1.20	35.62	37.60	2.25	**63.63**
31	Japan	"	"	36.75	1.40	38.18	31.82	2.31	**62.93**
32	White Swiss	Main	"	34.13	1.16	43.71	35.66	2 24	**62.66**
33	Giant Yellow	Spreading	Yellow	34.25	1.10	32.68	34.88	2.14	**62.54**
34	Black Mane	Main	Black	25.75	1.57	31.03	29.40	2.32	**59.58**
	Grown for six years:								
35	White Baltic	Spreading	White	29.75	1.37	42.79	34.49	2.20	**67.89**
36	Abyssinian	Main	"	34.00	1.86	46.65	35.98	2.48	**62.44**
37	American Beauty	"	"	34.63	1.75	47.21	29.02	2.35	**60.77**
38	Thousand Fold	"	"	33.75	1.89	41.91	35.15	2.33	**58.08**
39	Badger Queen	Spreading	"	37.63	1.29	38.79	39.36	2.23	**56.34**
40	New Wonderful	"	"	37.00	1.25	38.09	38.95	2.09	**55.26**
41	Wilson's White Prolific	Main	"	32.88	1.76	40.85	32.44	.....	**53.31**
	Grown for five years:								
42	Improved American	Spreading	White	26.13	1.89	60.71	31.19	2.20	**71 69**
43	New Zealand	"	"	29.25	2.29	62.56	31.25	2.31	**70.78**
44	New American	"	"	26.38	1.43	45.41	30.60	2.13	**69.85**
45	Green Mountain	"	"	26.50	1.67	54.59	30.63	2.01	**68.75**
46	Lincoln	"	"	26.25	1.54	46.32	32.86	2.08	**66.82**
47	High Bred	"	"	33.88	1.76	37.41	37.07	.....	**65.83**
48	Black Beauty	"	Black	28.13	1.21	37.41	32.47	2.04	**65.19**
49	Pringle's No. 6	Main	White	25.38	1.98	38.15	31.13	2.61	**62.55**
50	Excelsior	Spreading	"	25.88	1.53	42.09	30.24	2.36	**62.47**

OATS.—COMPARATIVE TEST OF 103 VARIETIES.—*Concluded.*

No.	Varieties.	Nature of head.	Color of grain.	Results for 1897.			Average results for number of years grown.		
				Weight per measured bushel.	Yield of straw per acre.	Yield of grain per acre.	Weight per measured bushel.	Yield of straw per acre.	Yield of grain per acre.
	Grown for five years:—*Con.*			lbs.	tons.	bus.	lbs.	tons.	bus.
51	Royal Prize Cluster	Spreading	White	33.25	1.29	34.32	38.19	2.17	**59.12**
52	South Carolina Black	"	Black	32.13	1.02	36.82	33.43	2.15	**58.77**
53	Rust Proof	"	White	34.75	1.27	36.85	35.14	2.22	**58.72**
54	Jarman's White Monarch	"	"	34.75	1.32	38.56	36.68	2.25	**57.18**
55	North Star	"	"	34.63	1.51	39.21	37.69	2.01	**54.92**
56	Challenge	"	"	30.75	2.00	39.53	36.00	2.47	**54.86**
57	Jarman's Black Defiance	Main	Black	23.13	1.95	29.32	27.37	2.35	**52.30**
58	Texas Rust Proof	Spreading	Dun	24.25	1.39	34.56	26.73	2.10	**43.20**
	Grown for four years:								
59	Peerless	Spreading	White	25.88	1.67	53.35	30.45	2.55	**82.16**
60	Bolton	"	"	25.50	1.52	51.74	30.79	2.21	**75.85**
61	Surprise	"	"	27.88	1.52	48.94	32.02	2.46	**75.57**
62	Bonanza King	"	"	25.75	1.66	46.74	31.97	2.09	**73.61**
63	Negro Wonder	"	Black	27.00	1.59	44.71	31.51	2.31	**72.76**
64	Improved White Russian	Main	White	26.50	1.79	53.32	31.56	2.45	**71.97**
65	Hull	"	"	25.50	2.36	42.24	30.43	2.60	**68.10**
66	Pride of America	"	"	34.13	1.99	43.24	35.89	2.56	**67.91**
67	White Swede	"	"	26.38	2.34	46.26	31.94	2.67	**67.63**
68	Australian Square Head	"	Yellow	24.00	1.94	40 53	29.02	2.44	**65.92**
69	Lousinee	Spreading	White	25.25	1.65	48.44	30.78	1.69	**58.57**
70	Mammoth Cluster	Main	Black	22.25	2.00	32.26	27.82	2.46	**58.25**
71	Salzer's Great Northern	Spreading	White	25.88	1.47	51.74	31.13	1.66	**55.93**
72	Red Tamworth	"	Dun	22.50	.96	29.00	25.94	1.85	**45.76**
	Grown for three years:								
73	New Electric	Spreading	White	25.25	1.41	46.74	29.94	2.17	**77.56**
74	Nameless Peauty	"	"	24.63	1.52	48.79	29.51	2.21	**77.42**
75	New Siberian	"	"	23.25	1.69	44.71	30.12	2.48	**75.65**
76	White Bedford	"	"	25.13	1.58	42.38	26.31	2.38	**74.67**
77	Black Diamond	"	Black	28.75	1.67	45.76	32.59	2.27	**74.38**
78	Daubeney	"	White	32.88	.90	47.00	35.13	1.51	**73.21**
79	Mexican Grey	"	Mixed	28.50	1.49	38.97	31.50	2.14	**68.72**
80	White Superior Scotch	"	White	37.00	1.11	34.94	39.91	1.98	**62.11**
81	Prolific Side	Main	"	33.25	1.56	37.74	35.28	2.38	**58.68**
82	Royal Doncaster	Spreading	"	34.75	1.26	34.50	34.88	2.19	**54.15**
	Grown for two years:								
83	Illinois	Main	White	28.38	1.53	48.06	31.29	1.74	**59.77**
84	Early Golden Prolific	Spreading	"	28.63	1.37	45.82	30.51	1.84	**57.70**
85	Danish Island	"	"	26.13	1.52	45.76	28.01	1.86	**56.29**
86	Abundance (O.A.C.)	"	"	27.63	1.38	45.59	28.26	1.89	**56.11**
87	Pearce's Black Beauty	"	Black	29.38	1.53	45.53	31.26	1.80	**54.05**
88	Abundance (D.E.F.)	"	White	27.00	1.31	46.74	26.75	1.91	**54.01**
89	White Star	"	"	29.50	1.51	43.65	31.35	1.91	**52.01**
90	Michigan University	"	"	28.25	1.66	48.26	30.53	1.86	**51.38**
91	Improved Ligowa	"	"	29.75	1.55	38.50	28.47	2.16	**49.17**
92	White Dutch	"	"	36.13	1.42	31.03	36.22	2.03	**44.23**
93	Fife	"	"	32.50	2.03	42 29	29 88	2.02	**39.98**
94	Black Irish	Main	Black	24.38	1.65	24.91	26 44	2.14	**37.78**
95	Perpetuated White Tartarian	"	White	18.88	2.40	22.12	23.82	2.17	**30.00**
	Grown for one year:								
96	Salzer's Gold Mine	Spreading	White	25.50	1.84	50.65	25.50	1.84	**50.65**
97	Tyrolian	"	"	30.13	1.55	49.91	30.13	1.55	**49.91**
98	Newmarket	"	"	28.25	1.63	42.38	28.25	1.63	**42.38**
99	Golden Tartarian	Main	Yellow	23.00	1.88	37.88	23.00	1.88	**37.88**
100	New Seizure	"	"	22.50	1.83	36.50	22.50	1.83	**36.50**
101	Whiteside	Spreading	White	34.38	1.42	33.91	34.38	1.42	**33.91**
102	Washington	"	"	31.50	1.58	30.74	31.50	1.58	**30.74**
103	Mortgage Lifter	"	"	35.00	1.31	30.38	35.00	1.31	**30.38**

The plots used for the variety tests for oats in 1897 were all exactly the same in size and shape, each plot being ten links wide by 100 links long, thus making 1-100 of an acre. The grain was sown broadcast at the rate of seventy-five pounds per acre, and the seeding took place on the 23rd of April, except in the case of the two varieties, numbers 101 and 102, which were sown on April 24th. The land on which the oats were sown was an average clay loam which was comparatively new, having produced only two crops previous to the one of 1897. This land has never received any manure or fertilizers.

It is rather a striking feature in connection with the tests of the different varieties of oats, that in nearly all cases the varieties which have given the most satisfactory results for a number of years possess a spreading head. This is somewhat different from what some farmers would expect, as the varieties of oats which possess a side or main head give the impression when standing in the field that the yield of grain will be large, but when the crop is harvested it is frequently found that the impression which had been formed was not a true index of the productiveness of the grain. A careful study of the foregoing table will show the comparative results of the varieties possessing heads of a side and of a spreading character.

It will be noticed that but few of the black oats rank high in the comparative results. The Joanette, however, which is a variety only suited for good rich soil on account of its very short straw, is an oat which has given the largest average yield of grain per acre among all the varieties under experiment. This little French black oat has certainly left all the other black oats behind in regard to productiveness of grain. The Black Tartarian, which has been grown over Ontario more or less for a good many years, stands the lowest in yield per acre among the seventeen varieties which have been grown for nine years in succession.

It will be observed that the yield of oats in 1897 was much lower than the average of the past few years; the highest yield in 1897 being that of the Joanette, which was 62.8 bushels, and the lowest yield that of the Perpetuated White Tartarian, 22.1 bushels per acre. The quality of the grain produced during the past year was inferior. Quite a number of the varieties produced grain which weighed less than thirty pounds per measured bushel.

The reader's attention is directed especially to the three columns to the right of the table, which represent the average results for the number of years that each variety has been grown in the experimental department. These results should carry with them much weight, as they are from experiments which were conducted each year on plots that were the same in cultivation, state of fertility, etc. If a person has soil which naturally produces a large amount of straw, it will be well for him to select a variety which produces a straw somewhat below the average in yield per acre. Another person having a soil which naturally produces a small amount of straw, will be wise in selecting a variety which the average results show to be capable of producing straw in abundance.

Although the Joanette variety of oats stands at the head of the list in yield of grain per acre, still, as this variety possesses a very short straw, the Siberian variety, which stands second on the list in yield per acre, gives better results on the majority of farms throughout Ontario. Although the Siberian shows an average of only about four-fifths of a bushel per acre more than the American Banner, still it will be observed that the Siberian, in those two years, did not make a very high record, and therefore the average for the nine years is somewhat lower on this account. By comparing the average yield per acre of the Siberian with the Banner for the past seven years, we find that the former has given about five bushels per acre more than the latter, and has produced a grain which weighs on the average about three pounds per measured bushel more than the Banner.

The Abundance variety of oats was grown in our trial grounds from 1889 to 1893 inclusive; and, after a test of five years along with eighty other varieties, it was dropped as not being one of the best seventeen kinds. As the Abundance at the Central Experimental Farm, Ottawa, appeared to be giving good results, a small quantity was received, through the kindness of Prof. Wm. Saunders, and sown for comparison with the

Abundance which we had grown, as indicated above. These two samples have now been tested on plots side by side for two years in succession, and the results from them are very similar. One of the greatest weaknesses which we have found in regard to the Abundance oats, in our seven years' trials, is its comparatively low record in average weight per measured bushel.

Much more could be said in regard to the various varieties in the foregoing tables, but, as the results are placed very clearly in tabulated form, the reader is left to give the results a careful study and compare the varieties with which he is not familiar with those in the list with which he has been acquainted for several years, and thus glean information regarding the merits of the varieties under examination.

Broadcasting and Drilling. In 1897 an experiment was conducted on twelve plots by sowing oats at six different dates. The oats were sown at the rate of seventy five pounds per acre with an ordinary grain drill and also by hand on the six dates, beginning on April 18th and ending on May 26th. Each plot was 1-100 of an acre in size, being 10 links wide by 100 links long.

Date of seeding.	Results from different methods of seeding.		Results from different dates of seeding.			
	Methods of seeding.	Yield of grain per acre. Average, two years.	Weight per measured bushel.		Yield of grain per acre.	
			1897.	Average, 3 years.	1897.	Average, 3 years.
		bus.	lbs.	lbs.	bus.	bus.
April 18-19	Broadcasted	68.97	28.82	33.19	62.43	**82.95**
	Drilled	78.01				
April 22	Broadcasted	78.90	27.75	32.59	64.35	**89.83**
	Drilled	81.31				
May 1-4	Broadcasted	57.96	23 38	30.73	48.97	**74.10**
	Drilled	64.59				
May 9-10	Broadcasted	38.35	21.38	28.42	40.85	**59.40**
	Drilled	47.55				
May 18	Broadcasted	23.69	20.13	25.90	23.15	**39.71**
	Drilled	28.35				
May 25-6	Broadcasted	15.97	18.57	22.40	23.21	**36.16**
	Drilled	19.18				

It will be seen that, in the case of oats, the grain which was sown with a grain drill gave much better results than that which was sown broadcast at each of the six different dates. The results in favor of the drilled grain are more marked in the case of oats than in that of peas, spring wheat or barley.

As in 1896, grain which was sown on April 22nd gave a larger yield per acre than which was sown three and four days previous. In the average of three years' experiments it will be seen that the first date of seeding has given about seven bushels per acre less than the second date. A very striking feature in connection with the experiment is the average decrease in yield of grain per acre from the second to the sixth date of seeding. It will also be noticed that there is a marked difference in yield of grain per acre from the first to the last date of seeding. The grain produced from the seed sown on April 18th and 19th weighed about one-half more per measured bushel than that which was sown on the 25th and 26th of May.

Spring Rye.

Test of Varieties. For three years in succession the Prolific Spring and Dakota Mammoth varieties of rye have been grown in competition in our experimental grounds.

In 1897 the Colorado Giant rye was grown for the first time. These varieties were sown upon plots 1-100 of an acre in size on April 22nd. The grain was sown broadcast at the rate of two bushels per acre.

Varieties.	Results for 1897.			Average results for number of years grown.	
	Weight of grain per measured bushel.	Yield per acre.		Weight of grain per measured bushel.	Yield of grain per acre.
		Straw.	Grain.		
Grown for three Years:	lbs.	tons.	bus.	lbs.	bus.
1. Prolific Spring	55.00	2.62	26.00	56.39	**33.92**
2. Dakota Mammoth	56.94	2.05	28.41	57.73	**33.25**
Grown for one Year:					
3. Colorado Giant	52.94	1.52	16.30	52.94	**16.30**

It will be observed from the foregoing table that the yield of grain per acre and the weight per measured bushel for this year are both somewhat lower than the average for the past three years. The heaviest weight of grain per measured bushel in 1897 was 56.9 pounds, while that of the Colorado Giant weighed only 52.9 pounds. The results of the Prolific Spring and the Dakota Mammoth varieties have been very similar during each of the past three years, the average results showing a difference of less than one bushel per acre in yield of grain. The Colorado Giant, which is a large, coarse grained variety, gave a very poor yield in the experiments of the present year. The St. John's variety, which is not mentioned in the above table, was also down. It is claimed for this variety that it is suitable for seeding either in the spring or in the summer. The spring sowing, however, proved to be unsatisfactory, as the yield of grain produced was less than two bushels per acre.

Buckwheat.

Test of Varieties. Three varieties of buckwheat have been grown in the experimental department for four years in succession. The plots used for the experiment in 1897 were 1-100 of an acre in size. The buckwheat was sown broadcast at the rate of one bushel per acre.

	Weight per measured bushel.		Yield of straw per acre.		Yield of grain per acre.	
	1897.	Average 3 years.	1897.	Average 3 years.	1897.	Average 3 years.
	lbs.	lbs.	tons.	tons.	bus.	bus.
Japanese	51.0	45.8	2.87	3.04	28.25	**22.**
Silver Hull	54.3	50.8	3.24	2.76	30.48	**18.**
Common Grey	53.8	49.5	3.83	2.76	24.94	**15.71**

The weight per measured bushel and the yield of straw per acre for the four years in which this experiment was conducted are given in the above table. Owing to the fact

that the sparrows ate part of the grain after the buckwheat had been cut in 1896, the yields for that year are not given in the foregoing summary. For three years in succession the Silver Hull variety has given the largest weight per measured bushel, the average for these three years being 50.8 pounds. In the average yield of grain per acre it will be seen that the Japanese variety gave upwards of four bushels per acre more than the Silver Hull, and that the Silver Hull variety gave about two and a half bushels per acre more than the Common Grey.

Beans.

Test of Varieties. As quite large areas are devoted to bean growing for commercial purposes in some parts of Ontario, especially in the western section, we have considered it important to make a thorough test of the principal varieties which are grown in Canada, the United States, and England. Although nine varieties were grown in the experimental department for three years in succession previous to 1897, we thought it advisable to increase that number this season, and consequently secured leading varieties from various sources. The beans were planted on the 10th of June, on plots 1-100 of an acre in size, there being three rows of each variety, four rods in length. Three and one-third links (twenty-six and two-fifths inches) were allowed between the rows. The experiment was a very satisfactory one, and the different varieties had a good opportunity to show their relative merits of productiveness. The different varieties of Horse beans and of Soja beans are not reported in the following table.

Varieties.	Stage of maturity.	Weight per measured bushel.	Yield of grain per acre.
		lbs.	bus.
1 White Wonder	Early	67.38	**36.77**
2 Burlingame Medium	"	68.00	**35.23**
3 Medium or Navy	Medium	67.50	**33.42**
4 Schofield Pea	Early	67.50	**31.57**
5 Snowflake	"	68.75	**31.47**
6 Pearce's Improved Tree	"	67.75	**31.22**
7 Marrowfat	Medium	67.50	**30.93**
8 Bosion Pea	"	67.00	**30.13**
9 Great Western	"	66.88	**29.80**
10 Wisconsin Tree	Early	67.63	**29.72**
11 Day's Improved Leafless	Medium	66.75	**27.95**
12 Boston Favorite	"	57.63	**27.78**
13 Small White Field	Late	67.75	**24.38**
14 Russian Horticultural	Early	61.75	**23.23**
15 Buckbee's Electric Tree	Medium	67.13	**23.23**
16 Early Extra Field	Early	66.88	**23.15**
17 Dwarf Horticultural	"	62.63	**21.80**
18 Zeland Haricots	Late	64.38	**21.30**
19 Eureka	Medium	67.00	**20.93**
20 Yellow Eye, or "Boston Favorite"	"	64.88	**20.50**
21 Giant Dwarf Wax	"	57.50	**19.82**
22 Wilson's Yellow Eye Pea	"	65.75	**19.03**
23 White Valentine	Early	66.13	**18.65**
24 Golden Wax	"	63.13	**18.52**
25 Prolific Dwarf Tree	Late	66.19	**17.55**
26 Crimson Beauty	Early	59.50	**16.90**
27 Red Kidney	Medium	59.13	**16.30**
28 Giant Haricots	Late	51.63	**14.48**
29 Mexican Tree	"	65.38	**12.83**
30 Dwarf Kidney	"	61.25	**12.72**
31 Large White Haricots	"	58.88	**12.60**

The California pea bean, which stood at the head of the list in the average yield of grain per acre produced by the varieties grown for three years in succession previous to

1897, is not reported for this year, owing to the germination of the seed having been unsatisfactory. It will be observed from the foregoing table that the early varieties of beans gave larger yields per acre than the late varieties in the past season. The 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 made a rather poor showing in the experiments of 1897. These three varieties were also tested in Kent county this season, and the report shows that they did not give satisfactory results because of their lateness in maturing. These varieties will be tested again next year along with the other varieties, in order to secure the comparative results in different seasons. The experiment of the past year with beans shows the great importance of farm crops being thoroughly tested under Ontario conditions before they are grown extensively. It is very necessary to test carefully all foreign crops, in order to find out whether those varieties which give good satisfaction in other countries will prove to be a success or a failure in this Province.

The reader will notice that eight varieties of beans gave a yield of over thirty bushels per acre in 1897, and also that nineteen varieties produced grain which gave a weight per measured bushel of fully sixty-five pounds.

Test of Seven Varieties Grown for Four Years in Succession.—As seven varieties of beans have been grown in the experimental department for four years in succession, and as we put much stress upon the average results of experiments conducted for a number of years, we give in the following table the average yields per acre and the average weights per measured bushel of these seven varieties for the four years.

Varieties.	Weight per measured bushel.		Yield of grain per acre.	
	1897.	Average four years.	1897.	Average four years.
	lbs.	lbs.	bus.	bus.
Boston Pea	67.0	65.4	30.1	21.0
Medium, or Navy	67.5	65.0	33.4	20.9
Small White Field	67.8	65.5	24.4	19.8
Prolific Dwarf Tree	66.2	65.4	17.6	18.0
Marrowfat	67.5	64.6	30.9	15.4
Yellow Eye, or Boston Favorite	64.9	62.1	20.5	13.3
Giant Dwarf Wax	57.5	54.2	19.8	12.9

There is a little irregularity when the yield of 1897 is compared with the average of four years, as, for instance, the Prolific Dwarf Tree bean gave 17.6 bushels per acre in 1897, and an average of 18 bushels per acre for four years, while the Marrowfat gave a little over 30 bushels per acre in 1897, and yet has a lower average than the Prolific Dwarf Tree bean for four years. Some seasons are somewhat better adapted for certain varieties of crops than for others; hence the great importance of extending an experiment over a number of years, in order to get the average results under varying conditions. Some years the early varieties give the best results, while in others the later kinds make the best returns. These varieties, however, which give the best satisfaction over a number of years are the ones which are likely to give the best all round results in general cultivation.

Grain Sown in Mixtures for the Production of Grain and Straw.

Spring wheat, barley, oats and peas have been grown separately and in various combinations in each of the past five years for the production of grain and straw. The combinations used consisted of six mixtures, with two kinds of grain used in each case; four mixtures with three kinds of grain, and one mixture with four kinds of grain. This made eleven mixtures in all. The four varieties of grain were also grown separately.

These fifteen plots were sown in duplicate in each of the past five years. In 1897 the grain for this experiment was sown on April 24th on plots 1-100 of an acre in size. Thirty plots were used for this experiment in the past season. The land on which the mixtures were sown was comparatively new, having produced only three crops previous to 1897. The following table gives the results of this experiment for 1897, and also for the five years in which this experiment has been conducted.

Mixtures.	Yield of straw per acre.		Yield of grain per acre.	
	1897.	Average 5 years.	1897.	Average 5 years.
	tons.	tons.	lb.	lb.
1. Barley and oats	1.91	1.73	2,119	**2,197**
2. Barley, peas and oats	1.58	1.63	1,900	**2,046**
3. Barley, wheat and oats	1.72	1.66	1,896	**1,971**
4. Barley, peas, wheat and oats	1.72	1.69	1,850	**1,922**
5. Peas and oats	1.74	1.70	1,711	**1,902**
6. Wheat and oats	1.82	1.62	1,980	**1,863**
7. Peas, wheat and oats	1.67	1.69	1,814	**1,797**
8. Barley and peas	1.95	1.48	2,063	**1,687**
9. Barley, peas and wheat	1.85	1.52	2,176	**1,648**
10. Wheat and barley	1.78	1.36	2,083	**1,498**
11. Peas and wheat	1.43	1.36	1,678	**1,335**

As a general rule the oats have more influence in the yield of grain per acre in the various mixtures than any other one class of grain. As the oats were rather light in 1897, in comparison with the other kinds of grain, it will be seen from the yields of grain per acre for 1897 that the three mixtures which usually stand comparatively low have given excellent returns in the experiment for this season. Barley and peas, barley, peas and wheat, and barley and wheat each gave a little more than one ton per acre of grain in 1897. These mixtures also stood quite high in yield of straw. It will be seen however in the last column of figures to the right of the table, that in the average of five years' experiments a mixture of barley and oats has given the largest average return of grain per acre; and a mixture of barley, peas and wheat stands the lowest in this particular. In yield of straw per acre, a mixture of barley and oats has given the greatest returns. When a comparison is made between the different grains grown separately and the same grains grown in mixtures, it is found, in about 90 per cent. of the experiments, that the mixtures produced a larger yield per acre than the same grains grown separately.

Spring Grain—Selection of Seed.

The attention of the reader is directed to the results of the experiments which have been conducted in the experimental department in testing different qualities of seed of the several kinds of farm crops. It is our intention to continue the experiment for several years in order to find out the influence exerted on the crops by a careful selection of seed. The results obtained so far indicate that, to get good crops, good seed must be used.

Barley.—Large plump, small plump, shrunken and cracked barley was sown on experimental plots in 1894, 1895, 1896 and 1897. The Mandscheuri barley has been used for this experiment throughout. For the large plump sample, none but well developed grains were selected; for the small plump sample, the grains selected were all of a uniform character; and for the shrunken sample, none but shrunken grains were used—the last selection being made regardless of the size of the kernels. The sample of cracked barley contained nothing but grains which were broken cross-wise, as is frequently done by the

grain separator in threshing. The grain was sown on the 24th of April on plots 1-100 of an acre in size. There was an equal number of grains sown on each plot, namely, 4,125. In the case of the cracked grains, however, the same weight was used as of the large plump.

Selection.	Weight per measured bushel.		Yield per acre.			
			Straw.		Grain.	
	1897.	Average of 4 years.	1897.	Average of 4 years.	1897.	Average of 4 years.
	lbs.	lbs.	tons.	tons.	bus.	bus.
Large plump seed	49 94	48.59	1.93	1.44	59.43	**44.34**
Small plump seed	49.19	47.23	1.86	1.48	55.75	**41.00**
Shrunken seed	49 94	47.53	1.80	1.38	48.74	**37.27**
Cracked seed	48.44	46.75	1.75	1.30	48.76	**34.17**

The results of experiments conducted for four years go to show that the large plump seed produced a larger quantity and a better quality of grain than any of the other selections. The average yield per acre of grain from the large plump seed gave $3\frac{1}{3}$ bushels per acre more than that from the small plump seed, 7 bushels per acre acre more than that from the shrunken seed, and 10 bushels per acre more than that from the cracked seed. These results certainly point to the importance of a careful watch in the cleaning of seed barley, as it is not an uncommon thing for some of the grain to be cracked unless the separator is carefully looked after.

Spring Wheat. As in the case of barley, an experiment has also been conducted for five years in succession by making different selections of spring wheat. Large plump seed, small plump, and shrunken seed were selected with great care in each of the five years. The grain was sown upon plots one rod square, and the seeding took place on April 24th. One-half pound of the large plump seed was taken, the grains were carefully counted out, and it was found that there were 7,628 in the half-pound. An equal number of grains of the small plump aud also of the shrunken were used.

Selection.	Weight per measured bushel.		Yield per acre.			
			Straw.		Grain.	
	1897.	Average 5 years.	1897.	Average 5 years.	1897.	Average 5 years.
	bs.	lbs.	tons.	tons.	bus.	bus.
Large plump seed	57.63	58.61	2.06	1.35	35.17	**21.71**
Small plump seed	57.00	57.94	2.28	1.19	30.51	**17.83**
Shrunken seed	55.75	52.21	2.15	1.19	29.63	**17.61**

This experiment has been conducted for four years in succession, starting with fresh seed each year, in order to find out as accurately as possible the influence of different selections of seed in the first year's crop. In the average results for four years we find that in yield of grain per acre the small plump seed and the shrunken seed have given results very similar, there being about one-fifth of a bushel per acre in favor of the small plump seed; but from each of these there has been an average of about four bushels

per acre less than from the large plump seed. In weight per measured bushel, and in yield of straw per acre, the large plump seed has given decidedly the best results in the average of the five years' experiments.

White Oats. For four years in succession an experiment has been conducted in which large plump, medium-sized, and small sized grains have been sown on plots of exactly the same size and situated side by side. One-half pound of the large plump seed was selected, the grains were then counted, and it was found that there were 6,659 grains in the half-pound sample. An equal number of the medium-sized grains and also of the small sized grains were then selected from the same variety of oats, the Siberian variety being used in each of the four years. The grain was sown on April 24th, 1897, on plots exactly one rod square.

Selections.	Weight per measured bushel.		Yield per acre.			
			Straw.		Grain.	
	1897.	Average 4 years.	1897.	Average 4 years.	1897.	Average 4 years.
	lbs.	lbs.	tons.	tons.	bus.	bus.
Large seed	31.25	32.26	2.49	1.82	55.91	**51.85**
Medium seed	31.00	31.11	2.40	1.79	61.40	**48.40**
Small seed	29.25	31.43	2.41	1.82	51.01	**40.03**

Large plump seed produced grain which, in the average of four years, has weighed about one pound per measured bushel more than the grain produced by either of the other selections. In yield of grain per acre, it will be noticed that the medium-sized seed gave the largest yield in 1897; but, when the average of the four years is taken into consideration, it will be seen that the large seed produced 3.4 bushels per acre more than the medium seed, and 11.8 bushels per acre more than the small seed.

Sound and Cracked Peas for Seed.

It is a common practice among many pea growers to thresh the crop with the machine. In many cases more or less of the peas are cracked in the process of threshing. This, of course, does not injure the peas for feed; and, in order to obtain definite information regarding the value of the cracked peas for seed, an experiment has been conducted for five years in succession, in which whole peas and cracked peas have been sown upon plots side by side, in order to determine whether or not the cracked peas would give satisfactory results.

Some people have thought that if one half of the pea did not grow the other half would; but we find that by the time the cracked peas reach the seed soil, the germ is usually separated from the rest of the pea. The following table gives the actual results of the experiment for the past five years.

Selections.	Yield of straw per acre.					Yield of grain per acre.					
	1892.	1893.	1895.	1897.	Average 4 years.	1892.	1893.	1894.	1895.	1897.	Average 5 years.
	tons.	tons.	tons.	tons.	tons.	bus.	bus.	bus.	bus.	bus.	bus.
Whole peas	1.54	1.01	1.16	1.63	1.34	25.9	19.8	18.8	48.5	33.5	**29.30**
Cracked peas	.86	.27	.60	.61	.59	12.2	4.4	.8	20.0	11.5	**9.78**

From the above table it will be noticed that in no year did the cracked peas give half so large a yield of grain per acre as was realized by the same weight of sound peas. In the average results for five years, the sound peas gave a yield more than three times as great as that produced by the peas which had been cracked by threshing.

Much interest was taken in this experiment by the farmers who visited the institution when the crops were growing on the land. The experiment of each year formed an excellent object lesson, and many went away apparently convinced that it was advisable to feed the cracked peas and sow nothing but good seed. A few peas might easily be threshed each year either with the flail or with horses, in order to get seed of the proper quality for sowing, and thus prevent a loss of part of the seed and the risk of a poor crop.

Peas—Large and Small Seed.

In an experiment which has been conducted for two years, by sowing large peas and small peas on separate plots, much interest has been taken. Not only have the peas of this selection been sown in the field, but grain of the same selection has been sown in boxes in the experimental building, and the growing crop examined by visitors. When grown in the field plots of an exact size were used, and the same number of peas were sown per plot. It will, of course, be understood that the same variety of peas was used in every instance. The following table gives the results of this experiment for 1897, and also the average results for two years :

Selections.	Weight per measured bushel.		Yield of straw per acre.		Yield of grain per acre.	
	1897.	Average 2 years.	1897.	Average 2 years.	1897.	Average 2 years.
	lbs.	lbs.	tons.	tons.	busb.	bush.
Large peas	60.6	59.5	1.63	1.14	33.5	26.2
Small peas	58.5	58.7	1.48	1.04	38.1	22.6

It will be noticed that in every instance large peas have given better results than small peas. In yield of grain per acre, large seed has produced an average of 3.5 bushels per acre more than the small seed. In 1897, the yield was even more marked, being 5.4 bushels per acre in favor of the large seed. It will also be noticed that large seed produced grain which weighed nearly one pound per measured bushel more than that produced by the small peas.

Seed Peas Injured by the Weevil.

As the ravages of the pea weevil have become very extensive in some parts of Ontario, especially in the western portion, experiments have been conducted to find the value of peas for seed which have been injured by the pea weevil. Although some experimental work has been done in the plots in determining the comparative yields, we give in the following table simply the percentage of germination of the injured peas.

Peas injured by weevil.	Large variety Marrowfat, average 3 tests.	Small variety Golden Vine, average 3 tests.	Average large and small varieties, 6 tests.
Percentage that grew	41	13	27
Percentage that did not grow	59	87	73

As the preceding table gives the results so clearly, but few comments are necessary. It will be observed that in the case of a large variety of peas, like the Marrowfat, about 3-5 of the peas which have been injured by the pea weevil do not germinate. With a small variety of peas, such as the Golden Vine, which is used very extensively in Ontario, the injury is even more marked, as in the average of the three years' experiments only 13 per cent. of the peas which contained the weevil grew. Thus if a person were sowing weevily seed of the Golden Vine variety of peas, it would be necessary to sow about 15 bushels per acre in order to get as many plants as would be produced by two bushels per acre of good sound seed.

Selection of Seed for Four Years in Succession.

In 1894 a careful selection was made of different qualities of seed of barley, spring wheat, and oats. The selections made were sown on plots of exactly the same size which were situated side by side. From the crop produced in 1894 seed was again selected in the same manner and was sown on similar plots in the spring of the following year. From the crops produced from the different selections of seed in 1895, a similar selection was again made in the spring of 1896. The selection was again repeated the next year, and the different selections of seed thus secured were sown upon plots each of which was one rod square. Exactly the same number of grains were used for the plots in the experiment with each class of grain. There were, therefore, 4,125 grains sown on each barley plot, 7,268 grains sown on each spring wheat plot, and 6,659 grains sown on each oat plot in the spring of the present year. As this experiment is specially concerned with the quality of grain produced, a table has been arranged giving the number of grains per ounce in the crop produced from the different selections of barley, spring wheat, and oats in each of the past three years. The smallest number of grains per ounce means, of course, the largest sized grains. The following table does not indicate the exact selection made in the case of oats, as the experiment in this case was with large plump grains, medium-sized grains, and small-sized grains. This fact should be considered when examining the following table.

Selection.	Average number of grains per ounce of crop.								
	Barley.			Spring wheat.			Oats.		
	1895. 2nd yr.	1896. 3rd yr.	1897. 4th yr.	1895. 2nd yr.	1896. 3rd yr.	1897. 4th yr.	1895. 2nd yr.	1896. 3rd yr.	1897. 4th yr.
Large plump.....	600	782	621	958	1,043	949	1,143	1,874	1,309
Small plump.....	704	844	724	1,137	1,147	1,112	1,161	1,845	1,292
Shrunken.....	807	897	842	1,161	1,306	997	1,196	1,917	1,434

The reader will notice from the preceding table that in every instance the large plump seed produced the largest seeds, with but two exceptions, these being with oats in 1896 and 1897, when the medium seed produced a little larger grain than the large plump seed With but one exception shrunken seed produced smaller grains than the small plump seed. The exception was that of spring wheat in 1897.

Selection of Seed Oats for Five Years in Succession.

In the years 1883, 1894, 1895, 1896, and 1897, an experiment has been conducted with Joanette oats by selecting large plump well developed seeds; light weighing and light colored seeds; and also seeds from which the hull had been removed by the separ-

ator. The experiment was started in the spring of 1893 by selecting seed from the general crop of the Joanette oats of the previous year. The selection made in each of the following years was from the product of the selected seed of the previous year. The size of the plots used for the experiment was one square rod in every instance. The number of grains used on each plot was carefully counted and an equal number was used of each selection in each of the years in which this experiment has been conducted.

Selection.	Number of grains per ounce, 1897.		Weight of grain per measured bushel.					Yield of grain per acre.			
	Total.	Hulled.	1893.	1894.	1895.	1896.	1897.	1893.	1894.	1896.	1897.
			lbs.	lbs.	lbs.	lbs.	lbs.	bus.	bus.	bus.	bus.
Dark plump	1,302	160	32.3	34.5	32.9	27.9	34.8	45.7	67.3	43.4	53.4
Light	1,418	169	30.2	32.8	31.1	24.0	32.4	38.0	50.9	28.7	49.3
Hulled	1,402	185	33.8	34.9	33.4	26.6	33.0	34.4	57.4	41.5	57.9

In the results, which are presented in the tabulated form above, it will be seen that the comparative size of the grains produced in the fifth year from the selection of seed, the comparative weight per measured bushel for the first, second, third, fourth and fifth years of this experiment, and the yield of grain per acre for the first, second, fourth, and fifth years, are given in detail. Owing to some trouble from the sparrows destroying a small amount of grain after it was cut in the summer of 1895, the yields were not given for that year.

On an examination which was made of the comparative size of kernels produced in the crop of 1897, it was found that the light seed produced the smallest grain, the hulled seed the next smallest, and the large plump seed the largest and the heaviest grain. The seed which was hulled by the separator produced good results in yield of grain per acre, but the table shows that there were a greater number of hulled grains from this selection than from any of the others in the crop of 1897. In weight per measured bushel, the large black seed produced a crop in 1897 which weighed 2.4 pounds more than that from the light seed.

At first sight it is a little surprising that the hulled seed produces a larger yield of grain per acre than either of the other selections in 1897, while it gave a less yield per acre than the dark plump seed in each of the other years. It is only well developed seed, having a large kernel and thin hull, that will be hulled in threshing. It will be noticed that in 1896 the quality of oats was exceedingly poor, as the weight per measured bushel was less than 28 pounds in every case. It is quite probable that the oats in that year, which became hulled in the process of threshing, possessed a larger and plumper kernel than those with the hull on and which were selected with the naked eye from the crop produced from the dark plump seed. As the removal of the hull from the oats does not necessarily injure the germinating qualities of the grain, I think it can be easily seen why it would be quite consistent that the hulled grain would produce a larger yield than the other selections in 1897.

Spring Grain—Different Dates of Seeding.

For six years in succession, barley, spring wheat, and oats, and for five years in succession, peas, have been sown on three different dates, beginning on April 21st and ending on May 10th. The experiments were conducted in duplicate in each case. The plots in every instance were 1/100 of an acre in size, and the seeding was done broadcast

with the hand. The following table gives the average weight per measured bushel, and the yield of straw and grain per acre, for each of the crops for either five or six years, as indicated in the table :

Date of seeding.	Average weight per measured bushel.				Average yield of straw per acre.				Average yield of grain per acre.			
	Barley, 6 years.	Peas, 5 years.	Spring wheat, 6 years.	Oats, 6 years.	Barley, 6 years.	Peas, 5 years.	Spring wheat, 6 years.	Oats, 6 years.	Barley, 6 years.	Peas, 5 years.	Spring wheat, 5 years.	Oats, 5 years.
	lbs.	lbs.	lbs.	lbs.	tons.	tons.	tons.	tons.	bus.	bus.	bus.	bus.
April 21-22	50.08	58.63	59.22	33.04	1.21	1.14	1.14	2.04	40.72	32.75	17.80	**71.95**
May 1-4	48.43	59.90	58.56	31.58	1.20	1.12	1.03	1.85	36.55	31.42	14.40	**63.86**
May 9 10	46.09	60.39	57.61	29.17	1.08	1.04	.87	1.61	28.99	28.46	10.52	**53.48**

As this experiment has extended over a period of five years, the results should be of value in regard to the sowing of the leading kinds of grain at different dates in the spring of the year in a climate somewhat similar to that in which the experiment was conducted. If the results from early sowing appear to be more satisfactory than those from later sowing, by an increase in yield and quantity of grain in the county of Wellington, it is quite likely that the same will hold good in other sections of the Province, although the exact dates may not be the same in all cases. In average weight per measured bushel it will be seen that the barley, spring wheat, and oats produced the heaviest grain from the seeding of the first date ; the second heaviest grain from that of the second dute ; and the lowest from that of the third date. In the case of peas, however, such was not the result ; but exactly the reverse was true. As the season advanced from April 24th to May 10th, the quality of the peas improved.

In the yield of grain per acre, the results are very interesting, as they show decidedly the best returns from the first date of seeding, In the case of peas, however, the yield from the second date is not much in advance of that prodnced from the first date of seeding, and it will be noticed that the grain from the second date averages 1.3 pounds per measured bushel more than that from the first date. Taking all things into consideration, it will be seen that oats, spring wheat, and barley give decidedly the best results from the earliest dates of seeding, while in the case of peas the returns were about equal for the first two dates ; but those for the last date were not quite so good. The reader will observe that there were only about nineteen days between the first and the last date of seeding, but there was a decrease of about twelve bushels of barley, four bushels of peas, seven bushels of spring wheat, and eighteen bushels of oats per acre from the last date of seeding as compared with the first.

Drilling versus Broadcasting. The following is a summary table which gives the average results of sowing peas, wheat, oats, and barley with the grain drill and by hand in each of the past four years. The experiment was conducted in duplicate in each of these years. The plots were 1/100 of an acre in size in every case.

Methods of seeding.	Yield of straw per acre.		Yield of grain per acre.	
	1897.	Average, 4 years.	1897.	Average, 4 years.
	tons.	tons.	bus.	bus.
Broadcasted	1.21	1.59	25.63	**42.37**
Drilled.....	1.24	1.62	27.03	**43.13**

In the average results given in the above table for oats, spring wheat, barley and peas, it will be seen that in yield of grain per acre the drilled seeding gave about three pecks per acre more than that which was sown broadcast with the hand. It should be clearly understood that the land was in a good state of cultivation. Had the soil been in a poor state of cultivation, it is quite likely that the results would have been more marked between the two methods of seeding. In connection with the results of the foregoing summary report, the reader should also study the results of sowing the different classes of grains by the drill, and by hand, on each of six different dates. These results will be found after the variety test of each class of spring grain.

Experiments with Potatoes and Field Roots.

The experiments with potatoes and field roots in 1897 were conducted in the north-western section of the experimental grounds. The land on which the potatoes were situated sloped gently to the north-east, while that occupied by the field roots had a gentle southwesterly slope. The land had a grain crop in 1896, and was manured at the rate of twenty tons of farmyard manure per acre in the spring of 1897, previous to the planting of the potatoes and the sowing of the roots. The ground was plowed in the autumn of 1896, and was thoroughly worked in the spring of the present year. For the variety experiments, the plots were 1-100 of an acre in size; but, for the experiments with different methods of cultivation, the plots varied somewhat, according to the individual experiments. Under the heading of "Roots," experiments were conducted with fall turnips, swede turnips, mangels, sugar beets, carrots, parsnips and kohl-rabi. The number of plots devoted to the root experiments was about equal to that devoted to the experiments with potatoes. The germination of the seed in 1897 was quite satisfactory throughout.

Potatoes.

Fourteen experiments were conducted with potatoes in 1897, and were as follows:

1. Comparative test of 194 varieties.
2. Early varieties most suitable for home use and for market.
3. Depth of planting tubers.
4. Different methods of preparing seed.
5. Selection of seed for four years in succession.
6. Planting sets of different sizes with one eye in each set.
7. Planting sets of equal size having a varying number of eyes in each set.
8. Influence of plaster and lime when sprinkled on freshly cut potatoes for seed.
9. Planting potatoes on the same day as cut and at four days after cutting.
10. Planting single eyes from different parts of seed tubers.
11. Submitting seed to different exposures for three weeks before planting.
12. Methods of cultivation.
13. Treatment for the potato beetle.
14. Application of thirteen kinds of commercial fertilizers for six years in succession.

As several of these experiments have now been conducted for four, five, six and seven years in succession, much valuable information has been obtained. But as our report is to be completed one month earlier than usual this year, it is considered advisable to retain for more complete preparation the results of the experiments with potatoes, which will likely be presented in bulletin form at an early date.

Swede Turnips.

Test of Varieties. In 1897 seventy-nine varieties of Swede turnips were grown in competition in plots in the experimental department. Twenty-nine of these varieties have been grown for seven years in succession, six for six years, eleven for five years, thirteen for four years, five for three years, and nine for two years, and six varieties were grown in 1897 for the first time. Seeding took place on the 20th of June. The seed was sown on the flat in rows 26 2-5 inches apart. The rows were four rods long, and there were three rows of each variety. When the plants reached about two inches in height, they were thinned to a distance of ten inches apart in the rows. The land was cultivated as required until the turnips were too large to allow the cultivation to continue. The land was kept comparatively flat throughout the season.

Varieties.	Results for 1897.			Average results for number of years grown.		
	Yield of tops per acre.	Average weight per root.	Yield of roots per acre.	Yield of tops per acre.	Average weight per root.	Yield of roots per acre.
Grown for seven Years:	tons.	lbs.	tons.	to s.	lbs.	tons.
1 Hartley's Bronze Top	5.40	2.10	23.65	5 92	2.18	**21.11**
2 White Swede	6 30	1.81	19.45	7.21	2.10	**19.88**
3 Skirving's Swede	7.25	1.95	21.90	6.46	2.06	**19.81**
4 Budlong White	3.00	1.80	20.50	4.14	1.77	**19.44**
5 Knowheld	5.05	1.93	20 20	5 61	2.06	**19.41**
6 P. W. & Co.'s Imperial Prize P. T	6.15	1.82	19.10	6.43	2.12	**19.30**
7 Our Selected Purple Top	4.55	1.69	17.85	5.32	2.07	**19.04**
8 Carter's Imperial Hardy	5.20	1.68	16.90	6.37	2.07	**19.00**
9 Green Top	6.60	1.88	20.75	6.77	2.03	**18.75**
10 Westbury's Improved	5.00	1 65	15.60	6.17	2.04	**18.63**
11 Sharp's Improved	4.50	1.63	15.35	5.64	1.95	**18.59**
12 Hazard's Improved	5.45	2.02	18.20	5.52	2.15	**18.59**
13 Sutton's Champion	4.15	1.77	15.55	5.25	2.10	**18.53**
14 East Lothian	6.00	1.75	19.10	6.08	1.99	**18.28**
15 King of the Swedes	4.50	1.72	19 65	5.67	1.97	**18.24**
16 Highland Prize, P. T	4.80	1.79	18.75	6.74	1.95	**18.18**
17 Carter's Prize Winner	3·15	1.56	11.80	5.76	1.97	**18.13**
18 Hall's Westbury	4.15	1.77	18.55	4.94	1.95	**18.13**
19 Bangholm	3.80	1.87	15.50	5.88	2.05	**18.06**
20 Laing's Improved	5.15	1.82	20.50	5.84	1.87	**17.99**
21 Drummond's Imperial	5.20	1.60	16.55	5.60	1.94	**17.86**
22 Marquis of Lorne, P. T	5.30	2.04	22.15	5.81	1.98	**17.86**
23 White Sweet Russian	5.90	2.06	20.15	6.95	1.88	**17.74**
24 Royal Norfolk, P. T	5.00	1.89	20.45	5.31	1.92	**17.63**
25 Marshall's Purple Top	9.50	1.46	13.95	6.25	2.04	**17.56**
26 Maston's Purple Top	4.00	1.76	18.70	5.53	1.89	**17.48**
27 Carter's Elephant	4.20	1.69	16.00	5.85	1.97	**17.22**
28 White Rock	4.05	1.78	20.15	5.10	1.80	**17.18**
29 Ashcroft's Purple Top	8.90	2.11	14.25	4.71	2.01	**15.24**
Grown for six Years:						
30 Queen of Swedes	5.25	2.36	25.45	5.87	2.06	**20.79**
31 Laidlaw's Improved	5.50	2.47	28.25	5.88	2.02	**30.73**
32 Crimson King	5 20	2.16	25.10	5.98	2.02	**20 08**
33 Shamrock	4.50	2.22	25.30	5.85	2.00	**20.03**
34 Rennie's Prize Purple Top	5.05	2.22	25.75	6.10	2.09	**19.96**
35 Aroostook Ruta Baga	4.25	1.76	20.60	5.84	1.75	**18.03**

SWEDE TURNIPS—*Continued.*

Varieties.	Results for 1897.			Average results for number of years grown.		
	Yield of tops per acre.	Average weight per root.	Yield o roots per acre.	Yield of tops per acre.	Average weight per root.	Yield of roots per acre.
Grown for five Years:	tons.	lbs.	tons.	tons.	lbs.	tons.
36 Kangaroo	4.85	2.27	25.75	6 35	2.21	22.13
37 Improved Long Island	4.65	2.51	29.25	5.64	2.15	21.81
38 Jarman's Improved King of West P.T	5.65	2.07	22.80	6 56	2.08	20,32
39 N. B. & G. Co's. Prize Winner	6.10	2.02	21.20	6.38	2.06	19,87
40 Scotch Champion	6.60	1.98	21.15	6.59	1.96	19.85
41 Maule's Heavy Cropping	5.25	2.12	24.25	6.06	1.98	19.73
42 Bloomsdale	6.25	2.07	22.90	6.64	1.96	19.48
43 Jumbo, or Monarch	4 90	1.98	21.50	6.28	1.99	19.06
44 Hurst's Monarch	4.50	1.88	21.10	5.86	1.93	18.65
45 White French	6.15	2.05	23.90	6.93	1.80	17.97
46 Thorp's Improved Shipping	4.55	1.62	18.10	5.25	1.74	17.18
Grown for four Years:						
47 Buckbee's Giant	5 00	2.19	23.45	6.58	2.21	21.31
48 Dreer's Improved Purple Top	4.20	2.50	27.85	4.61	2.01	20,52
49 New American Yellow	5.90	2.08	24.75	6.07	2.02	19,82
50 Mammoth Russian	4·15	2.41	27.30	5.33	1.91	19,81
51 Halewood's Bronze Top	5.10	2.35	25.25	5.45	1.98	19.49
52 Keith's Green Top	4.70	1.98	23.55	6.31	2.03	19.33
53 Skirving's Liverpool	4.65	2.26	25.80	6.32	1.98	19.08
54 Improved American Purple Top	5.00	1.98	23.10	6.00	1.96	18.90
55 Crosse's Improved	5.80	1.88	20.70	6.98	1.81	17.88
56 Sweet German	6.10	2.29	25.65	5.68	1.70	17.43
57 Burpee's Breadstone	3.15	1.67	19.50	4.97	1.69	17.11
58 Burpee's Improved Purple Top	3.55	2.18	24.45	5.54	1.53	15.85
59 American Breadstone	3.00	1.92	21 70	3.95	1.56	15,27
Grown for three Years:						
60 Simmer's Champion Purple Top	5.35	2.25	25.10	5.88	1.86	19.57
61 Perfection Purple Top	4.30	2.18	24.55	5.41	1.88	19.49
62 White Giant Purple Top	4.20	2.19	23.40	5.98	1.87	19 47
63 Mammoth Siberian	4.20	2.17	23.30	4.80	1.78	17 75
64 Pearce's Standard	4.60	1.97	20.05	5.55	1.68	17.44
Grown for two Years:						
65 Sutton's Magnum Bonum	4.75	2.28	26.15	6.10	2.26	24.88
66 Gloucester White Fleshed G. T	6.65	2.19	25.50	7.58	2.01	23,73
67 Improved Purple Top Yellow	4.70	2.03	22.75	5.30	2.16	23,50
68 Lord Derby Green Top	5.60	2.13	23.45	5.91	2.07	22,85
69 Mammoth Clyde P. T	4.70	2.07	23.70	5.78	1.98	22,03
70 Evans' New Ontario P. T	3.80	1.94	22.65	5.28	1.91	21,75
71 Evans' Improved Monarch or Elephant	4.80	1.87	21.20	6.30	1.86	20,43
72 Sheppard's Golden Globe	4.40	1.74	19.05	5.45	1.75	19.13
73 Fettercairn Green Top	5.25	1.83	19.85	7.08	1.79	19.00
Grown for one Year:						
74 Vaughan's Improved	4.35	2.01	23.10	4.35	2.01	23.10
75 Myer's Purple Top Beauty	3.50	1.94	21.40	3.50	1.94	21.40
76 Kinaldie Green Top	4.55	1.86	20.35	4.55	1.86	20.35
77 Webb's Giant King	5.05	1.74	17.95	5.05	1.74	17.95
78 Dakota Gem	4.35	1.56	16.15	4.35	1.56	16.15
79 Vick's Imperial P. T	4.00	1.53	16.05	4.00	1.53	16.05

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In the table on results of Swede turnips, it will be noticed that the yield of tops per acre, the average weight per root, and the yield of roots per acre, for each of the varieties, are given for 1897, and also for the number of years that the varieties have been grown on the experimental plots. It will be observed that there is quite a variation in the amount of tops produced by Swede turnips of different varieties—for instance, one variety gave as high as nine and one-half tons of tops per acre, while another variety, under similar conditions, gave only three tons per acre. About one-half of the varieties produced roots which averaged over two pounds each in the crop of 1897. The heaviest average roots were produced this year by the Improved Long Island and the Dreer's Improved Purple Top varieties of Swede turnips. These two varieties gave 29.25 and 27.85 tons of roots per acre respectively.

The reader's attention is especially directed to the column of figures at the right hand side of the table, as these give the average yield of roots for the number of years that each variety has been grown in the experimental department. The varieties are mentioned in the list according to their comparative yields, as indicated by the last column referred to. From these figures, it will be seen that the Hartley's Bronze Top heads the list, with an average of 21.1 tons of roots per acre. As there have been twenty-nine varieties tested for seven years in succession, the Hartley's Bronze Top occupief a high place as a large yielder. A few varieties have given an average of only about three-fourths as large a yield per acre as the Hartley's Bronze Top; and the variety standing next to it in yield per acre, has produced about $1\frac{1}{5}$ tons less than the Hartley's Bronze Top in the average of seven years.

Thinning Plants in the Drill. An experiment has been conducted for six years in succession, in which Swede turnips have been thinned to 4, 8, 12, 16 and 20 inches between the plants in the drill. The experiment was conducted in duplicate during each of these years. In 1897, the plots were 1-100 of an acre in size. The soil upon which this experiment was conducted this season was comparatively new, as only three crops had been taken from the land previous to this year, and the soil never received any farm-yard manure or commercial fertilizers. The plants were thinned when about two inches high and were left at the distance required.

Distance between roots in the drill.	Yield of Tops per acre.		Average weight per root.		Yield of Roots per acre.	
	1897.	Average 6 years.	1897.	Average 6 years.	1897.	Average 6 years.
	tons.	tons.	lbs.	lbs.	tons.	tons.
4 inches	2.90	5.62	.53	.77	13.03	**17.26**
8 inches	3.03	5.04	1.03	1.41	13.93	**17.58**
12 inches	2.35	4.66	1.38	1.83	11.28	**15.56**
16 inches	2.23	3.87	1.79	2.31	11.70	**15.35**
20 inches	1.90	3.93	1.85	2.51	9.98	**13.52**

It will be seen from the foregoing results that the crop in 1897 was comparatively light, being about four tons per acre less than the average yields for six years. Although there is not much difference in the average yield of roots per acre produced from the thinnings of four and eight inches, it will be noticed that as the distance increased from eight to twenty inches, the yield gradually decreased. There is an average difference of almost four tons of roots per acre in favor of the eight inch thinnings, as compared with the thinnings of twenty inches. This holds good in the yield of 1897, and also for the average yields of six years. It might be taken as a general conclusion, that as the distance between the plants increased from eight to twenty inches, the average yield per acre decreased, but the average weight per root increased.

Different Distances Between the Drills. An experiment in sowing Swede turnips in drills twenty, twenty-six and thirty-two inches apart was conducted in duplicate in 1892, 1893, 1894, 1896 and 1897. The roots were all thinned to a distance of ten inches apart in the row when they were about three inches in height. The character and prepara

tion of the soil, including manuring, etc, was the same in 1897 as that mentioned in the experiment with the varieties of Swede turnips. The seeding was done on June 28th. There were ten rows in each plot, the rows being two rods in length.

Distance between drills.	Yield of Tops per acre.		Average weight per root.		Yield of Roots per acre.	
	1897.	Average 6 years.	1896.	Average 6 years.	1897.	Average 6 years.
	tons.	tons.	lbs.	lbs.	tons.	tons.
20 inches	4.06	5.15	1.48	1.53	16.29	17.97
26 inches	3.77	4.98	1.74	1.86	16.56	16.89
32 inches	3.82	4.89	2.26	2.10	15.55	15.70

As the soil for this experiment was somewhat different from that used for the experiments of thinning Swede turnips at different distances between the plants in the drill, and as it received a dressing of twenty tons of farmyard manure per acre in the spring of 1897, it will be seen that the yields per acre for this test are about three tons per acre larger than those of the previous experiment. Although the drills twenty-six inches apart gave a slightly larger yield per acre than the drills twenty inches apart in 1897, still, in the average results for six years, we find that the drills standing twenty inches apart gave about one ton per acre more than the drills placed twenty-six inches apart, and over two tons per acre more than those situated thirty-two inches apart.

Fall Turnips.

Test of varieties. In 1897 there were forty-seven varieties of fall turnips grown in the comparative test in the experimental plots. This class of roots is frequently called soft turnips, or white and yellow fleshed turnips. The land upon which this experiment was conducted in 1897 might be termed an average clay loam which produced a grain crop in 1896, and had no manure of any kind since the spring of 1895. The plots were 1-100 of an acre in size. Each plot consisted of three rows, four rods in length, the rows being 3 1-3 links (26 2-5) inches apart. The seed was sown on the flat and the land was kept comparatively level throughout the growing season. When the plants were about two inches high, they were thinned to a distance of about ten inches apart in the drills. At the time of harvesting, they were immediately weighed on being pulled.

In the month of July, 4.8 inches of rain fell, and in August 3.4 inches. These were two very wet months, the land being soaked with water nearly all the time. Hence, it proved to be an unfavorable season for the production of healthy turnips of the fall varieties. Many of the roots were badly decayed. But as the land was very uniform throughout, and as all the varieties were subject to the same detrimental conditions, one of the most interesting and valuable results of the experiment for the past year is the record of the ability of the different varieties to resist the rot. The roots were accurately counted when the plants were partly developed, and before any rot had started. The number of roots which had not rotted at the time of harvesting was again counted, and the percentage of decayed roots was calculated from these notes. This information is given in the left hand column of results in the following table. It will be seen that the Cow Horn, Early American Purple Top, and the Yellow Stone were the only three varieties in which upwards of ninety per cent. of the roots were comparatively sound. In the case of Pomeranian White Globe, Early La Crosse, Yellow Globe, Yellow Aberdeen Purple Top, and Red Globe Norfolk Varieties, the portion of the roots not rotten when harvested was less than twenty per cent. As the rotting of the roots did not naterially influence the average size of the sound roots, good information in regard to the size of the roots of the different varieties is also given. In the following table it will be observed that the Jersey Navet, in the average of seven years' experiments, has produced roots which have given an average of 2.38 pounds apiece.

FALL TURNIPS.—*Continued.*

	Varieties.	Percentage of roots not rotten when crop was harvested.	Average weight per root.	
			1897.	Average for number of years grown.
	Grown for seven Years:		lbs.	lbs.
1	Jersey Navet	72	1.57	**2.38**
2	Greystone Improved	54	1.45	**2.36**
3	Purple Top Mammoth	77	1.89	**2.35**
4	Early American Purple Top	92	1.77	**2.22**
5	Early Purple Top Munich	37	1.54	**2.11**
6	Pomeranian White Globe	12	1.41	**2.10**
7	Red Globe Norfolk	19	1.17	**2.07**
8	Whitestone	38	1.58	**2.05**
9	Red Top Strap Leaf	71	1.48	**2.00**
10	Orange Jelly	20	1.11	**1.70**
11	Yellow Aberdeen Purple Top	17	1.03	**1.51**
12	Yellow Aberdeen Green Top	23	.86	**1.43**
	Grown for six Years:			
13	Imperial Green Globe	57	1.09	**1.61**
14	Purple Hybrid	41	.90	**1.43**
	Grown for five Years:			
15	Cow Horn	98	1.98	**2.16**
16	Jersey Lily	73	1.75	**2.09**
17	Yellowstone	92	1.94	**2.08**
18	Green Barrel	63	1.49	**1.99**
19	Early White Model	65	1.51	**1.92**
20	Sutton's Imperial Green Globe	61	1.43	**1.91**
21	White Flat Dutch Strap Leaf	46	1.53	**1.86**
22	Jarman's Selected Green Globe	53	1.46	**1.85**
23	White Six-Weeks	68	1.49	**1.85**
24	Extra Early Milan	26	1.16	**1.71**
25	Yellow Montgomery	86	1.12	**1.70**
26	Jarman's Improved Green Top Scotch Yellow	67	.83	**1.66**
27	Amber Globe	63	.93	**1.57**
28	Dale's Hybrid	56	1.05	**1.49**
29	Fosterton Hybrid	52	.85	**1.29**
30	Carter's Champion Green Top Scotch or Aberdeen Hybrid	40	.81	**1.19**
31	Seven Top	81	.80	**.91**
	Grown for four Years:			
32	Milk Globe	74	1.63	**2.73**
33	White Egg	84	1.59	**2.57**
34	White Lily	50	1.49	**2.11**
35	Early La Crosse	16	1.46	**2.04**
36	All Gold	31	1.30	**1.72**
37	Orange Sweet	23	1.16	**1.57**
	Grown for three Years:			
38	Red Top White Globe	81	2.53	**2.70**
39	Our Selected White Globe	21	1.79	**2.00**
40	Yellow Globe	17	1.18	**1.98**
	Grown for two Years:			
41	Long Tankard	34	1.32	**1.79**
42	Sutton's Favorite Purple Top Yellow Hybrid	35	1.13	**1.49**
43	Sutton's Perfection Green Top Hybrid	43	1.16	**1.45**
44	Yellow Finland	29	1.19	**1.44**
	Grown for one Year:			
45	White Top Strap Leaf	86	1.65	**1.65**
46	Large White Norfolk	58	1.38	**1.38**
47	Sutton's Purple Top Scotch	22	1.02	**1.02**

Thinning Plants in the Drills. This experiment has now been conducted for six years in succession, and consists in growing fall turnips in drills, having the roots thinned to the distances of four, eight, twelve, sixteen, and twenty inches apart. The experiment has been conducted in duplicate in each of the six years. The plots were exactly 1-100 of an acre in size, there being six rows each two rods long in every plot.

Distance between the plants in the drills.	Yield of tops per acre.		Average weight per root.		Yield of roots per acre.	
	1897.	Average 6 years.	1897.	Average 6 years.	1897.	Average 6 years.
	tons.	tons.	lbs.	lbs.	tons.	tons.
4 inches	4.30	7.18	0.62	0.97	16.80	**23.22**
8 inchss	4.25	6.42	1.27	1.74	17.50	**22.70**
12 inches	3.30	6.00	1.58	2.45	14.95	**21.31**
16 inches	2.75	5.84	1.94	3.06	13.80	**20.62**
20 inches	3.25	5.58	2.09	3.36	13.65	**18.80**

The reader will notice the uniformity in the results in the foregoing table. By examining the column which gives the average results for six years, it will be seen that there is a gradual increase or decrease in every instance. In yield of tops per acre, the largest amount was produced from the roots which were four inches apart. In yield per acre of the roots, the highest record was also made by plants situated four inches apart in the drills. There was a gradual decrease in yield as the number of roots became less, until in the case of those which had been thinned to twenty inches apart, the yield was only 18.8 tons per acre. In regard to the average weight of the individual roots, however, it will be seen that the roots having the greatest amount of room were decidedly larger than those situated closer together. The results go to show that both the size of the roots and the yield per acre can be regulated by the distances apart that the plants are allowed to remain on the land. If the farmer has plenty of land and a small amount of help, it might pay him best to grow large roots even if he should obtain a smaller yield. If, however, he has a fair amount of assistance and wishes to crop his land heavily, he will obtain a larger yield of roots per acre, and also a larger percentage of dry matter in the roots, by having them closer together on the land, providing he keeps within the limits of this experiment.

Different Distances Between the Drills. An experiment in sowing fall turnips twenty, twenty-six, and thirty-two inches apart has been conducted for four years in succession. In 1897 the seed for this experiment was sown on land which had not been ridged. The character of the soil, method of cultivation, etc., was similar to that described for the different varieties of Swede turnips. When the plants were about two inches high, they were thinned to a distance of ten inches apart in the drills.

Distance between drills.	Yield of tops per acre.		Average weight per root.		Yield of root per acre.	
	1897.	Average 4 years.	1897.	Average 4 years.	1897.	Average 4 years.
	tons.	tons.	lb.	lb.	tons.	tons.
20 inches	3.74	6.04	1.51	1.94	16.98	**22.88**
26 inches	3.77	5.82	1.81	2.28	16.18	**22.14**
32 inches	3.68	6.07	2.06	2.64	14.42	**20.8**

As can be seen in the foregoing table, the results of this experiment are quite regular. As the distance between the drills increase, the yields of roots per acre decreases, but there is at the same time an increase in the average weight of the individual roots.

MANGELS.

Test of Varieties. Sixty-two varieties of the long, intermediate and globe classes of mangels were grown in plots side by side in 1897. Of this number, twenty-seven have been grown for seven years in succession, seven varieties for six years, five varieties for four years, two varieties for three years, and four varieties for two years; and in 1897 six varieties were grown for the first time. The land on which the mangel seed was sown in the past year was quite uniform throughout, and was manured at the rate of twenty tons per acre previous to planting. The soil was plowed in the autumn of 1896, and was thoroughly worked on the surface in the spring of the present year. The seeding of the mangels took place on the 7th day of May, and the germination was very good indeed. The seed was sown on the level and the land was kept comparatively level throughout the season. When the young plants were about three inches in height, they were thinned to a distance of ten inches apart in the drills. There were three rows of each variety four rods in length, and the rows were situated 26 2-5 inches apart, thus making 1-100 of an acre devoted to each variety.

Varieties.	Results for 1897.			Average results for number of years grown.		
	Yield of tops per acre.	Average weight per root	Yield of roots per acre.	Yield of tops per acre.	Average weight per root.	Yield of roots per acre.
Grown for seven Years:	tons	lb.	tons.	tons.	lb.	tons.
1. Evans' Improved Mammoth Saw-leg (long red)	3 40	2 336	27.10	4.26	2.289	**25 17**
2. Simmer's Improved Mammoth (long red)	4.90	2.681	31.90	4.18	2 234	**25 11**
3. Steele's Long Red Selected	4 30	2.658	31.50	3.89	2.188	**24 25**
4. Carter's Champion Yellow Intermediate	2 50	2.383	28.60	3 01	2.192	**23.91**
5. Norbitan Giant (long red)	4.75	2.626	60.20	4 00	2.149	**23.45**
6. Elvetham (long red)	5 10	1.950	23.40	4 31	1.941	**22.60**
7. Eiffel Tower (long red)	3.95	2.261	26.90	3 61	2 037	**2[illegible].35**
8. Yellow Obendorf (intermediate)	3.10	2.221	25.65	3.01	1.946	**22.08**
9. Carter's Mammoth Long Red	4.65	2.376	27.80	4 09	2.011	**22 08**
10. Yellow Oval-shaped Giant	3.50	2.533	30.40	2 21	1 922	**21.55**
11. May's Mammoth Long Red	5.10	2.576	29 50	4.07	1.911	**21 50**
12. Oblong Giant (yellow)	3.20	2.493	29.80	2.49	1.916	**20.97**
13. New Monarch (long red)	4 20	2.357	27.70	3.38	1.823	**20 91**
14. Colossal Long Red	3.70	1.953	22.75	3.39	1.899	**20 71**
15. Chirk Castle (long red)	3.70	2.440	28.30	3.19	1.814	**20 42**
16. Giant Holstein (long red)	6 75	1.957	22.50	3.94	1.857	**20.41**
17. Mammoth Red (intermediate)	3.10	1.700	20.40	2 92	1.843	**19 90**
18. Mammoth Golden Giant (yellow intermediate)	2 40	1.972	25.25	2.67	1.687	**18.52**
19. Red Globe	5.15	2.529	35 10	2.72	1.673	**18.29**
20. Carter's Warden Orange (oval)	1.60	1.826	21.55	2.47	1 564	**17 56**
21. Yellow Globe	1.85	1.966	23.10	2.30	1.764	**16.70**
22. Clark's Devon Orange Globe	3.30	1.982	22.60	2.11	1 535	**16.41**
23. Golden Tankard	2.20	1.756	20 90	1.87	1.459	**16 21**
24. Fisher Hobb's Orange Globe	3.55	2.100	25.20	2.08	1.457	**15 51**
25. Kinver's Yellow Globe	2.15	1.816	22.70	2.01	1.391	**15.11**
26. Long Yellow	5.00	1.902	22.25	2.57	1.720	**15.17**
27. Oblong Giant Red	.75	3.000	4.50	1.63	1.886	**12.11**
Grown for six Years:						
28. Sutton's Mammoth Long Red	6.50	3.034	35.50	3.68	1.781	**19.50**
29. Canadian Giant (long red)	5.20	2,630	30.90	3.14	1.580	**17.24**
30. Gate Post (long red)	5.50	2.533	30.65	3.18	1.556	**16.78**
31. Beck's Champion Globe (yellow)	1.85	1.953	22.85	1.86	1.442	**16.15**
32. Berkshire Prize Yellow Globe	2.10	1 756	20.90	1.60	1.468	**15.88**
33. Sutton's Yellow Intermediate	2.20	1.992	24.20	1.57	1.390	**15.34**
34. Sutton's Golden Tankard	2.25	1.882	22.40	1.88	1,372	**14.83**

MANGELS.—*Continued*

Varieties.	Results for 1897.			Average results for number of years grown.		
	Yield of tops per acre.	Average weight per root.	Yield of roots per acre.	Yield of tops per acre.	Average weight per root.	Yield of roots per acre.
Grown for five Years:	tons.	lb.	tons.	tons.	lb.	tons.
35. English Prize (long red)	7.35	3.120	36.50	3.68	1.864	20.73
36. Yellow Leviathian (intermediate)	4.75	2.854	34.10	2.75	1.851	20.34
37. Giant Yellow Intermediate	3.35	2.311	27.50	2.57	1.798	19.76
38. New Eschendorf (yellow oval)	2.90	2.342	28.10	2.09	1.732	19.28
39. Ward's Oval (yellow)	2.55	1.939	23.75	2.21	1.684	19.30
40. Sutton's Yellow Globe	2.80	2.212	27.10	1.80	1.866	18.62
41. Jarman's Giant Long Red	5.60	2.550	30.60	3.29	1.678	18.52
42. Jarman's Giant Intermediate (yellow)	2.20	2.244	27.60	1.42	1.697	18.26
43. Yellow Ovoid	3.25	2.365	28.50	2.44	1.638	17.83
44. Jarman's Selected Golden Tankard	2.50	2.326	26.75	1.82	1.817	17.29
45. Jarman's Model Yellow Globe	1.95	2.185	27.75	1.61	1.557	16.17
Grown for four Years:						
46. Thorp's Own Yard Long	5.40	2.486	30.95	4.01	1.974	22.43
47. Jumbo (long red)	6.50	3.062	36.75	3.85	1.943	21.93
48. Carter's Warden Prize Yellow Globe	5.00	2.783	35.90	2.51	1.873	21.35
49. Dignity	5.80	2.538	30.20	3.23	1.880	20.74
50. Thorp's Own Champion Yellow Intermediate	2.00	2.351	28.45	1.81	1.773	19.92
Grown for three Years:						
51. Long White	5.20	2.504	32.05	3.49	2.028	24.50
52. Erfurt Model (yellow intermediate)	2.25	1.655	22.10	2.02	1.685	20.12
Grown for two Years:						
53. Surprise (long red)	5.05	2.605	31.00	3.48	2.348	27.00
54. Cornish Giant Yellow Globe	2.44	2.534	31.55	1.65	1.947	24.53
55. Sutton's Crimson Tankard (red)	3.00	2.104	26.50	2.08	1.912	22.50
56. Red Tankard	2.45	1.473	19.00	1.63	1.437	16.93
Grown for one Year:						
57. New Model	5.45	2.902	35.55	5.45	2.902	35.55
58. Taber's Yellow Gate Post	4.75	2.840	35.50	4.75	2.840	35.50
59. Riverhall Giant Yellow Globe	3.35	2.855	35.40	3.35	2.855	35.40
60. Golden King	3.48	2.618	33.90	3.48	2.618	33.90
61. Jersey Queen	1.98	2.504	32.55	1.98	2.504	32.55
62. Buckbee's New Mastadon	4.60	2.619	32.35	4.60	2.619	32.35

The average weight per root and the yield of tops and roots per acre for 1897, and for the average of the years in which the varieties have been under experiment, are here presented. It will be noticed that the yields for 1897 were good. Several varieties gave upwards of one thousand bushels per acre. Among twenty-seven varieties of mangels which have been grown for seven years in succession it will be seen that the Evans' Improved Mammoth Saw-log stands at the head of the list, with an average of 25.17 tons per acre. This variety is closely followed by Simmers' Improved Mammoth Long Red, with 25.11 tons per acre, which is again closely followed by the Steele's Long Red Selected, with 24.24 tons per acre. The fourth place is occupied, not by a long red variety, but by a yellow intermediate mangel which surpasses a large number of the long red strains of mangels in yield per acre.

Thinning Plants in the Drills. **In 1897 the seeding for this experiment took place on May 12th. The land used for this experiment was similar to that used for the experiment with the different varieties of mangels, having received a dressing of 20 tons of farmyard manure per acre in the spring of 1897. The seed was sown on the flat and the**

land was kept comparatively level throughout the season. The plots were exactly 1-100 of an acre in size, there being six rows 3½ links (26 2-5 inches) apart and two rods long in each plot. The plants were thinned to their respective distances when from two to three inches in height.

Distance between roots in drills.	Yield of tops per acre.		Average weight per root.		Yield of roots per acre.	
	1897.	Average 5 years.	1897.	Average 5 years.	1897.	Average 5 years.
	tons.	tons.	lbs.	lbs.	tons.	tons.
4 inches	5.94	7.38	1.11	1.08	32.21	**29.69**
8 "	4.30	5.52	2.18	1.90	32.20	**28.22**
12 "	4.59	5.05	3.30	2.66	33.15	**27.45**
16 "	5.15	4.83	4.48	3.32	35.70	**26.45**
20 "	4.23	4.17	5.21	3.80	31.38	**23.93**

The yields of mangels per acre from the thinnings of different distances between the plants in the drills, were somewhat different in 1897 from the average of the past five years. It will be noticed that the plots in which the mangels were sixteen inches apart in the drills, gave the largest yield of roots per acre in the past season, while in the average results for this experiment it will be seen that the mangels left comparatively close in the drill gave the largest yields per acre ; and as the distance between the roots increased the yield per acre decreased, but the average weight of the individual roots increased. While the average yield per acre for five years is a very good one indeed, being about nine hundred bushels per acre, the yield for 1897 is still larger, reaching nearly twelve hundred bushels per acre. The season appeared to be particularly favorable to the roots which had plenty of room for development, as the average weight of the roots which were thinned to twenty inches apart was over five pounds, while that of those four inches apart was only a little over one pound.

Different distances between the drills. The mangel seed for this experiment was sown on May 12th, and the plants were thinned to ten inches apart when from two to three inches high. The preparation and character of the soil was similar to that used in the preceding experiment.

Distance between drills.	Yield of tops per acre.		Averrge weight per root.		Yield of roots per acre.	
	1897.	Average 6 years.	1897.	Average 6 years.	1897.	Average 6 years.
	tons.	tons.	lbs.	lbs.	tons.	tons.
20 inches	4.58	3.72	2.11	1.78	32.84	**22.67**
26 inches	4.58	3.72	2.72	2.15	32.67	**21.38**
32 inches	4.39	3.78	3.20	2.52	31.32	**20.33**

It will be seen from the above table that as the distance increased between the drills the average size of the individual roots also increased, but there was a decrease in total crop of roots per acre in the returns of 1897 and also in the average for six years.

CARROTS.

Test of varieties. The plots on which the carrots were grown were twenty links wide by fifty links long, thus being 1-100 of an acre in size. There were six rows of each variety, the rows being two rods in length. Twenty-six and two-fifths inches were

allowed between the rows. The seeding took place on May 10th. When the plants were about three inches in height, they were thinned to an average of four inches apart in the rows.

Varieties.	Results for 1897.			Average results for number of years grown on plots.		
	Yield of tops per acre.	Average weight per root.	Yield of roots per acre.	Yield of tops per acre.	Average weight per root.	Yield of roots per acre.
Grown for six Years:	tons.	ozs.	tons.	tons.	ozs.	tons.
1. Pearce's Improved Half Long (white)	6.50	16.30	29.00	7.11	15.73	29.28
2. Steele Bro's. Improved Short (white)	6.90	16.19	29.30	7.33	15.59	28.88
3. Mastadon (white intermediate)	7.80	17.62	32.60	6.45	14.96	27.95
4. White Green Top Orthe (intermediate)	6.85	15.70	28.60	6.42	14.48	26.62
5. Large White Vosges (intermediate)	5.90	15.91	27.70	5.81	14.05	26.39
6. Simmer's Short White Vosges	8.35	18.12	32.00	5.82	13.95	25.77
7. Sutton's Yellow Intermediate	6.55	14.78	25.50	5.88	13.02	23.68
8. Large White Belgian	7.60	15.94	27.90	5.95	13.25	23.08
9. Giant Wiltshire (long white)	6.90	13.57	23.50	6.43	11.50	21.50
10. Danver's Orange (short red)	4.15	12.53	22.35	4.06	10.91	21.33
11. Guerande	4.90	14.20	25.20	3.53	9.72	20.78
12. Mitchell's Perfected (red intermediate)	5.85	13.08	23.10	4.09	10.96	19.47
13. Half Long Stump Rooted (red)	6.05	15.33	28.55	3.22	9.49	18.14
14. Carter's Orange Giant (long)	5.80	11.68	20.95	4.44	11.88	17.55
15. James' Scarlet Intermediate	5.00	10.62	21.05	3.56	8.46	16.06
16. French Intermediate	2.85	6.26	10.60	3.84	7.98	15.20
17. Sutton's Improved Intermediate (red)	4.65	11.44	20.45	3.18	8.35	15.91
18. Yellow Belgian	5.60	11.02	19.90	4.50	8.89	14.43
19. Long Red Surrey	2.40	7.89	15.00	3.82	7.97	14.85
20. Long Orange	6.75	10.73	20.25	5.63	7.91	14.85
21. Improved Long Red Altringham	4.70	9.84	17.00	3.92	7.48	13.18
Grown for five Years:						
22. Rubicon Half Long (red)	5.60	15.00	27.00	3.69	10.43	19.26
23. Chantenay (short red)	6.20	15.70	28.35	3.32	10.78	18.76
24. Nichol's Improved Large Orange	5.75	12.52	23.20	4.12	9.88	18.51
25. Nante's Half Long Stump Rooted (red)	2.70	10.84	20.50	2.82	9.09	17.03
26. Half Long Scarlet	4.30	11.21	20.95	3.45	8.42	16.95
27. Long Red St. Vallery	4.50	11.11	21.35	3.35	9.65	16.87
28. Jarman's Selected Green Top (long red)	6.60	15.00	24.80	3.15	12.83	12.10
29. New Long Red Coreless	1.55	6.30	10.75	1.89	6.05	11.28
Grown for four Years:						
30. Mammoth Intermediate Smooth (white)	6.70	18.55	32.70	5.73	17.38	31.38
31. Iverson's Champion White (intermediate)	7.10	15.35	27.70	6.44	15.98	26.19
32. Improved White Belgian (long)	6.50	13.77	24.70	5.11	12.93	22.11
33. Yellow Intermediate	6.75	14.43	23.90	6.49	14.18	21.20
34. Victoria (long red)	7.05	13.94	25.05	4.27	10.40	18.53
35. Midsummer (short red)	3.25	11.04	19.90	2.68	9.95	17.61
36. Yellow Giant	5.45	9.92	17.60	4.09	10.27	16.51
37. Early Half Long Carentian	1.60	6.42	11.60	1.38	5.85	10.96
Grown for three Years:						
38. Thorp's Own Short White	7.00	14.53	26.25	4.90	12.44	21.93
39. Henderson's Intermediate (red)	4.85	10.76	20.85	4.14	10.31	18.42
Grown for two Years:						
40. Carter's Gate Post Orange (long)	9.25	17.24	29.80	6.88	13.77	23.38
41. Intermediate Red	5.35	12.26	23.15	5.08	11.54	21.33
42. Cooper's Yellow Intermediate	7.30	14.90	27.00	6.03	17.66	21.13
43. California Mammoth Orange	4.70	10.17	18.95	4.75	10.22	18.35
Grown for one Year:						
44. Long Yellow Stump Rooted	6.70	16.03	27.70	6.70	16.03	27.70
45. Lobberich's Agricultural	4.60	14.03	25.00	4.60	14.03	25.50
46. Peer of All	5.60	13.47	24.80	5.60	13.47	24.80
47. Buckbee's Majestic	6.80	11.83	21.15	6.80	11.83	21.14

The average yield of carrots per acre is fairly constant one year with another, and the results from the different varieties of carrots at this place is very satisfactory indeed. It will be seen from the results here presented that twenty varieties gave twenty-five tons of roots per acre in 189., and three of the varieties gave upwards of thirty tons per acre. It will also be noticed that, in the average results for six years in succession, twelve of these varieties have given an average of twenty tons of roots per acre, three of which yielded over twenty-seven tons (900 bush.) per acre.

There are a number of intermediate white carrots which are very similar in general characteristics, and which have given good satisfaction. There is, however, some difference in the yield of those roots which are somewhat similar in general appearance.

Thinning Plants in the drills. An experiment in thinning plants to two, four, six, eight, and ten inches apart in the drill has been conducted in duplicate during each of the past six years. Owing to the unfavorable weather in 1895, the experiment was ruined for the season. We, therefore, have the results for five years to present in this report. The seed was sown on the level surface in rows $3\frac{1}{3}$ links (26 2 5 inches) apart. Each plot consisted of six rows, each two rods in length, thus making 1-100 of an acre in every plot.

Distances between plants in the drills.	Yield of tops per acre.		Average weight per root.		Yield of roots per acre.	
	1897.	Average 5 years.	1897.	Average 5 years.	1897.	Average 5 years.
	tons	tons.	lbs	lbs.	tons.	tons.
2 inches	6.40	7.50	.58	.61	28.18	**28.20**
4 inches	5.20	6.45	.84	.90	24.90	**25.45**
6 inches	5.48	5.50	1.30	1.23	25 55	**22.57**
8 inches	5.48	5.19	1.70	1.44	20 83	**20.46**
10 inches	4 78	5.11	2.01	1.45	18 58	**20.22**

The results of this experiment in growing carrots at different distances between the plants in the drills are very interesting. In the average of five years' experiments, 28 tons per acre were produced from the carrots which were left close together. As the distances between the carrots in the drills increased, the yields per acre decreased, until the limit of ten inches wns reached, when the average yield of carrots per acre was 20.2 tons.

Different distances between the drills. In 1897, an experiment was repeated for the sixth time in which carrots were sown in rows of twenty, twenty-six, and thirty-two inches apart. When the plants were two or three inches in height, they were thinned to an average distance of four inches apart. Two rows were used in each plot, the rows being two rods in length. An experiment was conducted in duplicate during each of the six years.

Distance between drills.	Yield of tops per acre.		Average weight per root.		Yield of roots per acre.	
	1897.	Average 6 years.	1897.	Average 6 years.	1897.	Average 6 years.
	tons.	tons.	lbs.	lbs.	tons.	tons
20 inches	6.36	6.03	.77	.77	28.46	**27.85**
26 inches	6 38	5.91	.97	.92	27.70	**26.33**
32 inches	6.36	5.49	1.01	.98	25.03	**22.74**

It will be seen that the drills situated twenty inches apart produced a little over five tons per acre more than those placed thirty-two inches apart, but the average weight of the roots from the close drills was only about $\frac{3}{4}$ that of the roots grown in the drills farther apart. The results are fairly uniform throughout, but should be considered along with those of the previous experiment, in which carrots were thinned to different distances apart in the drills.

Sugar Beets.

Tests of varieties. Much interest has been taken of late in the growing of sugar beets in Ontario, partly from the standpoint of their qualities for producing sugar, and partly from that of their value for feeding purposes. These varieties have been grown solely for the information of the Ontario farmer, who may desire to grow a quantity for feeding to his stock, and is desirous of securing the best varieties. Eight varieties have been grown for six years in succession, three for four years, and one for two years, and two varieties were grown in 1897 for the first time. The soil on which this experiment was conducted in 1897 was quite similar to that described in the experiment with varieties of mangels. Three rows, each four rods long, were given to each variety. When the plants were about two or three inches in height, they were thinned to an average of eight inches apart.

Varieties.	Color of roots.	Results for 1897.			Average results for number of years grown.		
		Yield of tops per acre.	Average weight per root.	Yield of roots per acre.	Yield of tops per acre.	Average weight per root.	Yield of roots per acre.
Grown for six years:		tons.	lbs.	tons.	tons.	lbs.	tons.
1. Lane's Improved	White	6.10	1.88	28.25	3.14	1.46	19.07
2. White Silesian	"	6.50	1.69	24.80	5.06	1.55	18.99
3. Red Top	Reddish	5.20	1.68	25.00	3.89	1.53	18.89
4. Champion	"	3.75	2.02	30.75	3.48	1.47	18.39
5. White French	White	7.60	1.36	20.95	4.40	1.39	16.74
6. Kleinwanzelben	"	7.75	1.57	22.70	4.97	1.28	15.49
7. Red Skinned	Reddish	6.50	1.62	23.20	3.59	1.21	14.82
8. Improved Imperial	White	6.60	1.41	20.50	3.96	1.62	13.11
Grown for four years:							
9. New Danish Island	Reddish	4.10	1.89	29.20	2.84	1.56	20.79
10. Jersey	"	3.90	1.58	23.20	3.23	1.45	19.37
11. French Yellow	Yellow	6.40	1.64	24.80	3.72	1.35	18.20
Grown for two years:							
12. Green Top White	White	10.20	1.88	27.65	6.75	1.60	21.44
Grown for one year:							
13. White	White	7.65	1.76	27.38	7.65	1.76	27.38
14. Vilmorin's Improved	"	7.40	1.50	21.60	7.40	1.50	21.60

The White Silesian, which has occupied the highest place in average yield per acre, for some years, is now surpassed by Lane's Improved, which has given a slight increase in yield per acre over the White Silesian in the average for six years. It will be noticed that the Lane's Improved gave nearly four tons per acre more than the White Silesian in 1897, hence the change in the order of these two varieties in the table. The Champion and the New Danish Island both gave excellent yields this year.

Parsnips—Comparative Tests of Eleven Varieties.

Up to the present year only four varieties of parsnips were grown in the experimental department in the comparative test for varieties for agricultural purposes. These four varieties were grown in 1897 for the third time; and, besides these, seven varieties were grown this year for the first time. Inquiries have frequently been sent to this department for information regarding parsnips for feeding purposes; we, therefore, felt the need of more information in regard to the various varieties of parsnips as a food for stock, as well as the results given by this class of roots in comparison with the other kinds of farm roots. The soil on which the parsnips were grown in 1897 was quite similar in every respect to that used for the varieties of sugar beets. The plots were 1/100 of an acre in size; and there were three rows, four rods long, in each plot. When the plants were about three inches high, they were thinned to a distance of eight inches apart in the drills.

Varieties.	Yield of tops per acre.		Average weight per root.		Yield of roots per acre.	
	1897.	Average for years grown.	1897.	Average for years grown.	1897.	Average for years grown.
Grown for three years:	tons.	tons.	lbs.	lbs	tons.	tons.
1. Improved Half Long	3.20	3.12	.81	.83	12.00	**12.56**
2. Improved Long Smooth	5.10	3.65	.93	.77	13.65	**12.18**
3. New Ideal Hollow Crown	2.90	2.79	.86	.78	13.30	**11.77**
4. Magnum Bonum	2.15	2.40	.74	.72	11.30	**10.39**
Grown for one year:						
5. Bloomsdale	4.35	4.35	.96	.96	15.00	**15.00**
6. New Maltese	3.90	3.90	.89	.89	14.95	**14.95**
7. Buckbee's New Sugar	3.25	3.25	.88	.88	13.50	**13.50**
8. Long White Dutch or Sugar	3.30	3.30	.85	.85	12.90	**12.90**
9. French Round	4.40	4.40	.82	.82	12.05	**12.05**
10. Early Short Round	3.55	3.55	.83	.83	11.55	**11.55**
11. Arlington Long Smooth	4.35	4.35	.73	.73	9.75	**9.75**

The Bloomdale variety, which was grown in the experimental department for the first time this year, gave the highest yield of roots per acre, namely, fifteen tons. This, it will be remembered, is considerably lower than many of the varieties of the other classes of roots. As the roots of parsnips penetrate deeply into the ground, the crop is one which is very hard to harvest, requiring much more labor than mangels, turnips or carrots. This is an objection to the growing of this class of roots for feeding purposes.

Kohl-rabi—Comparative Test of Six Varieties.

As Kohl-rabi is sometimes grown for food for stock in some of the older countries, three varieties were tested in the experimental plots in 1896, and six varieties during the present year. The yields in both seasons were quite satisfactory. The root of the Kohl-rabi somewhat resembles that of cabbage, while the leaves closely resemble those of the Swede turnip. The valuable part of plants, however, grows a few inches above the level of the ground in the form of a bulb. Kohl-rabi makes a very nice vegetable for domestic use, and is prepared for culinary purposes in much the same way as Swede turnips. The seed of Kohl-rabi resembles very closely that of Swedish and fall turnips, and the crop is grown in much the same manner as that of the other classes of roots. Plots 1-100 of an acre in size were devoted to each variety.

KOHL-RABI—COMPARATIVE TEST OF SIX VARIETIES.—*Continued.*

Varieties.	Yield of tops per acre.	Average weight per root.	Average yield per acre.
	tons.	lbs.	tons.
1. Large White	4.40	2.45	**36.40**
2. Earliest Erfurt	2.45	1.87	**27.15**
3. Early White Vienna	5.40	2.03	**26.95**
4. Purple Vienna	2.60	1.88	**25.85**
5. Green	3.25	1.99	**25.35**
6. Earliest Green Vienna	2.05	1.80	**23.10**

It will be seen that the Large White variety of Kohl-rabi gave a yield of 36.4 tons per acre in 1897. This is a yield of over 900 bushels per acre, which is certainly very satisfactory. There is a marked difference between the yields of the different varieties, the Earliest Green Vienna producing less than 2-3 and amount of the Large White variety.

MANGELS, CARROTS, SUGAR BEETS, SWEDE TURNIPS, AND FALL TURNIPS SOWN AT DIFFERENT DEPTHS.

An experiment was conducted in 1896 and 1897 with Swede turnips and fall turnips, and in 1897 with mangels, carrots, and sugar beets, by planting the seed one, two, three and four inches deep in the soil. The land used for this experiment in 1897 was similar to that used in the experiment with sugar beets. The seed was placed in the soil with great care; and the yields per acre were determined from the actual yield of the plots.

Depth of planting.	Yield of roots per acre (tons).					Average yield per acre.
	Mangels. 1897.	Carrots. 1897.	Sugar beets. 1897.	Swede turnips. Average 3 years, 1895-6-7.	Fall turnips. Average 2 years, 1896-7.	
1 inch deep	43.45	31.20	37.50	16.47	22.68	**30.26**
2 inches deep	41.75	15.15	28.35	13.08	19.96	**23.62**
3 inches deep	18.00	8.18	10.35	3.68	5.78	**10.00**
4 inches deep	7.28	5.85	1.73	1.40	1.05	**3.46**

The results here presented are very interesting, as they show quite distinctly a marked difference between the results obtained from planting seed of our common field roots at different depths in the soil. In every instance, the seed which was planted one inch deep gave the best result. The advantage of planting one inch deep as compared with planting two inches deep is most marked in the case of carrots and sugar beets. It will be noticed that the carrot seed which was planted but one inch deep gave more than double the yield produced by seed which was planted two inches deep. The seed which was planted four inches deep produced very few plants. It is considered advisable in any experiments of this kind to go even beyond what be met with in ordinary farm work, in order to secure a good general grasp of the subject under experimentation. Even though root seed may never be sown so deeply as four inches, still the experiment shows how the yield in all kinds of roots decreases to a very marked degree as the depth increases beyond two inches, and in some cases even beyond one inch.

Mangels, Carrots, Swede Turnips and Fall Turnips thinned at different stages of their growth.

An experiment was conducted in 1896 for the first time in thinning Swede turnips and fall turnips when the plants were about two inches in height, as compared with thinning them when they had reached the average of eight to ten inches in height. In 1897, however, this experiment was conducted with mangels and carrots. It may be said by some that plants are never allowed to reach eight to ten inches in height before they are thinned; but the writer has on several occasions seen roots thinned when they had reached fully that height. This experiment was conducted on land similar to that previously described for the variety experiment with fall turnips. The plots were 1-100 of an acre in size and the test in every instance was made in duplicate. The plants were carefully thinned in the rows, an equal number being left in each plot. The following table gives the results of each class of roots and also the average returns for the different classes of roots taken together:

Height of plants when thinned.	Yield of roots per acre (tons).				Average yield of roots (tons).
	Mangels, 1897.	Carrots, 1897.	Swede turnips, 1896	Fall turnips, 1896.	
Plants thinned when 1½ to 2 inches high	22.48	14.83	21 10	32 05	**22.62**
" 8 to 10 "	18.18	14.43	16.35	17.95	**16.73**

It will be seen that the plants thinned when young produced a larger yield of roots per acre than those which were not thinned until they reached an average height of from eight to ten inches. The difference in the results of the two dates of thinning is most marked in the case of the turnips, and is least marked in the experiments with carrots. In the average of the four kinds of roots, it will be seen that the plants which were thinned when young gave nearly six tons per acre more than those which were thinned at a later date.

Mangels, Carrots, Swede Turnips and Fall Turnips grown on the flat and on ridges.

This experiment has been conducted for two years in succession with all the classes of roots mentioned in the heading of this report, with the exception of carrots, in which case it was conducted in 1897 for the first time. The experiment was conducted in duplicate during each of the past two years. The land was ridged with a double mould-board plow, the ridges being made to the height of about four inches. The rows were exactly the same distance apart for the flat as for the ridged cultivation, being 26 2-5 inches in both cases. The yields per acre of the duplicate plots were averaged for each year, and the results for 1896 and 1897 averaged in the case of each class.

Method of cultivation.	Yield of roots per acre (tons).				Average yield per acre for all kinds of roots (tons).
	Mangels, 2 years.	Carrots, 1 year.	Swede turnips, 2 years.	Fall turnips, 2 years.	
Flat cultivation	23.30	15 23	13.08	18.38	**17.50**
Ridged cultivation	22.95	14.35	11.89	18.04	**16.81**

roots. In every instance the land which was cultivated on the flat gave a larger yield of roots per acre than the land which was ridged. In the case of fall turnips and mangels, however, the results were not very different, there being about one-third of a ton per acre in favor of the flat cultivation in each class of roots. In the results of the whole experiment, however, it will be noticed that the flat cultivation gave about three-quarters of a ton per acre more than the average realized from the land which was ridged with a double mould-board plow.

Mangels, Carrots, Sugar Beets, Swede Turnips and Fall Turnips grown from different selections of seed.

This experiment has been conducted for three years in succession with mangels and carrots, two years in succesion with Swede turnips and fall turnips, and was conducted in 1897 for the first time with sugar beets. In every instance the seeds of the different sizes were taken from ordinary stocks as sold by leading seedsmen. Large plump seed, medium-sized seed, and small-sized seed was selected from each class of roots mentioned. In selecting the seed great care was taken to use nothing but that which was apparently sound in every respect.

Selections.	Yield of roots per acre (tons).					Average yield per acre for all classes of roots (tons).
	Mangels, average 3 years.	Carrots, average 3 years.	Sugar beets, 1 year.	Swede turnips, average 2 years.	Fall turnips, average 2 years.	
Large plump seed	38.71	30.72	19.72	15.07	23.82	**25.16**
Medium-sized seed	34.74	27.44	20.25	13.66	19.70	**23.15**
Small-sized seed	24.67	20.38	19.05	2.46	10.90	**15.49**

The results of the foregoing table are certainly very suggestive as to the comparative value of the different samples of seed under experiment. In 1896 the results were influenced to a certain extent by the difference of the germination of the seed comprising the different selections, as the smaller seeds did not germinate so well as the larger ones. But as five seeds were dropped wherever it was desired to have one plant growing, it will be seen that a good showing was given to each selection of seed. In 1897, even more pains were taken by placing a larger number of seeds in the soil wherever a root was desired. As a result, we were enabled, by thinning, to have nearly an equal number of roots from the different selections, in order to show the comparative merits of the plants produced by seeds of different sizes. The results show that the large plump seed gave the largest yields and the medium-sized seed the second largest yields in every case, except with the sugar beets in 1897. In this particular instance, it will be noticed that the medium sized seed gave about half a ton per acre more than large plump seed. The results of this test, however, are from only one year's work, and may be looked upon as an exception to the rule as regards the results of the four classes of roots which have been used in this experiment for two and three years in succession.

Swede Turnips and Fall Turnips—Application of Fertilizers.

In both 1896 and 1897, an experiment was conducted in using commercial fertilizers with Swede turnips and fall turnips. The fertilizers used were nitrate of soda, muriate of potash, superphosphate, and a mixture of the three. There was one plot in each set of the experiments which was left without any fertilizers as a basis of comparison. One hundred and sixty pounds of the nitrate of soda, and also of the muriate of potash were used per acre, and three hundred and twenty pounds of the superphosphate. The mix-

ture was composed of these three fertilizers, one-third of the above quantity of each being used. In 1897, the test was made on comparatively new ground from which only three crops previous to this season had been removed. No fertilizers or manures of any kind had been applied to the land previous to this year. One row was left unfertilized between each two plots. The plants were thinned to ten inches apart in the drills.

Fertilizers.	Quantity of fertilizer per acre.	Yield of roots per acre (tons).				Average yield per acre, two classes of roots for 2 years.
		Fall turnips.		Swede turnips.		
		1897.	Average 2 years.	1897.	Average 2 years.	
	lbs.					
1. Mixture	213.3	14.95	20.78	13.18	16.39	**16.33**
2. Nitrate of soda	160.0	13.20	21.55	10.27	15.76	**15.20**
3. Superphosphate	320.0	13.00	19.20	12.18	15.33	**14.93**
4. Muriate of potash	160.0	12.05	19.78	8.88	14.19	**13.73**
5. No fertilizer		12.20	17.78	8.90	13.53	**13.10**

The mixed fertilizers gave over three tons per acre more than the unfertilized plot. The cost of the fertilizer in every case for the amount used per acre would be between $4.00 and $4.50. An increase of three tons of roots per acre was produced, in the case of the mixed fertilizers at a cost of about $4.50, which is equivalent to $1.50 per ton or nearly five cents per bushel.

Silage and Forage Crops.

A number of experiments have been conducted within the past six years, with corn, millet, rape, sunflowers, grasses, clovers, etc. We have conducted some very interesting experiments with several of the classes of crops under this heading, and the results should give valuable and interesting information regarding the comparative value of the different classes of crops, the different varieties in the same class, the special methods of cultivation, the selection of seed, etc. These crops are receiving increased attention year by year by the farmers of Ontario, especially in the cases of corn, rape, and mixed grain for green fodder.

Corn for Fodder, Silage and Grain.

The experiments in 1897 with corn were quite successful and include the following :

1. Comparative test of 173 varieties of sweet, dent, and flint varieties of corn.

2. Comparative test of 17 varieties of sugar cane, kaffir corn, Jerusalem corn, etc.

3. Planting of small, medium, and large varieties at different distances between the drills, and between the plants in the drills.

4. Planting seed taken from different parts of the ear.

5. Planting seed at different depths in the soil.

6. Using seed corn grown in Ontario as compared with seed which was grown farther south.

7. Growing corn from different selections of seed.

8. The comparative value of different kinds of commercial fertilizers for corn.

As this report has to be completed this year one month earlier than usual, it is considered advisable to retain for more complete preparation, the results of the experiments with corn, which results will likely be presented in bulletin form at an early date. As a number of the experiments have been conducted for five and six years in succession, valuable results have been obtained.

Millet—Comparative Test of Eighteen Varieties.

Exactly the same number of varieties of millet were grown in 1897 as in 1896. Three of the varieties, however, which were grown last year were dropped from our list, and three new varieties were introduced this year for the first time. Although seven of the varieties have been grown for six years in succession, it is considered advisable to give no more than three years results, as a number of the leading varieties have been grown for that length of time, and this would place a greater number of varieties under similar conditions, and thus give a better basis for the comparison of results. The plots used in 1897 for the experiments with the different varieties of millet were exactly 1-100 of an acre in size. The seed was sown broadcast and the germination of the different varieties was quite satisfactory. The crop of each variety was cut as it came into head and was weighed immediately after being cut.

Varieties.	Earliness or lateness of crops.	Average height.		Yield of crop per acre when cut.	
		1897.	Average for number of years grown.	1897.	Average for number of years grown.
Grown for Three Years.		ins.	ins.	tons.	tons.
1. Japanese (Crus Galli)	Late	63	40.3	23.1	14.8
2. " (Milleacum)	"	61	42.0	22.0	14.7
3. " (Italicum)	"	46	32.5	19.0	13.6
4. Holy Terror Gold Mine	"	42	34.2	16.6	12.5
5. East India Pearl	Very late.	46	33.3	20.7	13.2
6. Golden Wonder	Late	46	34.0	15.9	12.6
7. German or Golden	Early	38	34.2	12.8	12.5
8. Canadian	"	38	32.3	10.8	10.6
9. Salzer's Dakota	"	43	37.7	12.7	10.3
10. Magic	"	38	32.3	11.1	9.4
11. Hungarian grass	"	40	32.8	13.7	8.9
12. Common	"	41	34.8	11.5	8.1
13. White French	"	40	33.5	11.2	7.8
14. Californian	"	39	31.7	12.4	7.4
15. Red French	"	40	29.2	10.6	7.0
Grown for One Year.					
16. Siberian	Early	38	38.0	13.8	13.8
17. Early Harvest	"	36	36.0	12.8	12.8
18. Hog	"	38	38.0	10.4	10.4

The results here presented show a marked difference in average yield per acre in the fifteen varieties of millet which have been grown in the experimental department for three years in succession. Each of five of the varieties has given an average of over thirteen tons per acre, while each of three varieties has given an average of less than eight tons per acre. The three varieties of Japanese millets which were brought into the United States a few years ago by Prof. Brooks, of the Agricultural College, Amherst, Mass., have given the highest yields among all the different varieties of millets grown. Although the results in the table for 1897 show the yields of these three varieties to be 23.1, 22.0, and 19.0 tons per acre respectively, still the same three varieties, when grown in another section of the experimental field which had been highly manured, gave much better results. The millets grown in 1897, of which the results are recorded in the foregoing table, were sown on land which had never received any manure, and, although the soil is comparatively new, two crops had been removed from the land previous to 1897. The East India Pearl millet which gave a little over twenty tons of green crop per acre in the past season, is an exceedingly late variety, there being nothing but leaves produced

on the plants grown at this institution in each of the past three years. It is a plant suited for a climate much warmer than that of Ontario. The Salzer's Dakota millet now occupies ninth place among the fifteen varieties grown for three years in succession. This variety has been grown in our trial grounds for six years. It gave excellent results for the first two or three seasons, but we find it very difficult indeed, at the present time, to get seed of the same strain of stock as we secured in 1892; hence the results are not equal to those obtained at first. The variety was imported from the State of Minnesota.

Mixed Grains for Green Fodder.

A considerable amount of experimental work has been done in the experimental department in growing different classes of grain in mixtures for fodder purposes. An experiment was conducted in duplicate in 1892, 1893, 1894, 1895, and 1896 by sowing four kinds of grain separately, and in eleven different combinations, thus making use of exactly thirty-two plots for this test for each year. In the average results for five years, it was found that a mixture of peas and oats gave a larger yield of grain per acre than any of the other mixtures. This experiment was not repeated in 1897, but another experiment which had been conducted for five years in succession in growing different quantities of peas and oats per acre was again conducted. An experiment with different varieties of peas and oats for a mixed crop was also conducted in 1897.

Peas and Oats.—Different Varieties Grown in Mixtures for Green Fodder.

In 1897, different varieties of peas and oats were sown in mixtures for the production of green fodder. A very careful selection was made with the object of securing a crop that would come early in the season, another that would come somewhat later, and another that would come still later. This experiment was conducted in duplicate on plots which were 1-40 of an acre in size. As these crops showed a good appearance at the time when some fifteen or eighteen thousand farmers visited this institution in the month of June, much interest was taken in examining the growth of the plots. The seeding all took place at the same time, and the crops were harvested when in about the right stage of maturity for using as a green crop, the peas being nearly full size, and the oats in the milk condition. The following table gives the average results of the duplicate experiment for 1897.

Mixtures.	Number of days from seeding time until ready for green fodder.	Yield of hay per acre.	Yield of green fodder per acre.
		Tons.	Tons.
Chancellor peas, 1 bus. per acre Daubeney oats, 2 bus. per acre	76	3.78	10.61
Prussian Blue peas, 1 bus. per acre Siberian oats, 2 bus. per acre	85	4.20	12.17
Oakshott Field peas, 2 bus. per acre Golden Giant oats, 2 bus. per acre	94	4.33	11.06

It will be seen that there is a variation of about eighteen days from the time the earliest crop was ready to feed until the last crop was ready for the same use. The mixture of Prussian Blue peas and Siberian oats, which is intermediate in time of growth, produced the largest amount of green crop per acre, namely 12.17 tons. This mixture has given excellent satisfaction and is one which we can safely recommend for general use.

Peas and Oats Sown in Different Quantities for Green Fodder.

This experiment, which has been conducted in our experimental grounds for six years in succession, occupied eighteen plots in each of these years, as the experiment was conducted in duplicate in every instance. The object has been to ascertain the best quantity of pease and oats to mix for a green fodder crop when the ability of each crop for standing up, and the yield of green feed per acre, are both taken into account. The seed was sown broadcast on plots 1-100 of an acre in size.

Mixtures.	Height of crop. Average 2 years.	Percentage of crop lodged. Average 2 years.	Yield of Green Crop per acre.	
			1897.	Average 6 years.
	ins.		tons.	tons.
Oats 2 bushels, peas 1 bushel	39	2	7.0	8.9
" 2 " " 3 "	39	9	6.8	8.9
" 1½ " " 2 "	40	8	8.1	8.8
" 1 " " 3 "	38	30	7.8	8.6
" 1½ " " 3 "	39	23	7.3	8.6
" 2 " " 2 "	39	5	6.7	8.5
" 1 " " 2 "	88	19	8.6	8.3
" 1½ " " 1 "	39	5	7.3	8.3
" 1 " " 1 "	39	7	7.3	8.1

The reader, when examining the results of the experiment here presented, will have but little difficulty in coming to the conclusion that two bushels of oats and one bushel of peas per acre has formed a mixture which has given very excellent results in the comparative tests of six years. The crop produced by this mixture was but little lodged at the time when the crop was harvested, and the yield per acre was quite satisfactory, giving an average of 8.9 tons. The Prussian Blue Peas mixed with either the Siberian, Banner, or Egyptian oats makes a very good combination for green fodder.

Sunflowers—Comparative Test of Three Varieties.

Seven varieties of sunflowers were tested in the experimental department previous to 1897. As some of these varieties, however, did not give satisfactory results, nearly all of them were dropped from our list, and this year the experiment was with but three varieties, namely, Black Giant, Mammoth Russian, and White Beauty, the two former having been grown in 1897 for the third time and the latter for the first time.

Varieties.	Average results for number of years tested.		
	Height.	Total yield per acre.	Yield of heads per acre.
Grown Three Years:	ins.	tons.	tons.
Black Giant	71.34	11.83	**5.05**
Mammoth Russian	68.17	9.39	**4.26**
Grown One Year:			
White Beauty	67.50	10 60	**4.30**

The Black Giant sunflower has given an average of nearly one ton of heads per acre more than the Mammoth Russian variety. Of all the varieties of sunflowers grown up to the present time, the Black Giant has given the best all round satisfaction, and any who are rowing the "Robertson Combination" might do well to give the Black Giant a trial, as the heads form the part used for cutting and mixing with corn in the silo.

Fodder Crops.

Seven kinds of fodder crops have been grown under experiment for three years in succession. This experiment is an interesting one, as several of the crops regarding which much has been said of late, are included in the comparative test. The plots were 1-100 of an acre in size in every case. The crops were harvested when in about the right condition for feeding purposes, and were weighed immediately on being cut; therefore, the results given below represent the yields of green crop per acre:

Varieties.	Average height of crop.		Average yield per acre.	
	1897.	Average 3 years.	1897.	Average 3 years.
	ins.	ins.	tons.	tons.
Dwarf Essex Rape	44	28.2	36.80	**24.05**
Grass Pease	56	46.3	8.25	8.
Egyptian Pease	16	17.1	6.10	**8.75**
Yellow Soya Beans	31	26.3	7.90	**8.67**
Crimson Clover	24	15.7	12.50	**8.56**
Prussian Blue Pease	65	54.9	5.10	**6.85**
Horse Beans	28	29.7	1.00	**4.25**

It will be seen that the Dwarf Essex rape gave a very large yield in 1897, namely, 36.8 tons per acre. This was certainly a magnificent crop, and was admired by visiting farmers who examined the crops on our trial grounds in the autumn. The crimson clover was also an excellent crop this year, but during the past five years has not proven to be a very satisfactory crop for either hay or green fodder. The horse beans have not given very satisfactory results in any of the experiments, as they are apt to turn black before they get their full growth, and it is necessary to cut the crop at an early stage in order to prevent further deterioration.

Varieties of Rape, Kale, etc

In each of the past two years, a very interesting experiment has been made by sowing different varieties of rape, kale and similar crops upon plots of uniform size to obtain information regarding the yield of these crops. The plots were 1-100 of an acre in size in every instance. The crop from each variety was weighed immediately on being cut.

Varieties.	Average height, 1897.	Yield of green crop per acre.	
		Average 2 years.	1897.
	inches.	tons.	tons.
Cow cabbage or Marrow Stem kale	42	.....	**39.27**
Dwarf Essex rape	44	30.69	**37.20**
Victoria rape	38	25.50	**32.40**
Thousand Headed kale	36	21.74	**27.87**
Tall Jersey cabbage	45	.....	**27.60**
Large tall French Brussels Sprouts	22	15.48	**28.00**
Tall green curled Scotch kale	11	14.02	**14.53**

The seed of the Cow cabbage which was secured from Montreal, and that of the tall Jersey cabbage which was obtained from Jersey Island, were grown in 1897 for the first time. It will be seen that in the crop of the past year, the Cow cabbage, or Marrow Stem kale, produced the largest yield per acre, namely, 39.27 tons, which was closely followed by the Dwarf Essex rape with 37.2 tons. The Victoria rape and the Dwarf Essex variety have been grown in our trial grounds for several years in succession. We find that the Dwarf Essex has given a larger yield per acre than the Victoria rape in every year of the experiment. The tall Jersey cabbage is used extensively on the Island of Jersey, and Prof. H. H. Dean of this institution, when visiting the Island of Jersey in 1895, observed that this special variety was in general use and was very highly prized. The growth this year in our grounds was good, even though the yield per acre was not quite so high as that of some of the other varieties here reported. Experiments with these crops will likely be conducted for several years, in order to get thoroughly reliable information in regard to their respective merits. As one of the College associates, Mr. W. E. Butler, is writing his thesis on the results of an experiment which he is carrying on by feeding these different crops to dairy animals and observing carefully the influence of each variety upon the dairy products, some interesting information should be obtained from his investigation.

Rape—Selection of Seed.

As in the case with nearly all farm crops, an experiment has been conducted with rape, in planting different-sized seed, to find out which will produce the most satisfactory results. The experiment has been conducted for three years in succession by selecting large plump seed, medium-sized seed and small-sized seed from the ordinary stocks of seeds as sold by leading seedsmen. The seed in all cases was sound and whole, and was carefully sifted and hand picked to make the samples as required for the three separate classes. The experiment was conducted in duplicate each year. The following table gives the result of the experiment for 1897 and of the average of two years in which this experiment has been conducted.

Selections.	Yield of green rape per acre.	
	1897.	Average 3 years, 1895-6-7.
	tons.	tons.
Large plump seed	17.7	**19.45**
Medium sized seed	16.1	**17.27**
Small sound seed	14.2	**14.65**

The results from this experiment in 1897 were quite similar to those of the two years previous. The average results showed that the large plump seed produced a crop of about two tons per acre more than that produced from the medium-sized seed, and about five tons per acre more than that from the small seed.

Rape—Application of Fertilizers.

In 1891, 1896 and 1897 an experiment was conducted by using different fertilizers with rape, in order to find out which gives the best results and whether any of them would furnish a sufficient increase in crop to pay for the fertilizer used. The plots were 1-100 of an acre in size in the experiments in the past year. The fertilizers were applied at the time the rape seed was sown. The mixed fertilizer consisted of nitrate of soda,

superphosphate and muriate of potash in quantities one-third of the amount used when these fertilizers were sown separately. The mixture, therefore, would be a complete fertilizer containing nitrogen, phosphoric acid and potash.

Fertilizers.	Amount of fertilizer used per acre.	Yield of green rape per acre.			
		1891.	1896.	1897.	Average 3 years.
	lb.	tons.	tons.	tons.	tons.
Nitrate of soda	160	15 8	14.7	14.0	14.8
Mixture (complete)	313	14.8	10.6	15.6	13.7
Superphosphate	220	12.6	10.4	13.8	12.3
Muriate of potash	160	12.2	10.4	12.7	11.8
No fertilizer		13 2	10.2	11.3	11.6

It will be observed that the nitrate of soda produced the largest results in 1891 and in 1896, and the second largest in 1897. In the average results for the three years it will be seen that the nitrate of soda produced a little over three tons per acre more than the unfertilized plot, while muriate of potash produced nearly 1-5 of a ton per acre more than where no fertilizer was used. For five years in succession rape has been grown with nitrate of soda and without any fertilizers in the co-operative experiments conducted throughout Ontario. The nitrate of soda has given a larger average yield per acre than the plot which was left unfertilized in each of the five years by about 2.1 tons of crop per acre. The fertilizers used in connection with the test conducted in the experimental department has cost from $2 to $2.25 per acre in each instance for the amount used.

Clovers—Comparative Test of Varieties.

In each of the past two years, reports have been given regarding eight varieties of clovers tested in the experimental grounds. We will be able in another year or so to present a report of a number of varieties under similar conditions, but for 1897 we give the returns of only lucerne and sainfoin, as it is necessary to have fresh plots sown with the other varieties of clover in order to get results under uniform conditions. The seeding of the lucerne and of the sainfoin took place on May 12th, 1894. No protection has been afforded the plots in any of the past winters. The following table gives the results of the experiment with this crop for 1896 and 1897.

Varieties.	Yield of green crop per acre.		
	1896.	1897.	Average 2 years.
	tons.	tons.	tons.
Lucerne or Alfalfa	19.88	23.96	21 92
Sainfoin	11.70	18.16	14.93

As the spring of 1896 opened up very early, we were enabled to get four crops of lucerne in that year; but, as the growth was later in starting in the spring of 1897, but three crops were obtained from the land during the summer. Owing to the heavy rains in the months of July and August, the lucerne grew abundantly, and although only three cuttings were made, still it will be seen that the total yield per acre in 1897 was

larger than that of 1896. Lucerne we find to be an excellent crop for green-fodder and for mixing with grasses and other clovers for a permanent pasture. For hay, however, much care is required in cutting lucerne at the right time, and in preventing its becoming too dry under the hot rays of the sun. If the crop is allowed to stand too long before being cut, the stems become fibrous and of a poor quality. If lucerne is properly handled, however, it produces a large amount of hay of a fair quality. Sainfoin is used particularly as a green fodder plant, but the stems are apt to become much larger and coarser than those of lucerne. The crop does not grow so rapidly, and there are not so many cuttings in one season. All things taken into consideration, lucerne has given better all round satisfaction than sainfoin. For information regarding crimson and other kinds of clover, the reader is referred to the reports of 1895 and 1896.

Grasses—Comparative Test of Twenty Varieties.

Thirty-one varieties of grasses were sown in the experimental grounds on the 15th of May, 1894. Several of the varieties were completely killed out during the first winter. Twenty varieties, however, have now passed through three winters, and the crops are still quite uniform over the ground in most instances. The plots are each exactly 1-100 of an acre in size.

Names of varieties of grasses.		Uniformity of crops, 1897.	Average height of crops 3 years.	Yield of green crops per acre.	
Common name.	Scientific name.			1897.	Average 3 years, 1895-6-7.
			ins.	tons.	tons.
Lyme Grass	Elymus Virginicus	Medium	27	7.04	7.51
Fringed Brome Grass	Bromus ciliatus	Medium to good	30	9.44	7.15
Western Rye Grass	Agropyrum tenerum	Medium	24	5.76	6.92
Bearded Wheat Grass	Agropyrum caninum	Medium to good	27	5.12	5.31
American Brome Grass	Elymus Americanus	Medium	20	5.60	4.95
Tall Oat Grass	Arrhenatherum avenaceum	Good	41	6.16	4.91
Orchard Grass	Dactylis glomerata	Medium to good	30	5.12	4.67
Timothy	Phleum pratense	Good	33	4.72	4.13
Awnless Brome Grass	Bromus inermis	Medium	21	4.80	3 45
Soft Brome Grass	Bromus Mollis	Good	31	3.92	3.31
Meadow Fescue	Festuca elatior	Good	28	3.20	3.31
Meadow Foxtail	Alopecurus pratensis	Medium to good	29	4.64	3.16
Rhode Island Bent	Agrostis canina	Good	22	2.80	2.23
Canadian Blue	Poa compressa	Extra good	16	3.52	2.20
Red Top	Agrostis vulgaris	Good	20	2.14	2.07
Perennial Rye	Lolium perenne	Good	18	2.16	1.73
Yellow Oat	Avena flavescens	Good	23	2.56	1.68
Creeping Bent	Agrostis stolonifera	Medium	14	2.36	1.53
Kentucky Blue	Poa pratensis	Good	21	1.36	1.37
Fine-leaved Sheep's Fescue	Festuca ovina	Medium	16	1.20	.85

The five varieties which stand at the head of the list in average yield of green grass per acre for three years, were imported from Manitoba. Although the growth of most of these varieties is somewhat coarse, still the yields in some instances are very large. The Tall Oat Grass, Orchard Grass, and Timothy have all made very good records.

Permanent Pasture.

Within the past twenty years, a considerable amount of experimental work has been done in testing varieties of grasses and clovers both singly and in combination. When the varieties have been grown alone, they have been allowed to remain in the land for several years, providing they have been hardy enough to stand the climate of Ontario. These grasses and clover have been carefully studied, and much information has been gleaned in regard to their usefulness for pasture and for hay. In 1885 Prof.

Brown recommended a mixture which he considered to be well adapted for a permanent pasture. Only the most hardy varieties which had been tested up to that time were included in that mixture. In 1893, after eight years' additional experimental work, during which time the writer was closely connected with the work of the experimental department, we recommended another mixture containing a less number of varieties and requiring a smaller amount of seed per acre. The grasses and clovers recommended in 1893 have proven themselves to be very suitable for a permanent pasture. They are all hardy varieties and when grown together give a large yield. An experiment was started in the spring of 1894 by sowing a plot of the mixture which was recommended in 1885, and another plot of the mixture which was recommended in 1893. The seed was sown with a light seeding of barley, and the germination of the seed of the grasses and clover was quite satisfactory. The following table gives the results from these two mixtures for the past three years:

Mixture recommended in	Grasses and clovers.	Varieties in mixtures.	Amount of seed per acre.	Average height of first cutting.	Yield of freshly cut grass per acre.	
				Average 3 years.	1897-2 cuttings	3 years 1895-6-7. 7 cuttings.
			lbs.	ins.	tons.	tons.
	Grasses	Meadow Fescue	6			
	"	Meadow Foxtail	3			
	"	English Rye	2			
	"	Timothy	3			
	"	Canadian Blue	4			
	"	Orchard	3			
1885	"	Red Top	2	30	16.64	15 87
	"	Yellow Oat	2			
	Clovers	Lucerne	4			
	"	White	3			
	"	Alsike	2			
	"	Red	1			
	"	Yellow	1			
		Total amount seed used	35			
	Grasses	Orchard	4			
	"	Meadow Fescue	4			
	"	Tall Oat	3			
	"	Timothy	2			
1893	"	Meadow Foxtail	2	32	18.80	19.36
	Clovers	Lucerne	5			
	"	Alsike	2			
	"	White or Dutch	1			
	"	Yellow or Trefoil	1			
		Total amount seed used	24			

There were two cuttings made from each plot in 1895, three in 1896, and two in 1897. Without a single exception, the mixture which was recommended in 1893 has produced the largest yield per acre. This mixture should be well adapted for good pasture soil. We have named all the varieties and clovers required for the mixture, and also the quantity of seed per acre, particularly, for two reasons: In the first place, that this experiment might thus be made as clear as possible; and, secondly, that any person wishing to know the quantity of seed per acre of the different varieties which are recommended as a permanent pasture mixture, would be enabled to find the information in good form

Co-operative Experimental Work.

One of the most extensive systems of co-operative experimental work in agriculture to be found at the present time is the one established in Ontario. During the past year we distributed 11,497 packages of grains, seeds, and fertilizers to Ontario farmers. The varieties thus distributed were those which had given the best results in a number of years' trials in our experimental department. The whole system of co-operative experimental work is conducted in close connection and in perfect harmony with our experimental work at the College. The two go hand in hand, each being made very much better by the assistance of the other. This work has increased year by year since it was started in 1886; and during the past four years the demand has been so great that we have been unable to supply material to the full number of applicants. In 1891 there were 2,642 plots; in 1892, 5,688; in 1893, 7,181; in 1894, 7,721; in 1895, 9,179; in 1896, 11,124; and in 1897, 11,497 used for these co-operative tests over Ontario.

This co-operative experimental work is conducted conjointly by the experimental department of the Ontario Agricultural College and the Ontario Agricultural and Experimental Union.

The Union opens up a channel through which the best material of the Experiment Farm can be brought to the homes of the farmers; it makes direct application of the information gained at the experimental farm by having experiments conducted upon hundreds of farms; and it systematizes the co-operative work in such a way that the results can be summarized and made into valuable reports for the guidance of farmers generally. The influence of the Union is potent in bringing the Agricultural College into closer touch with the farmers, in fostering kindly feelings between the graduates and their Alma Mater, and in awakening wholesome lines of thought and observation in the minds of those engaged in the various branches of agriculture.

Nearly all of the eighteen different experiments carried on throughout Ontario during the past year were carefully conducted in the experimental department at the College in 1897. These experiments were made at the College in accordance with the printed instructions which were sent out to all co-operative experimenters. The results of these tests are not included in this report, but will be embodied with those of the other co-operative experiments for presentation at the annual meeting of the Experimental Union.

Miscellaneous Crops.

Besides the systematic experiments which have been reported upon in the foregoing table, there were quite a number of minor experiments, the result of which cannot be placed in tabulated form to advantage. Under this heading might be mentioned experiments with flax, hemp, pea-nuts, ground almonds, horse beans, soja beans, tares, winter rye, winter barley, Speltz spring wheat, sand buckwheat, prickly comfrey, sachaline, flat pea (*Lathyrus Sylvestrus*), collards, teosinte, ramie, Australian salt bush, lupines, lentils, banana field beans, cow peas, sweet clover, chicory, field pumpkins, and field squashes. Besides the tests made with these different crops other experiments were conducted in growing a number of fodder crops late in the season with and without manure; in the use of nitrogin with peas, red clover, horse beans, lupines, and serradella; in growing green crops o plowing under; in the separate seeding of three varieties of grasses and four varieties of clovers with and without a grain crop in the autumn and also in the spring; in the growing of rape, crimson clover, etc., with oats; in preparing land differently for sowing spring grain; in the seeding of lucerne with and without a grain crop, and with and without an application of farmyard manure; and in the seeding of clovers and grasses in twenty-one different combinations in the spring of 1897. For the results of

the experiments of a few of the crops here mentioned, the reader is referred to the report of the Agricultural College for 1896. Further details of the results of the experiments with these miscelllaneous crops, methods of seeding, etc., will probably be given in the report of 1898, when another year's experience with each of them will be secured.

Crops for Experiments in Feeding.

Several crops were grown in 1897 in order that Mr. G. E. Day, our Agriculturist, could conduct a practical experiment in feeding dairy cows. The experiment consisted in determining the comparative feeding qualities of winter rye and of lucerne as a green fodder in early summer; of oats and peas and of oats and tares as a green fodder in late summer: of dent corn and of sweet corn as a green crop in autumn; and of mangels and sugar beets as food in winter. For the results of the feeding experiments, the reader is referred to the report of the Agriculturist.

Conclusions.

The experimental department was never so well equipped for good work as it is at the present time. The plots, which now number upwards of 2,000, were admired by the thousands of farmers who visited our College during the past summer. Seedsmen, fertilizer manufacturers, agricultural editors, and farmers generally have shown much interest in our work of experimentation. The students in attendance at the College have had an opportunity of examining the various crops under investigation, and have thereby received information which should be of great service to them when engaged in farming at their own homes. We have aimed to make our work practical, accurate, and reliable, and ask for the advice and the support of the farmers of Ontario in the further prosecution of this work.

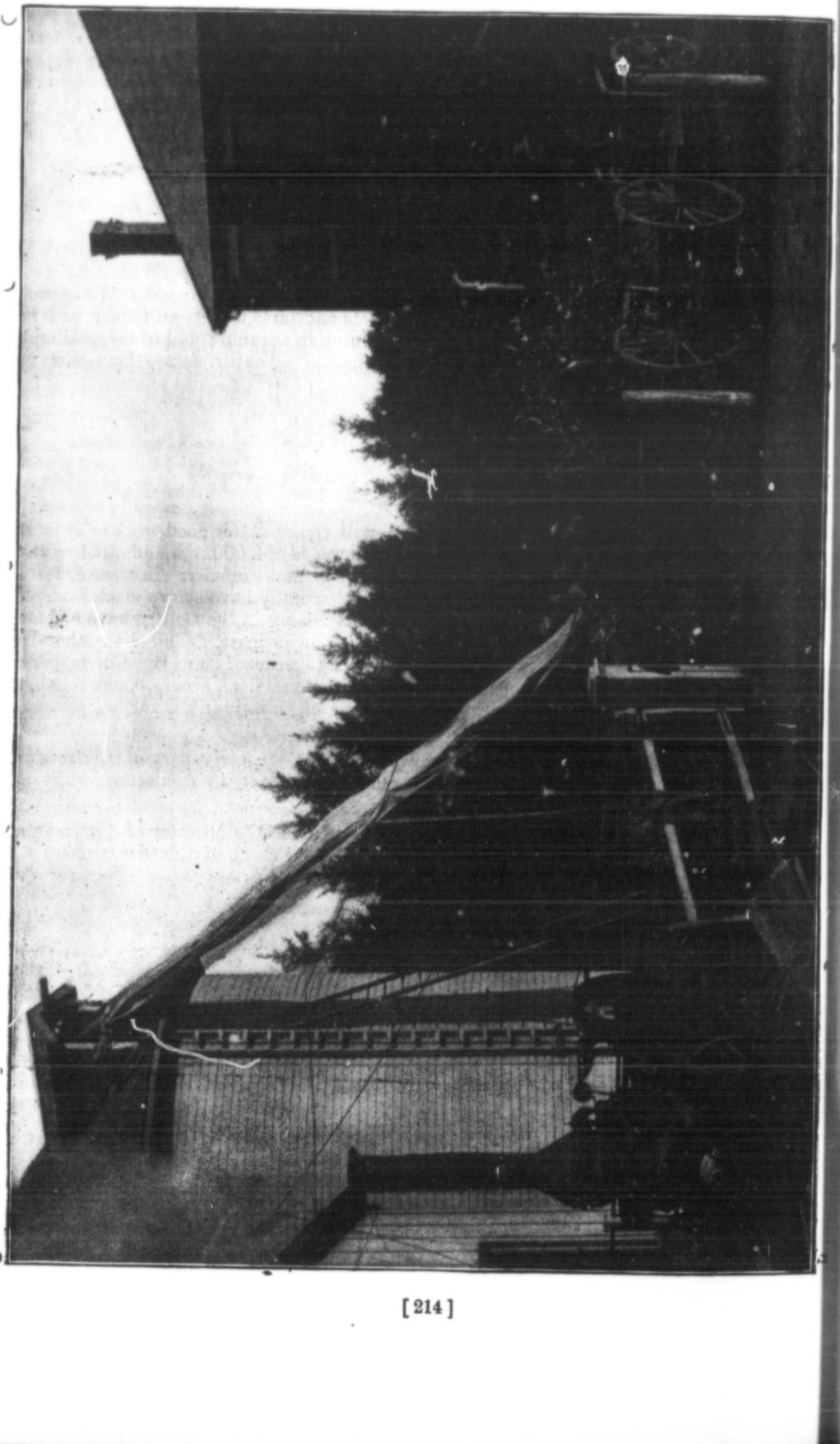
Mr. Jas. Atkinson, B. S. A., who was with me in the early part of the season, resigned his position here to accept a more remunerative one in connection with the Agricultural College of the State of Iowa.

In conclusion, allow me to thank you, and through you, the Minister of Agriculture, for the able support you have given me in advancing the work of this department.

Respectfully submitted,

C. A. ZAVITZ,
Experimentalist.

Ontario Agricultural College,
Guelph, Nov. 30th, 1897.



REPORT

To the President

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PART XI.

REPORT OF THE FARM SUPERINTENDENT.

To the President of the Ontario Agricultural College:

SIR,—I have the honor to submit herewith my annual report for the year 1897. Notwithstanding the protracted extremes of wet and dry weather during the past season, we had more than an average crop of most farm products.

IMPROVEMENTS. The re-painting of farm buildings commenced last season, was continued by giving the barn, sheep-pen, and piggery two coats each; the fence posts around the farm were also painted. The composition mentioned in the last report was used again. The lane has been gravelled from the buildings north to the woods, eighty rods; and the grading continued through the swamp land to the north field, 115 rods. This uncultivated portion of the farm, consisting of twelve acres, is being drained and stumped as time will permit.

ROTATION OF CROPS. Four years ago it was decided to follow a systematic rotation of crops (a four years' course), viz.: Two years, grass, meadow and pasture, 180 acres; third year, corn, roots and peas, 90 acres; fourth year, grain and seeded down, 90 acres. As no system of rotation had been pursued in former years, some portions of the farm were lacking in vegetable matter, caused by growing grain crops for several successive years. The fertility of those parts has been restored by growing clover and plowing under the second growth every second or third year; and the whole farm is now in a good state of fertility. The changed appearance of the soil is quite noticeable, being now of a dark color, which shows that there is an abundance of humus, *i. e.*, decayed vegetable matter, present. Under this system, any farm should increase in fertility without the use of any fertilizer except the barnyard manure which is made on the farm.

MEADOW. We had ninety-seven acres of meadow, which averaged fully two and a half tons per acre. Seven pounds red clover, three pounds alsike, and four pounds timothy were sown per acre. The larger proportion of red clover was used because it is more valuable for fodder and as a fertilizer than the grasses. The extreme wet weather made it difficult to cure so large a quantity of clover; but by the use of the hay-tedder we were able to put it in cocks soon after it was cut, and by this means the whole crop was fairly well saved. We commenced cutting on June 23rd, and on the 29th wet weather set in, which continued until the end of August, and caused a large amount of extra labor during haying and harvest.

PASTURE. There were forty acres in pasture, besides the wood lands, which were equally divided between the Dairy Department and the Farm.

FALL WHEAT. Twenty acres of fall wheat were grown—twelve acres of Dawson's Golden Chaff, and eight acres of Early Genesee Giant. Both varieties yielded about forty bushels per acre, and a very heavy crop of straw, which was, however, badly lodged. Cutting was begun on July 21st, and finished on the 26th. There were showers nearly every day and for a week after, which gave much extra labor to prevent the grain from

sprouting. According to our rotation, fall wheat follows peas; and before the peas were sown in the spring the land received a dressing of coarse barnyard manure, about fifteen loads per acre. This was gang-plowed lightly and mixed with the surface soil before sowing the peas. After harvesting the peas, the land was again gang-plowed and thoroughly cultivated before sowing the fall wheat, which was done the last week in August at the rate one and a half bushels per acre.

SPRING WHEAT. Fifteen acres of Herison Bearded were grown, ten acres on root land and five acres on sod. Under both conditions it had the same unhealthy appearance as last year; and, though there was an abundance of straw, the grain did not mature properly. I believe it would be advisable to stop growing spring wheat in this section for one or two years.

OATS. The north section of the farm, formerly known as fields Nos. 19, 20, and 21, containing fifty-five acres under cultivation, was sod in 1896. It was plowed early in the fall and was thoroughly cultivated, and was sown with Siberian oats last spring and seeded down with the usual mixture; so it will now come in the regular rotation. One and a half bushels per acre were sown, which yielded a very heavy crop, a portion of which was so badly lodged that it had to be cut with the mower.

BARLEY. Fifteen acres of Oderbrucker barley were grown on root land which had simply been cultivated and drilled the previous fall. The barley was sown on April 21st, and made a remarkable growth; so much so that it had to be cut with a mowing machine and hauled in loose. Twenty acres of Mandscheuri barley were grown after corn which had been cultivated and drilled the fall before. This also yielded a large crop, but this variety, having a stiffer straw, was cut with the self-binder.

In places where the crops were badly lodged they smothered out the young grass, which was resown by hand immediately after harvest, so that there will be no blanks.

PEAS. Twenty-four acres of peas (Prussian Blue) were sown. On account of wet weather, the crop was not equal to those of the two preceding years, which yielded over thirty-five bushels per acre. As soon as the peas were harvested, the land was gang-plowed, harrowed, and thoroughly pulverized with the disc-cultivators, for fall wheat, which was sown 30th and 31st August. Although only one and a quarter bushels per acre were sown and September was exceptionally dry, the wheat grew luxuriantly and soon covered the ground. As a portion of the grain sown was sprouted, according to test, only about one bushel per acre grew, which is quite sufficient on land properly prepared.

CORN. Thirty-three acres of ensilage corn were grown, as follows: Fifteen acres Mammoth Cuban, eight acres Wisconsin Earliest White Dent, eight acres Compton's Early, and two acres Black Hills, the latter a new variety which did not prove equal to the others. On account of the cold and wet weather in the end of May, a large portion of the corn planted on the 17th, 18th, and 19th did not germinate, so the land was again cultivated and replanted June 6th, 7th, and 8th, which is rather late for this section, as we are liable to get frosts in September before the corn is sufficiently matured to cut and put into the silo. Though there was no rain for three weeks after this second planting, the corn grew very rapidly and yielded an average crop of twenty tons per acre. We commenced cutting and filling the silo September 18th; the previous night there were two degrees of frost and the following Monday night four degrees, after which the leaves became quite dry and had a bleached appearance.

I do not consider this ensilage equal to that made from corn matured without being frosted. After filling both silos to their utmost capacity, the balance, about 150 tons, was set up against the fence for present use, about one ton a day being cut and fed to cattle and horses. The corn was sown with the ordinary grain drill in rows forty-two inches apart; fourteen pounds of seed per acre was used. The horse weeder was kept going both before and after the corn came up, to keep the surface soil thoroughly pulverized. After the corn was up several inches, we used the two horse cultivator, repeating three times until the corn was two or three feet high. Very little hand hoeing is required, if the land has been thoroughly cultivated the previous fall.

RAPE. Six acres of rape were grown—one acre sown May 22nd, to feed lambs after weaning in July; the remainder on June 19th and 21st, for fall and early winter feeding. It is principally used for fattening steers. During October a cartload was taken each day to the pasture field; and during November and December to the stable, and left in the passage about a day to thaw out before feeding. About November 20th, the rape was cut with a scythe and put in heaps where it will remain frozen until brought into the stable. Rape fed with ensilage and clover hay for producing beef gives the very best results.

FIELD ROOTS. This year the root crops were grown on that portion of the farm formerly known as Field No. 15, the old permanent pasture which was plowed two years ago. It is mostly low land, and only partially underdrained, so that with the wet season and a large number of wire worms, which are always numerous in old sod, our root crop was a partial failure. There were three acres each of Long Red and Yellow Intermediate mangels, and two acres of sugar beets, giving a total yield of 3,200 bushels, an average of 400 bushels per acre. Six acres of Swede turnips gave a total yield of 2,650 bushels an average of 441 bushels per acre.

POTATOES. Six acres of potatoes were grown on the same portion of the farm. Following are the varieties: four acres of Empire State, half an acre each of American Wonder, Crown Jewel, Rose of Erin and Burpee's Extra Early. We had the appearance of an abundant crop until the beginning of August, when the tops became diseased; and then the tubers commenced to rot. On the 25th August, dry weather set in, which checked the disease. Although two-thirds of the crop was destroyed, we harvested 545 bushels of sound potatoes.

FALL CULTIVATION. The success of our crops depends very much on the thorough cultivation of the soil the previous fall. Our method is as follows: In August we commenced plowing sod in the 90-acre section intended for corn, roots and peas the following year. This was plowed about three inches deep, and, as there was a heavy growth of clover, chains were used on the plows to drag it under. The land was harrowed soon after being plowed and the vegetable matter being near the surface rotted quickly, so that in about three weeks after being plowed it was cultivated across with the spring tooth cultivator. Should any thistles or other weeds appear, those portions are gone over with a broad-share cultivator. During October and November all the manure made through the spring and summer, which had remained in the barnyard, was hauled out and spread on the surface as far as it would go at the rate of sixteen loads per acre. This was covered with a double mouldboard plow in drills about twenty-two inches wide. By this means the decomposed vegetable matter and manure were placed in the centre of the drills where it will remain during the winter without fear of leaching away or being lost by evaporation. On the balance of this section the manure will be hauled out during the winter and spread on the snow, and in the spring gang-plowed lightly to mix it with the surface soil. The fall cultivation of our corn and root land was as follows: As soon as the corn was harvested, the land was cultivated with the broad-share cultivator with the centre tooth removed, cultivating along the rows. This cleaned the land of weeds, except those in the corn rows (which were more numerous than usual, owing to the great amount of rain). These were destroyed by plowing out the corn roots with an iron plow, without the mouldboard, and harrowing, after which the land was drilled with a double mouldboard plow. In ordinary seasons it is not necessary to plow out the corn roots, simply cultivate and drill with the double mouldboard plow lengthwise with the rows, so that there will be a row of corn roots in each alternate drill. By this means the corn roots may remain in the ground until they rot. The potato and root land is ribbed across the old drills, turning the tops into the centre of the drills. Thus all the vegetable matter that has become decomposed during the summer and made available for plant food is preserved in the centre of the drills for the next year's crop. Land treated in this way and seeded with a grain crop invariably gives good results; and with such treatment we have never failed to get a good catch of clover.

LIVE STOCK. We have at present fifty-six head of cattle, viz., twenty-one feeding steers, twenty-seven females of the different breeds, required for educational purposes and

to supply the college with milk; also eight bulls of the different breeds. Fifteen of the steers were tied up on the 1st November, their average weight on that day being 1,222 pounds; the remaining six are together loose, their average weight November 1st being 1,219 pounds. Both lots are receiving the same food and attention, and with two exceptions all are dehorned.

RESULTS OF FEEDING STEERS. On November 20th, 1896, eleven steers were bought, averaging 1,035 pounds at three cents per pound. They were sold July 3rd, 1897, averaging 1,383 pounds at five cents. Following are the results, with variety and cost of food. Silage is valued at $1.50 per ton, roots $2.00, clover hay $7.00, chaff $1.50 per ton, mixed grain and bran 75 cts. per hundred:

Ration for December.

17 lbs. silage	cost	$1.27
17 " pulped roots	"	1.70
10 " cut clover hay and chaff	"	2.12
3 " bran	"	1.50
Rape at noon	"	2.00
Average cost per day		$8.59

Average gain in weight for December, 91 lbs. at 5 cents	$4.55
Less cost of food	2.66
Average gain per steer for December	$1.89

For January, the same mixture was used, except that 4 lbs. chopped grain and bran was fed, and the rape at noon was changed to 30 lbs. sliced turnips.

30 lbs. turnips	3	cents.
4 " grain and bran	3	"
Cost of food per day.	11.09	"

Average gain in weight for January, 76 lbs. at 5 cents	$3.80
Less cost of food	3.44
Average gain per steer for January.	$0.36

In February, the same as January ration, but the grain and bran was increased to 7 lbs. 4.75 cents.
Average cost per day. 12.84 "

Average gain in weight for February, 69 lbs. at 5 cents	$3.45
Cost of food	3.59
Average loss per steer for February.	$0.14

March ration just the same as February.

Average gain in weight for March, 63 lbs. at 5 cents	$3.15
Cost of food	3.98
Average loss per steer for March	$0.83

In April half chopped grain and bran was added, making
Average cost per day.. 13.71 cents.

Average gain in weight for April, 59 lbs. at 5 cents	2.95
Cost of food	4.11
Average loss per steer for April	$1.16

The May ration was the same as April.

Average gain in weight for May, 40 lbs. at 5 cents	$2.00
Cost of food	4.25
Average loss for May	$2.25

Ration for June:

30 lbs. silage	2.25	cents.
12 " cut clover	4.20	"
7½ " chopped grain and bran.	5.62	"
	12.07	cents.

Average loss in weight for June, 50 2/11 lbs. at 5 cents	$2.51
Cost of food	3.86
	$6.37

The loss of weight in June is due to the allowance for shrinkage.

Cost of 11 steers, Nov. 30th, 1896	$341.55
Cost of food for 7 months	284.79
Total cost	$626.34
Sold July 3rd, 1897, for	760.50
Total profit	$134.16
Average profit per steer	$12.20

The steers were kept two months longer than necessary in order that the large number of farmers who visited the college during June might see the result of this method of feeding. Had they been sold two months earlier the profits would have been much greater.

On April 7th, 1897, eight steers were bought. They were sold on July 3rd also. The result was as follows:

Cost of 8 steers, total weight 8,290 lbs., at 3½ cents	$290.15
Cost of feed for 2¾ months	82.00
Total cost	$372.15
Sold July 3rd, total weight 8,930 lbs., at 4 cents	357.20
Total loss	$14.95
Average loss	1.87

They were fed the same as above, but received one pound less grain in April and May, and one-half pound less in June. While there was an apparent loss on these eight steers, there was an actual gain, as a large portion of the food would have been wasted, because it could not have been sold so late in the season.

The steers and milch cows are fed a full ration morning and night of silage, pulped roots, clover hay and chaff, and chopped grain and bran. At noon they get only twenty-five pounds of sliced roots. Under this system better results are obtained, and the animals are healthier than with three full feeds per day.

SHEEP. The sheep are in excellent condition, although they get no grain except for about two months in the spring, when they are suckling their lambs, and then only a very limited quantity. During the winter they receive, morning and night, a mixture of cut clover, silage, and pulped turnips. Pea straw alone is fed at noon. We arrange to have the lambs dropped in March. Shearing is done in April, before the sheep are turned out to grass. After shearing, the ewes and also the lambs are dipped to clean them of ticks, etc. This is repeated in October.

Following are the average weights per fleece, unwashed, of the different breeds:

Lincoln	14.21 lbs.	Hampshire Down	8.10 lbs.
Cotswold	13.50 "	Suffolk	7.93 "
Leicester	9.42 "	Dorset Horn	6.78 "
Shropshire	8.96 "	Southdown	6.00 "
Oxford Down	8.33 "		

The wool was all sold for thirteen cents per pound, although the demand at present is in favor of the long wools.

SWINE. Of all the animals kept on the farm, our pigs give the best returns for the food consumed. The brood sows are fed, morning and night, boiled roots mixed with about one pound each of chopped grain and bran; at noon they get raw roots. The young pigs, after weaning, get bran, middlings and milk. A number of grade pigs are kept to consume the refuse from the college, as it has been found not desirable to feed this kind of food to breeding animals.

HORSES. Four teams and two cart horses are kept for work on the farm. A man is engaged for each team during the summer season. In winter when the farm work is not so pressing, the students get an opportunity of driving the teams. During the summer season, when the horses are hard at work, the daily ration for each animal is a mixture of cut clover and silage—all they will eat up clean—and sixteen pounds of chopped grain and bran mixed. The grain is composed of oats, barley and peas. This winter, when they will have but little work, the ration will be the same mixture of cut clover and silage, morning and night, with six pounds of grain and bran; at noon, fifteen pounds of carrots with half the quantity of cut clover and silage. By this method of feeding the horses are healthier, and are kept at considerably less cost than by the general custom of feeding oats and hay.

LIVE STOCK FOR EDUCATIONAL PURPOSES. The following live stock, all typical, pure bred animals, are kept for educational purposes:

8	breeds of	cattle,	1	male and	2	females of each breed.
9	"	sheep,	1	"	6	" "
5	"	swine,	1	"	2	" "

PRACTICAL INSTRUCTION. The first and second year students are required to work on the farm or in the other departments each alternate afternoon, for which they are allowed in proportion to the work performed, and credited on their board account.

Before the examinations last June, the second year students plowed a ridge each for the purpose of testing their skill, and marks were given according to work performed. The plowing was judged by the following scale of points:—Beginning, 20; even holding, 20; shape of ridge, 20; straightness, 20; finish, 20; total, 100. The minimum number of marks required to pass was 40; and all passed except two.

In the beginning of November an opportunity was given to the first and second year students, who have had more or less efficiency in plowing, to test their skill in plowing sod. Thirty-five entered into the competition; and each one plowed ten furrows, using the same team and plow. One hour was allowed for each student. Ten awards were made by competent judges as follows:

1st. W. Mason, Northumberland Co.
2nd. H. P. Westgate, Lambton Co.
3rd. R. J. Broomfield, Ontario Co.
4th. J. Wilson, Bruce Co.
5th R. Wilson, Huron Co.
6th. A. J. McFiggins, Northumberland Co.
7th. E. J. McMillan, Prince Edward Island.
8th. D. McEwen, Northumberland Co.
9th. D. A. Ross, Glengarry Co.
10th. A. F. Eddy, Algoma District.

The annual sale of surplus young live stock was held at the farm on October 13th. A large number of farmers from different parts of the Province were present. The prices realized were considerably in advance of former years, yet moderate, considering the quality and breeding of the animals offered.

11	calves,	various breeds, realized	$570.00
29	lambs,	" "	335.25
52	pigs,	" "	716.75
			$1,622.00

I submit herewith a statement of the farm accounts for 1897:

CASH RECEIPTS.

Sales of	Cattle	$ 1,969 52
"	Pigs	1,161 26
"	Sheep	220 98
"	Wheat	257 10
"	Oats	79 62
"	Barley	110 28
"	Peas	35 00

Sales of Potatoes	$49 45	
" Wool	70 33	
" Hay and Ensilage	13 31	
" Hides and Skins	5 65	
" Milk	109 45	
" Old Fence Rails	36 95	
Service of Animals	158 00	
Feed for Poultry Department	7 46	
Work done at Mr. Harrison's house—men and team	11 25	
		$ 4,295 55

FOOD, FEED, FODDER, AND SERVICES OF MEN AND HORSES SUPPLIED TO OTHER DEPARTMENTS.

To College.

Milk, 6052 gals , at .08	$484 16	
Potatoes, 425 bus., at .40	170 00	
Keep of three horses, 1 year, at $75	225 00	
Team for hauling ice, 3 days, at $2.50	7 50	
Team and man, 1½ days, at $2.50	3 75	
Hauling gravel for reservoir, 150 loads, at .25	37 50	
Excavating reservoir, man and team, 17 days, at $2.50	42 50	
Single horse and cart at reservoir, 26 days, at .65	16 90	
Keep of extra horse carting at reservoir, 13 weeks, at $1.50	19 50	
Horse for hauling sewage during year 1897	50 00	
		$1,056 81

To Experimental Department.

Keep of four horses, 1 year, at $75	$300 00	
Keep of extra horse, 2½ weeks, at $1.50	3 75	
Turnips for experimental feeding, 75 bus, at .07	5 25	
Hay, 11⅓ tons, at $6.50	73 60	
Hauling five loads of pigs to Guelph, at .75	3 75	
		$386 35

To Horticultural Department.

Keep of two horses, 1 year, at $75	$150 00	
Man and team, 1½ days, at $2.50	3 75	
		$153 75

To Dairy Department.

Wood supplied, 72 cords, at $1.25	$ 90 00	
Hay " 38 tons, at $6.25	237 50	
Mangels, 750 bus., at .07	52 50	
Ensilage, 250 tons, at $1.50	375 00	
Pasture, 25 acres, at $4.00	100 00	
Soiling crop, 1½ acres, at $8.00	12 00	
Chaff, 1½ tons, at $1.50	2 25	
Hauling sawdust from mill, 27 loads, at .75	20 25	
Teaming, 1¾ days, at $2.50	4 50	
Teaming ice	5 00	
Milk supplied, 1,637 lbs., at 65c. per 100	10 64	
Service of cows, 10 grade and 10 pure bred	30 00	
	$939 64	
By skim-milk, 30,000 lbs., at 10c. per 10	30 00	
		$909 64

OTHER ITEMS.

Expenditure for steers in 1897 above that in 1896	$686 73	
Allowance for time spent by farm superintendent in other duties	400 00	
Keeping of live stock for educational purposes	400 00	
		$1,486 73
		$8,288 83

DISBURSEMENTS.

Superintendent's salary	$1,200 00	
Wages	2,948 82	
Live stock	1,842 33	
Maintenance of stock	600 80	
Seeds	173 01	
Binding twine	25 20	
Postage, stationery and advertising	119 06	
Fuel and Light	75	
Contingencies	63 70	
		$6,973 67
Permanent Improvements.		
Painting, repairs and alterations	$441 68	
Furnishings	128 39	
Implements	190 67	
	760 74	
One-fifth of this expenditure reckoned for 1897		152 15
Total expenditure		$7,125 82
Cash receipts	$4,295 55	
Other "	3,993 28	
		$8,288 83
Net profit		$1,163 01

NOTES.

In 1896 the cost of eleven steers for feeding purposes was $341.55. In 1897, owing to an unusually large amount of fodder, this outlay was increased by getting twenty-one steers, at a cost of $1,028.28; hence the increased expenditure of $683.73 for this season on account of steers to be sold in 1898.

A considerable portion of the farm superintendent's time being devoted to work other than that of the farm proper, a certain portion of his salary should be credited in the farm account. The amount might be placed at $400.00, to be an equivalent for the time spent in attendance at farmers' institute meetings, lecturing in college, attending to visitors nearly every day during the month of June, drawing plans for beautifying country homes, besides attending to a large correspondence.

In addition to the above an amount should be credited to the farm for the maintenance of live stock that are kept for educational purposes.

Respectfully submitted,

WM. RENNIE,
Farm Superintendent.

PART XII.

REPORT OF THE

MANAGER OF THE POULTRY DEPARTMENT

To the President of the Ontario Agricultural College :

SIR,—I have the honor to submit herewith my third annual report with details of a few experiments undertaken, and work accomplished during the past year.

Numerous letters were received during the year from different parts of the country describing the symptoms of different diseases that had broken out among flocks of fowl, and asking for causes of the disease and remedies. These inquiries received careful attention and the best known treatment was recommended in each case. In most cases very favorable results were attained.

INFLAMMATION AND PROTRUSION OF THE EGG PASSAGE.—On the 10th of April we had a hen suffering from an inversion of the egg-sac (containing the egg) which had been expelled. The egg was removed in the following manner: The sac was washed with warm water; then the egg was broken at the end and its contents removed before destroying the shell; the shell was then removed in parts, not allowing any to remain in the sac; and by careful manipulation the sac was put into its proper place while the hen was held head downwards. The hen was then removed to a quiet place, and in a few days was apparently as well as ever, and continued to lay during the season.

SOFT EGGS.—The laying of soft shelled eggs or eggs without any shell arises from several causes, and all cases cannot be treated alike. The shell of the egg consist entirely of carbonate of lime, and the requisite quantity for the formation of the shell must be obtained in or with the food; otherwise soft eggs will result. When unshelled eggs arise from a deficiency of calcareous matter, the remedy is evident: A quantity of old mortar, or oyster shells broken up will readily supply the material needed. If fowls are excited or worried in their pens or yards, it may cause soft-eggs, especially among the larger breeds of poultry.

APOPLEXY.—The symptoms of apoplexy are very plain and decisive. A bird apparently in the most robust health will fall down suddenly, and may be either found dead or without sensation and the power of motion. It is occasioned by the rupture of a blood vessel in the skull, and the consequent flow of blood pressing upon the brain produces the trouble.

Causes.—It is invariably caused by a full habit of body, and is more frequent in over-fed birds, and most common among laying hens, which are often found dead on the nest. No doubt the expulsive efforts when laying bring on the attack. We find the Plymouth Rock fowl quite subject to this disease, as they take on fat more readily than any other breed of poultry. We lost two Barred Rock hens with this disease this season; one was found dead on the nest and the other under the perch.

Treatment.—In this disease little can be done towards a cure in an actual attack, but a great deal may be done in the way of prevention, as over-feeding or using over-stimulatin food, and the want of sufficient exercise, greatly increase the danger of this disease

VERTIGO.—A bird affected with vertigo may be seen to go around in a circle, or may flutter about with but little control of its muscular action.

Causes.—It is caused by a rush of blood to the head, a sudden fright, or the result of over stimulating diet.

Treatment.—I have found that holding the head of the bird affected under a stream of cold water, or pouring cold water on the head for a few minutes will arrest the disease. Afterwards an opening medicine should be given which will remove the tendency to another attack.

CROP-BOUND.—The crop, whose office is to receive the food when swallowed and transmit it to the gizzard in portions, may become so over-crowded that it is impossible for it to expel its contents into that organ. The gizzard being empty, the bird continues to feel hungry and eats until at last by the swelling of the grain a hardened mass is formed in the crop, and the enormous size gives evident indications of its being bound.

Treatment.—In ordinary cases, a dessert spoonful of castor oil poured down the throat, and the kneading of the crop with the thumb and finger will remove the trouble; but I have known cases where a purgative medicine did not serve the purpose. I operated on two cases this season. Making an incision with a sharp knife, first through the skin and then through the upper part of the crop, I removed the food with a wooden spoon. A few stitches closed the incisions, and the birds recovered in a few days.

CHICKEN POX.—An eruption on the face, comb and wattles. This disease is very contagious, and birds affected with it should be at once isolated. I went last spring to see a flock where this disease had broken out; more than half of a flock of Rocks were thus affected.

Treatment.—I had the diseased parts washed with warm water and carbolic soap, then the scab was easily removed from each pustule and the sore was touched with lunar caustic (nitrate of silver). One application was found sufficient to effect a cure. Persons using caustic should be careful not to touch the eyes, as it will destroy the sight.

LEG WEAKNESS.—This disease usually occurs in young birds while growing, and more frequently in cockerels than pullets. The bird sinks upon its hocks after standing for some time, unable to support itself, and in bad cases unable to get up. In other respects the health may be good.

Causes.—This complaint, which often attacks the finest and best specimens, is caused merely by a rapid increase of weight which is out of proportion to the muscular development, and is most common in the heavy varieties, as Cochins and Brahmas.

Treatment.—A due supply of nutritious food, care being taken to select such food as is flesh-producing and not fattening, avoiding the use of corn and peas. A little chopped meat or ground green bone two or three times a week, along with ground oats, middlings, or bran, is considered the best food to use, with a liberal supply of skim milk.

SCURFINESS OR SCALY LEGS.—A peculiar scurfy eruption is developed between the scales on the legs. In several cases where the disease has been allowed to go unchecked, agglutinated masses of scurf an inch in thickness are produced on the back and front of the legs.

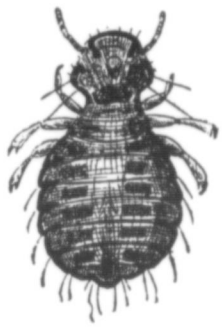
Causes.—Microscopic investigations have proved that this disease is caused by a parasite or insect that works between the scales on the legs.

Treatment.—Soak or wash the legs in warm water until the scurf is softened, so that it can be removed. Apply lard and sulphur, to which may be added a little carbolic acid. Severe cases may require two or three applications before a cure is effected. Wampole's antiseptic solution, if applied at the commencement, will prevent further trouble.

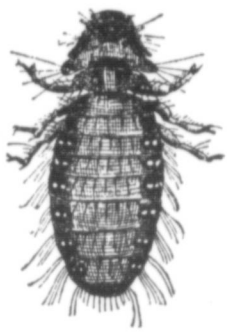
THE TICK LOUSE.—This insect may be found with its head embedded in the skin of the chick's head. Thousands of chicks die annually from this cause. The presence of these lice is known only by the experienced poultry breeder. I have sometimes found more than a dozen upon the head of a single chick. The following treatment, recommended by Mr. Lewis Wright, is a sure preventive, if applied when the chicks are but a few days old ; or it may be applied when the chicks are first removed from the nes :

Mercurial Ointment	1 ounce
Pure Lard	1 "
Flour of Sulphur	½ "
Crude Petroleum	½ "

Apply a small amount to the head of chick in a melted or semi fluid state.



Fowl louse (*Goniocotes hologaster*) (greatly enlarged,)



Fowl louse (*Menopon pallidum*) (greatly enlarged)

We are still in the dark as to the source of these lice. They have never been discovered on hens. They are not hatched with the chick, as they are not found on chicks hatched artificially and raised in a brooder. At least this is the case in my experience.

BRONCHITIS.—A cold may settle on the lungs and in the throat and not affect the head as in roup, the symptons being different. There is a rattling in the throat, from the accumulation of mucus, which the bird coughs up and expectorates at intervals.

Treatment —The bird should be kept in a dry room ; and a small quantity of kerosene oil given daily for three or four days, will effect a cure A small oil can such as is used for a sewing machine, is the most convenient when oil is to be administered.

I purchased two birds at the Ontario poultry show held in Guelph last winter. Both were suffering from this disease, contracted at the exhibition, and were cured by the above treatment.

ROUP —At our fall exhibitions we invariably find chickens affected with this disease ; and I am sorry to say that I have noticed birds exposed for sale on the markets that have had every evidence of having "roup." It is almost incredible, yet a fact, that hundreds of birds are offered for sale on our markets every season that have been diseased. Fowls showing signs of disease are sold to hucksters and by them dressed and marketed ; and to avoid suspicion, the heads are removed, so as to prevent detection. Never sell a fowl that you cannot leave the head on. Never buy one with the head off.

Symptoms.—The symptoms of roup are those of catarrh or cold affecting the lining membrane of the nasal cavities. The cavities often become so clogged by a thick discharge as to fill the eyes, and when neglected may entirely close those organs. This discharge when collected forms a cheesy mass that has a very offensive odor. Fowls having a cold or distemper and a discharge from the nasal passages, may be thought to have roup ; and, if neglected, such colds and distempers often pass into roup. While the discharge

remains thin and watery and devoid of odor, there is usually nothing beyond a severe cold; but if it thickens and becomes offensive, the general health also suffering, roup has supervened.

With respect to the communication of this disease, experiments prove that it is contagious. I procured a bird, a Brown Leghorn cockerel, affected with roup last April. I placed a hen in the best of health in the same coup and in ten days she exhibited the symptoms of the disease in its worst form. Both birds were allowed to drink from the same vessel; and I am inclined to believe that the disease is generally communicated in this way, as the discharge from the nostrils of the sick bird contaminates the water which it drinks.

Treatment.—In general, I would say: kill a roupy fowl at once, unless a valuable bird, rather than run the risk of communicating the disease to the remainder of the flock. Warm, dry, and comfortable quarters and nutritious food are the first essentials to recovery, and the frequent removal of the dry discharge from around the eyes and nasal cavities by bathing with warm water must not be omitted. I have used Dr. Hess's Pancea with good results. The use of kerosene oil, injected into the nasal cavities, and a little added to the drinking water, will be found a useful remedy.

Egg-eating.—This habit may be prevented by placing six or seven artificial eggs in the nests. I have cured the most confirmed egg-eaters in this way. They soon tire of pecking at them, and in a few days are broken of this vice. The habit is generally confined to hens in close quarters, and may be acquired from hens laying soft shelled eggs that get broken in the nest or on the floor.

While there are numerous other diseases, the foregoing are the most prominent and important; and my attention has not been directed to any but the above during the past year.

Testing Eggs.

To attain the best results, it is necessary to test the eggs during the period of incubation. Our practice is to examine the eggs on the sixth day and remove those not fertile. This is best accomplished at night or in a dark room with the aid of a lamp and an egg tester. A piece of cardboard with an oval hole cut in the centre, not sufficiently large to allow the egg to pass through, may be used. The cardboard is held in front of the light, and the egg to be examined placed within the opening. A proper egg-tester can be purchased very cheaply from incubator manufacturers, with which the eggs can be tested more accurately and rapidly. Few persons understand testing eggs properly, being unable to detect the fertile eggs, *i.e.*, to distinguish a dead from a living germ, or a weak from a strong one. A little practice renders the distinction easy. A fertile egg will on the sixth day (temperature having been kept at 100° to 103°), show a dark, movable spot with veins running from it, somewhat resembling a spider as in Fig. 1. A weak germ will show a spot, but is cloudy-looking and muddled, as in Fig. 2. The unfertile or sterile eggs are readily distinguished, being clear, and the yolk easily seen, which looks somewhat darker than the rest of the egg and not muddled. Those who follow the plan of testing will find it advantageous to set two hens on the same day; and on examinining the eggs on the sixth day, if many unfertile eggs are discovered, the fertile eggs from both may be given to one hen and a fresh setting placed under the other. The clear eggs may be preserved, as they are valuable food for the young broods.

Fig. 1 represents a strong fertile egg as seen in the tester on the sixth or seventh day; the dark spot *b* is the live germ, *aa* blood vessels extending from it. The germ *b* will be seen by placing the egg against the aperture of the tester and revolving it between the thumb and finger until the side on which the germ has formed comes nearest the eye. The germ at this time, being quite lively, can be seen to move.

In a strong fertilized egg, the blood vessels should show plainly; but the germ is not always seen so plainly, as it varies, more or less, with the color and thickness of the shell; *c* shows the average size of the air-space in an egg on the sixth day of incubation.

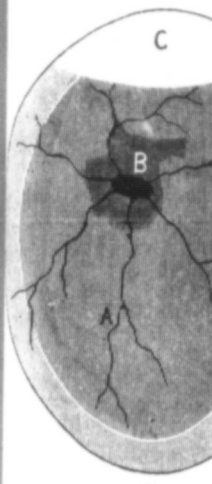


Fig. 1.

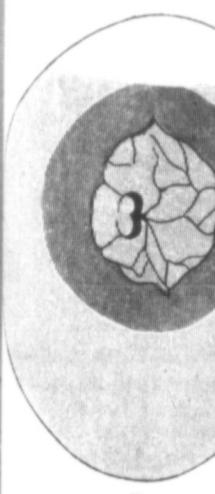


Fig. 4.


Fig 7.

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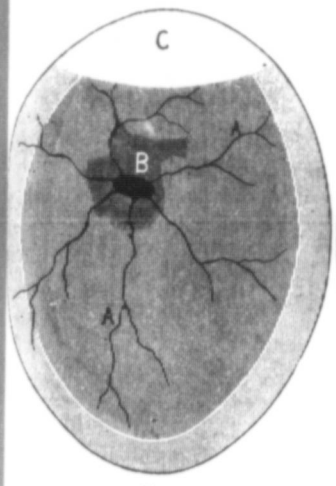


FIG. 1.

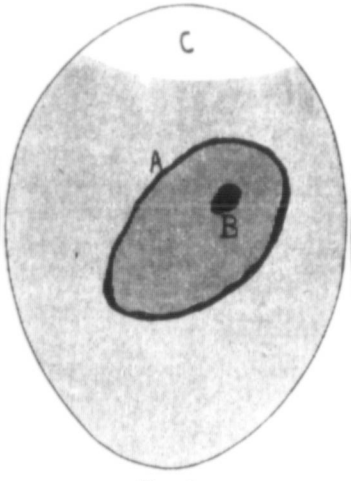


FIG. 2.

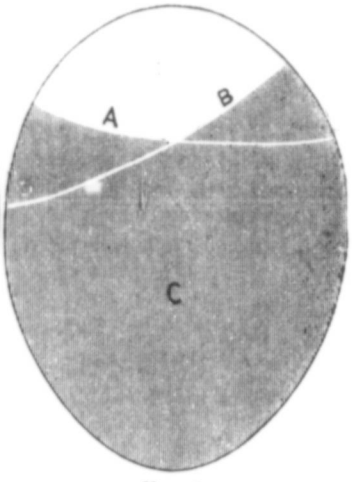


FIG. 3.

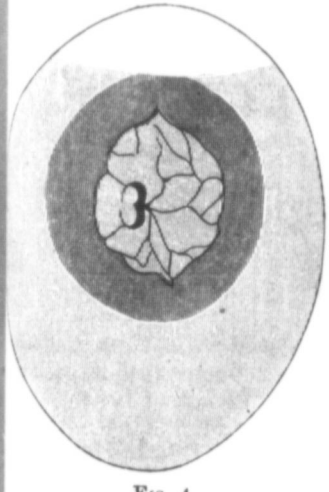


FIG. 4.

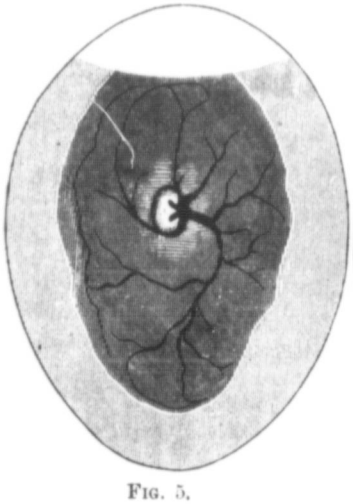


FIG. 5.

FIG. 6.

FIG 7.

FIG. 8.

FIG. 9.

Fig. 2 represents a weak or imperfectly fertilized egg, as seen in the tester on the sixth day; *a* is an oblong or circular blood vessel which has started, but nothing more. B is a small dark spot, a weak germ without blood vessels; *c*, the air space. This egg will not hatch, and should be removed.

Fig. 3 represents a live egg on the sixteenth day; *c* is the space occupied by the chick. Lines *a* and *b* show the air space, which may be on the top, or partly to one side, as indicated by the respective lines. At this stage in the period of incubation, a live chick darkens the egg, except the air space, when seen through the tester.

Eggs should be tested in a warm room free from draught.

Development of Chicks.

Fig. 4 shows the heart and minute arteries and veins in a circle on the yolk, which is enclosed in a thin sac. They may be seen by the naked eye when a fertile egg is carefully broken into a saucer after thirty-six hours' incubation. The veins gradually surround the yolk, from which the chick derives its nourishment during the period of incubation. What is left of it is drawn into the abdomen just before hatching.

Fig. 5 represents the interior of the egg on the sixth day, when the live germ can be seen to move, and will appear on top when the egg is laid on the side. In testing, the large end of the egg is held up as in fig. 2, which shows how the egg looks in the tester through the shell. Ffg. 6 is seen with shell partly removed.

Fig. 6 shows the appearance on the eighth or ninth day.

Fig. 7 represents the eleventh or twelfth day.

Fig. 8, the development on the fourteenth day.

Fig. 9, the sixteenth.

Dead in the Shell.

Why do chicks die in the shell; and what is the cause?

This question is very frequently asked, not only by those who use incubators, but by those using hens, geese, turkeys, and ducks for hatching. In a great many instances, the cases of "dead in the shell" may be attributed to the incubator or sitting hen; yet it cannot be so in all cases. Some hens steal their nest and bring out a full hatch; others do so and hatch only a very small percentage, or fail to hatch any.

A hen that hides her nest generally sits on her own eggs; and if they are strongly fertilized, and she is attentive, and she has a good place to sit, she usually brings out a good hatch. If the eggs are not well fertilized, you may expect poor results.

The unhatched eggs may prove to be unfertile, or most of the chicks may be dead in the shell. What is the cause? A poor incubator, or a bad sitter may cause the trouble; but if a hen sits steadily on thirteen eggs and only hatches four or five of them, is it not reasonable to suppose that the unhatched eggs have differed somewhat in quality at the beginning, or they, too, would have hatched? All having been subjected to the same treatment and conditions, why did not all hatch, or all fail to hatch, if they were all alike at the time of setting?

There are many answers to this question. It might be a lack of vigor in the germ, traceable to the parent stock, or a weakly condition of the laying stock from which the eggs were procured. Had all the eggs failed to hatch, we would naturally suspect that the hen had neglected her nest; but as some hatched, the blame could not be attributed to the hen, for chicks could not be produced without proper conditions of incubation to which they were subjected together with those that failed to hatch.

NOTE.—The nine illustrations on page 227 are taken from "The Art of Incubation and Breeding," by Col. Van. Culin (1894).

Hens that are too fat do not produce eggs that will hatch well; and the chicks that do hatch from such eggs will generally be found weak. The germs do not seem to receive the proper nourishment to develop strength enough to enable them to break the shell, even if they grow to full size.

Stale eggs do not hatch well. Fowls kept in close confinement lose their vigor. They must have a reasonable amount of exercise to produce good fertile eggs.

It is quite possible to kill a vigorous germ, or a full-grown chick, by improper treatment. Too much or too little moisture, heat, or ventilation, may ruin a hatch. Lack of moisture at the time when needed, or too much when not required, will injure or destroy life when hatching by artificial means.

Eggs of various breeds vary considerably in shell. Some are thick and porous, some thick and dense, or hard, while others are thin and porous. The question of how much moisture should be used in an incubator has never been fully and correctly answered. We find that different incubator manufacturers differ materially as to the amount of moisture which should be used, when to use it, and how to apply it. When we think of the great difference in the construction of incubators, and the different kinds of shells that envelop the egg, each requiring different treatment (the hard shell requiring more moisture than the porous one), we at once see the difficulty in coming to a conclusion as to how much moisture should be used in an incubator.

I find that the printed directions sent out by the manufacturers of incubators do not in most cases give satisfactory results.

Periods of Incubation.

Chickens	Twenty to twenty-two days.
Geese	Twenty-eight days.
Ducks	Twenty-eight days.
Turkeys	Twenty-eight days.
Guinea Fowl	Twenty-eight days.
Pheasants	Twenty-eight days.
Partridges	Twenty-five days.
Ostriches	Twenty-four days.
	Forty to forty-two days.

Feeding and Value of Different Foods.

It is obvious that the cheaper the cost of production the greater the margin of profit. All food given represent cash expended. Food may be productive, yielding more than its own value; or it may be wasted, producing nothing whatever; and, again, it may be injurious to the fowl, producing so much actual loss. What should be sought after in the management of poultry is a well-balanced ration. As an egg contains animal food in its natural form, its regular production must demand a sufficient supply of food adapted to produce it.

Fowls are raised either for the table or for egg production. In the former case the object is to prepare the young chickens so that they may be fit for market at the earliest possible period. It is evident that they are not only better in quality, but command a better price when they are young; and as young birds consume a smaller amount of food on account of their shorter lives, they inevitably return a larger profit than older ones. Eggs are obtained from hens out of the materials furnished by their food, and a scanty supply of the former is therefore the inevitable result of a short supply of the latter. In winter, when eggs are scarce and most valuable, this is particularly shown, for as then no insect or other food is to be obtained by scratching, the production of eggs is diminished, unless the fowls are well fed with proper egg-producing food.

How often to feed. If fowls have a full range we believe in feeding twice a day. They should receive their morning meal at a fixed hour, and their evening meal as late as they can see to eat before going to roost. If is often asked how much feed should be given per

head? It is impossible to give an answer to this question that would be of any practical value, as so much depends on the size of the birds and the amount they have obtained during the day. It is obvious that a fowl weighing ten pounds, and another five pounds, require different quantities of food.

When a hen is producing eggs a greater amount of food is required. Nevertheless there is a rule which is easily understood, which will secure both health and eggs—that is to give the birds no more than they will eat with an eager or ravenous appetite. We often have visitors remark, when passing through our buildings, that our fowls must be starving, for when their food is given them they fly in the air and endeavour to get into the pail containing the food. They are, in fact, always ready for their food, and we may say that this is the way it should be. It has been my experience that this system of feeding is the best.

In bad or cold weather, or when fowls are moulting, a little more may be given, but we never allow our stock (speaking of adults only) to eat till they are fully satisfied.

Different foods. In choosing foods, either meal or grain, there is a considerable variety to select from, and it is well to give a change.

Corn is chiefly remarkable for the quantity of oil it contains; and, if used exclusively, poultry fed with it are very apt to become too fat; but when fed in conjunction with other food, it will be a valuable addition to the poultry ration.

Buckwheat, which is very largely used as poultry food in different parts of the country, in consequence of its low price, is not quite equal to barley or wheat in the amount of gluten it contains, yet the French, who send immense quantities of poultry and eggs to the English market, used buckwheat almost exclusively both for fattening and egg production. From our experience we can confidently recommend its use as a staple in preference to almost any other grain.

Oats may be fed for a change, but the heaviest samples should be procured, as they contain little, if any, more husk than the lightest, and are consequently much cheaper, if the proportion of meal is taken into consideration.

Peas may be regarded as stimulating for general use.

Wheat is a favorite food for fowl and they eat it greedily; but it should be used sparingly on account of its tendency to produce fat.

Clover Hay.—There can be no doubt that clover hay is an excellent food during the winter months or when fowls are confined to small runs during the summer, as it supplies the want of green food. It should be cut as fine as possible with a clover cutter and then steamed for several hours either in a kettle or by throwing boiling water over it in a tub, which should be covered over so as to retain the steam. When fed, it should be mixed with shorts or bran, as the fowls do not eat it very well when given alone. This makes an excellent morning ration and should be fed at least two or three times a week.

Milk.—Milk, either sweet or sour, we find to be an excellent food for poultry as regards health, growth and egg production.

Green Bone.—At my request, Prof. A. E. Shuttleworth made an analysis at the laboratory of samples of the fresh ground green bone, meat meal, and dried-blood meal which were being fed at this department. The results were as follows:

	Protein.	Phosphoric acid ($P^2 O^5$)	Lime. (Ca. O)
Fresh green bone	17.87	13.20	18.84
Meat meal	56.06	7.07	8.94
Dried-blood meal	95.75	Traces	Traces

From the best authorities we learn that lime, nitrogen and phosphoric acid are among the important constituents of eggs; also that green bone is rich in albumen: hence the value of green bone as an egg producing food.

The blood meal and meat meal were furnished us for trial by Mr. Fearman of Hamilton, and I have no hesitation in saying that for fattening purposes, if mixed with the soft feed it is a great acquisition. Birds fed thus, increase in weight much faster than those fed without the meal.

Winter Rations.

Ration.—Morning: Cut clover hay, ground oats and middlings, equal parts, mixed with warm water. Feed this in a "crumbly" state, not porridgy, and in such quantities as barely to satisfy the hunger of the birds.

Noon: A very small quantity of grain thrown in litter or straw on the floor so as make fowl work; otherwise they will huddle together in the corner of the pen or sit on the perch without having sufficient exercise to keep them in a healthy condition.

Night.—The last meal, which should consist of grain, should be given just before dark and in such quantity as to fill their crops before going to roost.

Ration 2.—Morning: Boiled potatoes, to which add bran and oat or barley chop and season with salt.

Noon: Enough grain, (barley, wheat or oats) to keep the fowls active.

Night: A liberal grain ration.

Ration 3.—Morning: Cut green bone, at the rate of four to six pounds for every twenty hens.

Noon: A little grain, and vegetable food, such as cabbage, beets or turnips.

Night: Grain, the kind being changed as often as possible.

Ration 4.—Morning: Cut clover hay, turnips or other vegetables boiled, bran and middlings or shorts, mixed and fed warm.

Noon: A little millet seed thrown among the litter, for the purpose before mentioned.

Night: The same as in foregoing rations.

Ration 5.—Morning: Bran, pea-meal, and finely cut clover hay.

Noon and night: Same as in ration 2.

Information Wanted.

During the past year, I have received numerous letters from different parts of the country as to the proper mode of feeding, when and what to feed, etc. This goes to show the greatly increased interest which is being taken in this branch of the work. I have answered concisely in the light of experience and observation the following questions received from farmers and others interested in the raising of poultry:

Question.—How do you manage to keep fowls free from lice and disease?

Answer.—By keeping the poultry house clean; having proper ventilation and using dust baths composed of road dust to which sulphur has been added, kerosene oil applied frequently to the perches and inside the nest boxes, fresh drinking water supplied daily, and in summer never allowed to stand in the sun until it becomes warm or put into a vessel that will allow the water to become contaminated with any kind of dirt, a supply of green and animal food when hens are confined to their winter quarters or in small yards. Do not omit grit, such as mica, crystal, broken oyster shell, and clean gravel; use a variety of food; and never keep more fowls than your poultry building will accommodate without over-crowding.

Question. For the production of eggs, table birds, or both, what breeds or crosses would you recommend as likely to give most general satisfaction?

Answer.—My experience has been that an egg-producing strain can be secured from almost any breed by systematic selecting eggs from the best laying hens, and using these eggs for hatching. We find some strains of Wyandottes, Rocks, Javas and Brahmas much better than other strains. For winter laying the Rocks, Wyandottes, Javas, Light Brahmas and Langshans, are considered the best. For summer laying the Andalusians,

Leghorns and Minorcas will undoubtedly give a larger yield of eggs than any other varieties of pure-bred fowl, especially if allowed their liberty, as they are great foragers and may be termed non-sitters.

The winter varieties mentioned lay dark or brown-colored eggs, while the latter, or non sitting varieties, lay white eggs.

The Andalusians and the Minorcas lay the largest eggs; yet those layed by the Rocks, Brahmas, or Javas, may weigh as much, since the white of the egg from the latter is thicker and heavier, and the shell is thicker and denser.

As an all round fowl I consider the Plymouth Rock equal, if not superior, to any of the varieties above mentioned, as they mature early, are good winter layers, and fine table fowl, and their flesh is of the finest quality.

Question. Can you give me any idea why some eggs do not hatch while others contain strong and active chicks?

Answer.—To account for eggs not hatching, we are compelled to look back beyond the production of the egg itself. A pullet not fully matured cannot compete with a year-old hen, while a hen two or three years old is not a vigorous rival of the pullet. An imperfect egg will not produce a perfect chick. Eggs vary in size and shape. A hen may steal her nest and hatch out every egg, providing they are fertile, because the eggs are uniform in every respect, as they are all her own laying; and such hens, having their liberty, are usually in full vigor. When eggs are placed under a hen, or in an incubator for incubation, they may have been produced by as many different hens as there are eggs, and in looking them over we find the very small egg, probably from an immature pullet, the large egg, of abnormal size and irregular shape, which may have been produced by the over-fat hen, the egg with a thin shell, and another with protuberances. With deficiency of vigor in the hen, impotency of the male often combines to cause failure. An egg perfect in shape, normal in size, with the shell free from defects of any kind, and fertilized by a male bird in full vigor, should produce strong, active chicks.

Question.—During what period of the year is it advisable to keep the male birds with the hens, and how many hens would you allow to one male?

Answer.—It is my opinion that hens will lay fully as many eggs, if not more, when kept away from the male; and that unfertilized eggs will keep much longer than fertilized eggs is an undoubted fact, for an egg not impregnated will come out from under a hen clear and good, while one that has been fertilized is spoiled if it is sat upon for even one or two days. An egg not impregnated may be sat upon for several days, and then be used for culinary purposes equal to the common run of store eggs. The hen is capable of producing eggs quite as well without the male. Hence the male is in no manner necessary to the production of eggs, his functions being simply to impart life to the egg for the purpose of reproduction. There are certain stages in the development of the eggs and their relative position when the influence of the male at a single union with the hen will impregnate several at a time, while at other times his influence does not extend beyond one.

With the larger varieties, I consider from six to ten hens sufficient to mate with one male. With the smaller varieties, from fifteen to twenty would not be considered too many.

Question.—Do you think it necessary to give tonics or stimulating food, such as Douglas's mixture, red pepper, etc., or what food would you recommend for fowls during the moulting season?

Answer.—Fowls when moulting are or should be as healthy as at any other period during the year. I do not believe in using any tonics or stimulants at any time, unless it would be for sick birds. As the growth of the new feathers takes from the fowl the elements necessary for the production of feathers, the food should be highly nitrogenous—meat, fresh green bone, and milk being preferred, mixed with their grain ration. This is all that is required as far as food is concerned. Often fowls are nearly naked; hence, at such times, a dry place and protection against exposure should be provided.

Question.—What kind of floor would you recommend for poultry houses?

Answer.—This largely depends on the soil on which the poultry house is erected. If you have a sandy or gravelly subsoil, all that is necessary is about a foot deep of sand or finely sifted gravel, the same as is used in scratching pens in our buildings at the Farm. The subsoil being gravelly, we find no difficulty in keeping it perfectly dry. If it be a clay subsoil, even though you have drainage from your buildings, you will find it impossible to keep a sand or gravel floor as dry as it should be. In such cases a board floor placed a foot from the ground, and covered with a few inches of gravel or sand, will give the best results. We find no objection to concrete; the objection that it is cold and disagreeable to the fowls is entirely overcome if it is kept covered with gravel or sand, as the floors of all poultry houses should be. It is proof against rats and similar vermin, and is so much more durable than boards that some prefer it for these reasons.

Question.—In your experience with pure bred fowls, what shaped hen gives the best record, or has shape anything to do with it? Is there such a thing as an egg type, *i.e.*, a peculiar shape and style characteristic of all good layers?

Answer.—I have never noticed that the best laying hens had any peculiar shape of body, and do not believe that the general make-up has anything to do with the laying qualities. Some hens are more prolific than others, and if eggs from such hens alone are used for hatching, the laying qualities of the stock will be much improved. A prize bird or a high scoring bird will not necessarily lay any better than one of ordinary merit. Hens or pullets that are active and always busy about the yard are the ones that produce the most eggs.

Question.—Would you advise a farmer to keep pure-bred stock in preference to the common barn-yard fowl?

Answer.—Pure-bred fowls cost no more to keep, bring better prices, and are altogether more profitable than the ordinary class of hens kept on the farm. Therefore, we would certainly recommend the raising of pure-bred stock.

By selecting one breed, you will have a uniform flock of birds, and the eggs from one breed will be uniform in color, which enhances the market value. If the birds are to be sold when young as broilers, or at any other time, their carcasses will also be of a uniform color, and, if well fattened and properly dressed, will bring the highest market price, for the pure-bred trade mark is there. Again, eggs from pure-bred stock can be sold at an advanced price for hatching purposes; and there is always a good demand for pure-bred cockerels in the fall, which is another source of revenue.

In selecting a breed, farmers and others should bear in mind what their market calls for. If both eggs and dressed fowl are required, either the Plymouth Rock or Wyandotte will best suit the purpose. They will be found to produce a good quantity of fairly large and uniform brown eggs, while the cockerels mature early and have the yellow skin which is so much desired in our Canadian markets.

If egg production alone is the chief object in view, the Leghorn, Minorcas, or Andalusians may be selected and will be found to give general satisfaction.

Experiments Made.

Fertile versus Infertile Eggs.—This season an experimont was made to test the keeping qualities of eggs laid by hens with which no male bird was permitted to run, and eggs laid by hens which were accompanied by the male. Further experiments along this line will be conducted at greater length during 1898, and also to determine what is the difference, if any, in the number of eggs laid by a pen of fowls mated with a male, and a pen of an equal number of birds of the same breed and ages not so mated.

On the 15th of July, 1897, four dozen fertile eggs and three dozen unfertile eggs were placed in the egg closet used by the department (the construction of which was fully explained in my report of 1896), and subjected to a temperature varying from fifty to sixty degrees. These eggs were merely laid on their sides in bran and not turned. On examining some of the eggs a month after they were placed in the drawers, no perceptible difference could be discerned; and this was practically the case when the second trial was

made on September 15th. At the test which took place on October 15th, however, it was noticeable that the whites of the fertile eggs were somewhat more watery than those of the infertile eggs, but not much difference could be found in the yolks. At the test made on November 15th, the result obtained at the October breaking was made more manifest, the whites of the fertile eggs being quite watery while those of the infertile were to all appearance as good as in a newly laid egg. During the meeting of the Experimental Union, which was held in December, several thoughts were suggested by the speakers in regard to this important question; and on the 12th December, the remainder of eggs under experiment were broken by myself in the presence of Mr. Thomas Duff, of Toronto, and two of the students. The result was that the whites of the fertile eggs were like water, and in some cases the yolks were broken, while in the cases where the yolks did not break they were found to be very much spotted and discolored, and gave every evidence of going bad. These fertile eggs were totally unfit for table use, and of even a very poor quality for culinary purposes. We then broke the remainder of the unfertile eggs and in every case the whites were found to be all right, and the yolks were standing up exactly as in a newly laid egg, and without showing the slightest tendency towards decay. These eggs were of as good a quality as any that could be bought in the stores for family use; but, of course, they could not be called fresh. The above would certainly go to show that infertile eggs are much to be preferred to fertile eggs; but, as I said before, further and more extensive experiments will be conducted during 1898. In the conclusion of this experiment, a striking feature was the fact that of the fertile eggs, the small white shelled eggs were in a much worse condition and showed greater loss from evaporation than did the large white or the brown shelled eggs. I am satisfied that brown shelled eggs or large white shelled eggs will keep much longer and lose less from evaporation than the small white eggs. Experiments along this line will also be conducted in 1898.

Cross Breeds.

We tried the following crosses this season, and are well satisfied with the results:

Indian Game Cock	Light Brahma Hen
Brown Leghorn "	Barred Rock "
Langshan "	Indian Game "
Silver Grey Dorking Cock	Barred Rock "
Silver Grey Dorking "	White Cochin "

Brown Leghorn—Barred Rock Cross.—Four cockerels hatched on the 27th May and weighed on the 29th November $5\frac{3}{4}$, 6, $6\frac{1}{2}$ and 7 pounds respectively; two pullets, the same hatch, weighed $5\frac{1}{2}$ and $5\frac{3}{4}$ pounds respectively. Cockerels and pullets were fully developed and matured on the date mentioned. The pullets commenced laying when five months old. The plumage resembled the Barred Rock in color, and were very handsome birds.

Indian Game—Light Brahma Cross.—One cockerel was hatched on the 2nd June, and weighed 6 pounds 2 ounces on the 29th November. A very fine specimen, a well developed bird with plump breast and body; will make a nice bird when dressed.

Silver Grey Dorking—White Cochin Cross—Two cockerels, hatched on the 27th May, weighed on the 29th November 6 and $6\frac{1}{4}$ pounds respectively. Two pullets, the same hatch, weighed $5\frac{1}{4}$ and $5\frac{3}{4}$ pounds respectively. The cross was not fully matured when weighed.

Langshan—Indian Game Cross.—Two cockerels, hatched on the 27th May, weighed on the 29th November $7\frac{1}{4}$ and $7\frac{1}{2}$ pounds respectively. Two pullets, same cross, weighed 6 and $6\frac{1}{4}$ pounds respectively. The plumage is a rich glossy black, resembling the Langshan, while in shape the birds resemble the Game.

Silver Grey Dorking—Barred Rock Cross.—Two cockerels, hatched on the 2nd June, weighed on the 29th November $5\frac{1}{2}$ and 6 pounds respectively. Three pullets, the same hatch, weighed 5, $5\frac{1}{4}$ and $5\frac{1}{2}$ pounds respectively.

Respectfully submitted,

L. G. JARVIS.

Ontario Agricultural College,
Guelph, November 30th, 1897.

PART XIII.

REPORT OF THE APICULTURIST.

To the President of the Ontario Agricultural College :

SIR,—I have the honor of submitting herewith my report for the year 1897.

The bee-keepers of the Province are taking an increased interest in the experimental work done in the Apiarian Department. Our report has been referred to in the United States and Europe ; and, by resolutions and otherwise, our bee-keepers are asking for increased work in the direction of apicultural experiments.

THE EXPERIMENTAL APIARY.

In the work of 1897, the line of experiment has been followed up in several cases, the object being to confirm or negative the work done during previous years. In the experiment in connection with pure air and artificial heat in cellar wintering, the result of two years' work is now given for the first time. The method of wintering proposed is so different that I thought it well to follow up and confirm the results obtained in 1896 by another season's work.

OUR EXPERIMENT IN OUTSIDE WINTERING.

In last year's report we gave the result of a three years' test in outside wintering, the conditions briefly being as follows : The experiment was conducted with one hive, the brood chamber being divided into two parts—the lower set of frames, ten in number, measuring $14\frac{3}{4} \times 8\frac{1}{2}$ inches, and the upper ten measuring $14\frac{3}{4} \times 4\frac{1}{2}$ inches. After swarming the young queen in the parent hive was lost, and we introduced a queen of our own rearing. In the fall of the year the entrance of this hive was contracted to

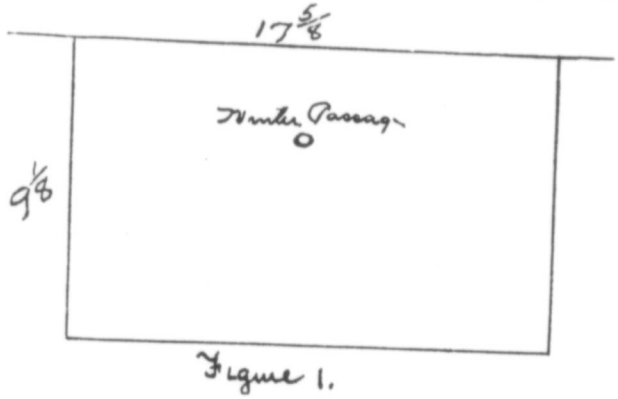


Figure 1.

five inches, and an empty super filled with old woolen clothing for packing placed on it. Without further protection the hive was left on its summer stand, the entrance being kept clear of snow. The hive has now been left in the same condition for four years, including the winters of 1896 and 1897 ; and in every case it has come through in first-class condition. Judging that the advantage and success was in part owing to the free

communication within the cluster, (allowing it to contract and expand according to the surrounding temperature without inconveniencing the bees on the outside of the cluster), we decided to carry on a more extensive experiment during the winter of 1896 and 1897. Eight colonies, or hives, of bees were set aside in eight-frame "Langstroth" hives. Good full colonies were selected, having plenty of bees and ample stores. The frame used was $17\frac{5}{8}$ x $9\frac{1}{8}$ inches.

A hole, about half an inch in diameter, was cut in each frame equal distance from the sides—about six inches from the bottom bar, and three inches below the top. (See Fig. 1.) Figure 2 shows the way in which the bees would cluster on the "Langstroth" combs, their only means of communication being over the top bar, under the bottom bar, or around the ends of the frames. In Fig. 3 is shown the condition of the hive now tested for four years; the bees have ready communication

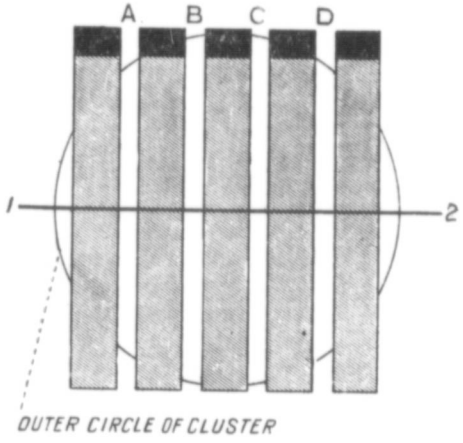


Fig. 2.

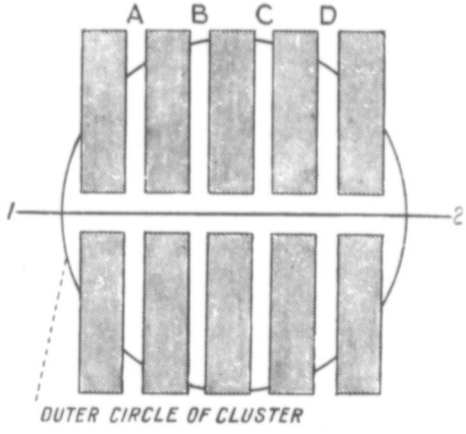


Fig. 3.

between the two sets of combs and through the space between the upper and lower sets of combs; our reason for cutting the winter passages in the "Langstroth" frame was to enable the bees to pass from one comb to another without breaking the cluster. The eight hives were protected on the top with absorbents, as in the case of the first hive tested. The bees in almost every case wintered well; and, as far as could be judged from an examination without actually removing combs, they were in good condition, until well into March. At this time we had a cold rain and ice storm, followed by much higher temperature; the snow and ice melted so rapidly in the neighborhood that the water collected as it had not done in any previous year. When visiting the apiary about 4 p m. the hives although on stands four inches high, were in from two to four inches of water. They were at once elevated, but the damage had been done. Cold weather followed, making the results still more disastrous; four hives perished out of eight, and the remainder were injured to such an extent that no practical value could be derived from their condition. It seems peculiar, but the odd-sized hive was saved from flooding, through having a special stand under the bottom board, raising it four inches higher than the others.

We notice a peculiarity in one of the eight hives wintered outside. Beginning in October, it was perceptible that every time the bees had a chance to clean house, they did so. This one hive carried out an unusual number of dead bees, and so marked was it that on Nov. 26th the following note was put on the back of the hive: "Bees carrying out an unusual number of dead."

We can account for this in only one way, viz.: That the bees in that hive were more delicately constituted. This is probably a point in bee-keeping to which sufficient importance is not attached. It appears to me quite possible that a ready means of com-

munication from one part of the cluster of bees to another is desirable, because the most trying position for the bees must be towards the outside of the cluster; and from what we know of the economy of the hive, we would expect the bees to change position in the cluster from time to time. If this cannot be readily done the bees on the outer sides may become restless and uneasy, and communicate this to the other bees, to the injury of all.

Comb Foundation in Sections. In connection with the production of comb honey, a very thorough and extensive test was made with comb foundation of different sizes in the sections. The results go to show that it is of very great importance that the sections should be filled to sides and bottom with comb foundation. Anything less increases the number of pop holes in the section, and even tends to prevent the comb from being fastened firmly to the sides or bottom wood.

Deep Cell Foundation. During the past year there has been put upon the market what is known as "Deep Cell" Foundation. It differs from ordinary comb foundation, in that it is flat bottomed instead of natural base, and the side wall is thin and one quarter of an inch deep or thereabouts. Thinking that this deep cell foundation would have a tendency to draw the bees into the sections and save them work, we decided to test it. It arrived too late to make a thorough test, but when placed in the hive with four other grades of foundation, and in no more favorable location, it was the first section the bees began to cap. In a section $4\frac{1}{4}$ x $4\frac{1}{4}$ inches we found two cells in which the bees thickened the base of the comb to give it the shape of the natural comb, thus increasing the wax in the section. If much of this was done it would prove a decided objection.

In comparing weights of comb foundation we found that running about twelve square feet to the pound to be most readily accepted by the bees; when thinner there is a greater tendency for the bees to gnaw it and cut pop holes.

So far the work in our apiary would lead us to recommend the following in the production of comb honey:

Full-sized separators not slotted.

A bee space above the section.

A double bee space and divider between the side of the hive and the first tier of sections.

A full sheet of comb foundation, about twelve feet to the pound.

A wedge between the bottom board and the side of the hive.

Carniolan Bees During the fall of 1896 we received two dozen tested Carniolan Queens, and introduced them to colonies of bees made queenless for the purpose. This was done in the latter part of July and August, in ample time to give the colonies time to develop a large number of these bees to go into winter quarters. It was our intention to test these bees in a general way, but, owing to the conflicting reports as to their tendency to swarm, we decided to test them, first of all, as to their disposition in this direction.

First, let me say that more than ordinary precaution was taken to give the hives shade and ventilation, particularly the latter; and room was given, as far as conditions and circumstances would warrant. The swarms from twelve of the colonies were placed in hives with only foundation starters in the frames, while the other twelve were given frames containing full sheets. I may say that in general we found the bees very gentle; they built up well in the spring; and the only point I could detect in which they were inferior to the Italian, was that the queen, being black, there was much greater difficulty in finding her in the hive.

The swarms put upon full sheets of foundation did not exhibit any undue tendency to swarm; but those hived on starters swarmed excessively and built exceedingly poor comb. Herewith will be found an engraving of seven combs out of eight in a

brood chamber; the eighth comb was entirely drone comb. At the stage of building herein illustrated the bees swarmed again, and the instance illustrated was not at all isolated. The result of the experiment must of course be received with caution; but thus far, without full sheets of foundation, the Carniolans have shown themselves a decided failure. They do not appear to build a proper proportion of worker comb, and the building is done very irregularly, but this deficiency seems to be overcome when the foundation of the comb is supplied. In the meantime we would advise bee-keepers not to be in any hurry to introduce the Carniolan bees until another season's test can be made.

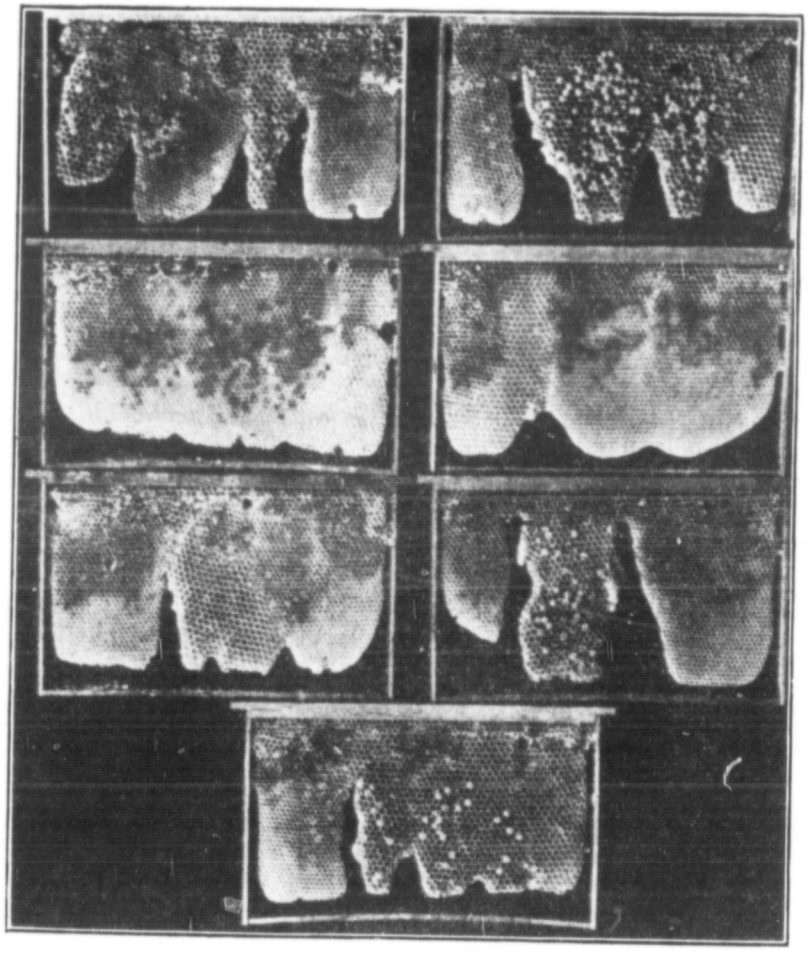


Fig. 4.—Comb from Carniolan bees, with starter foundation.

FOUL BROOD. Having, during the season of 1896, rendered Mr. F. C. Harrison, B.S.A., College Bacteriologist, what assistance we could in securing material with which to carry on investigations in connection with the disease known by bee keepers as "Fou Brood" (Bacillus Alvei), Mr. Harrison during that season continued his investigations in connection with the disease.

This year the experiment with comb foundation made of bees-wax infected with the germs of foul brood was repeated on a more extensive scale. Mr. Harrison made cultures of the germ; and, instead of incorporating these in the melted wax and then re-melting the wax to make it into comb foundation, he sent the wax to the makers of

this article and had the germs incorporated in it when it was made up, thus managing to have one melting less than last year. The wax was barely melted and at once cooled. Six hives were prepared and given full sheets of this infected wax, and at the close of the season there was not a trace of disease in the hives. The colony put upon such infected comb foundation last year was entirely free from the disease this year. We should like to pursue investigations in feeding medicated syrup to colonies infected by foul brood with a view to effecting a cure, but to do this under normal conditions it would be necessary to take the diseased colonies to some isolated district, in some of the more sparsely settled parts of the Dominion. We hope in another season to be able to co-operate with Mr. Harrison in this matter.

Although Mr. Harrison has a great deal of work to do, I understand he has kindly consented to test different samples supposed to be foul brood. They should be sent carefully packed, by sample post. Those in doubt about the disease will now have an opportunity of satisfying themselves, as the bacteriological test can be relied on as absolutely accurate in every case. With a decrease in the number of cases, it may be practicable to have bacteriological tests made whenever the owner of the bees has doubt as to the genuineness of a case.

The Condition of the Brood Chamber in Early Spring. Those who are known as our most advanced and progressive bee-keepers (and many of the more conservative) have advocated leaving the brood chamber of the hive undisturbed during the cold and changeable weather of spring, even to leaving untouched the sealed quilts shown on the hive, to prevent as far as possible the escape of the warm air.

With great reluctance we decided during the past spring to make a series of extensive experiments as to the effect certain conditions would have upon the amount of brood reared in the hive. The first bees were set out on the eleventh of March ; and the remainder at varying intervals during the next three weeks. The results from the various settings out showed a very marked difference—so much of a difference, in fact, that, in almost every case, after examining the brood chamber, we could tell the date of setting out. Upon examination of the colonies when first placed on their summer stands, brood was found in only one or two hives, and these showed indications of imperfect wintering. The inspection at that time went to show that in healthy cellar wintering there is no brood rearing. The day the bees were set out they had an exciting and cleansing fly, after which the queen began to deposit eggs and kept this up for a day or two, unless followed by weather suitable for flying. During the past spring, owing either to continuous low temperature or wet weather, the bees were confined for as long as a week at a time. The different stages of brood in the hive, upon inspection, gave indication just when the bees were ready to fly, the stimulus from flight, aided probably by the increased temperature, having a marked effect. Some colonies were fed diluted honey by means of a feeder above the brood chamber ; the results were very beneficial, and the brood chamber under this condition was enlarged by the bees. Great care, however, should be taken not to over-estimate the value of one season's work.

The spring of 1897 was exceptional ; the weather was too wet and cold to allow the bees to fly, and yet not cold enough to make it likely that the brood would chill in the hive. Another season, with more frequent opportunities to fly and greater extremes of temperature, with feeding added, there might be the danger of enlarging the brood chamber to such an extent that, during cold days and nights, a portion of the brood might chill to the great injury of the colony.

Moving Bees for Fall Pasture. Upon referring to the report of the last two years, it will be seen that it paid well to move a certain number of colonies a distance of about ten miles to fall pasture. This year, after the clover and linden flow was over, we moved one hundred and fifty-five colonies to fall pasture. The season was unfavorable, and, although the bees made a very good showing for a short time, the crop secured barely paid the expense of moving them. Taking the average for the three years we find that this plan has paid. Taking the fall of 1897 alone, and considering the

risk, trouble and expense of moving the bees, the returns received would not warrant a repetition; but during the other seasons better results have been obtained and the average would justify continuing the work.

Do Bees Move Stores from the Brood Chamber to the Super? About two years ago a bee-keeper, recognized as a leader in his profession, wrote an article in one of the leading United States bee journals upon feeding bees sugar syrup in the spring of the year and by this means crowding the brood chamber, the object being to compel the bees to store all the honey they gathered in sections in the super. Some did not hesitate to venture the opinion that the bees when given super room, would carry a portion of the sugar syrup into the sections and in this way make an adulterated article of the produce put upon the market; others thought not, as the quantity thus taken up would not be large, but as the appliances for readily detecting adulteration were not within easy reach of the practical bee-keeper, a definite answer could not be given. The matter was not allowed to rest, however, and our experimental apiarian was asked to make a test. About the middle of May ten strong colonies were purchased, and the combs in the brood chamber contained in every instance an abundance of brood and stores. The latter consisted entirely of dark honey, almost exclusively of buckwheat honey gathered the previous autumn. When clover opened, extracting supers were put on the hives with a queen excluder between the supers and the brood chamber, and the results were as follows: Upon removing and holding the combs to the light, the contents of many appeared dark. Upon uncapping these combs the honey underneath was amber in color, and the flavor unmistakably buckwheat. This was the case in seven out of the ten supers. No buckwheat being in blossom during the early clover flow, the bees must have carried the buckwheat honey from the brood chamber. This should be very conclusive evidence that when the brood chamber becomes crowded, before the supers are placed on the hive, the bees are likely to remove a portion of the store from the brood chamber. Their object, in all probability, being to make more room for brood.

In the above there is another lesson for the practical bee-keeper. By this carrying up about 270 pounds of first-class honey was deteriorated to the extent of about three cents per pound. In the production of comb honey extracting supers should first be put on, to allow the bees to store this dark honey in the extracting comb; and after they have ceased to carry up the dark honey the sections should be put on and the mixture extracted. The above directions are given because it is not practical to remove the dark honey from the sections. If it is the intention to produce extracted honey it should be removed from the extracting supers when the bees appear to have ceased carrying up the dark honey; by so doing a smaller percentage is deteriorated. At the present time many bee-keepers allow the dark and light honey to be mixed, as described above, and do it at a financial loss.

The Production of Comb Honey. To improve the finish of comb honey taken in the Province is an important matter. To get a well finished section improves the appearance of the honey, increases the demand, puts it in a better shape for the inexperienced retailer to handle, and makes it less liable to break out of the wood when jarred in shipping. A repetition of the experiment in the production of comb honey will be of interest and practical value, as, during the previous year's work, the main objects in view were:

1st. To compare the number and size of pop holes in the sections of supers with the bee space above, and of those without. Those without, had a quilt or board next the sections; those with, had a board with quarter inch bee space over the supers, between the board and the sections.

2nd. To compare comb honey having the face of the last section and wood sides of supers separated by only the usual bee space, and those having two or more bee spaces. The two or more bee spaces were secured by means of dividers of different construction. Some were of solid boards very thin, with holes three-eights inch in diameter. During the season of 1896 they were of wood only, but during 1897 we used some of wood and others of metal. The bee space was quarter inch in every case.

During 1897 we also tested, in connection with the above experiment, a wedge placed at each side of the hive, and between the bottom board and brood chamber, the wedge being seven-eights inch square at the end next the entrance and tapering to a feather edge by seven-eights inch at the other end.

The following is the result of a group of seven colonies with cloth or board and no bee-space over the sections compared with seven having a quarter inch bee space above :

Those without the bee-space had decidedly more pop holes in the sections ; there was also decidedly more propolis about them. Where pop holes existed, in those having no bee space above, they were much larger.

The result of seven colonies with the perforated divider and one bee-space between it and the wall of the hive, and those without the divider and additional bee-space :

The sections in the tier next the outside of the hive were much better filled where the divider and extra bee-space were used. In addition to the repetition of last year's work, in a number of cases perforated metal was used in place of the divider of wood, and in no case did there appear to be any difference between the metal and the wood divider. The metal has, however, the advantage that it can be thrown into a weak solution of lye and cleaned, lasting for an indefinite time. This cannot be done with the wood.

Our object was two-fold in trying the wedges between the sides of the bottom board and the sides of the brood chambers. First, to increase the facilities for ventilating the hive ; next, to compel the bees to go to the sides and end of the hive when coming in to unload honey. While we found them of great value in ventilating the hive, we are not prepared to say just to what extent the wedges assist in filling the outside sections. A more thorough test will be made of this next season.

Pure Air, Ventilation, and Artificial Heat in the Wintering of Bees. During the summer of 1895 I had the good fortune to visit the apiaries and home of one of our foremost and most enterprising Canadian Bee-keepers, Mr. C. W. Post, of Trenton, Ont. Mr. Post expressed great confidence in artificial heat for cellar wintering. He was kind enough to give his ideas and the system he thought it well to follow ; and, as a result, a very thorough test was made during the winters of '95-6 and '96-7.

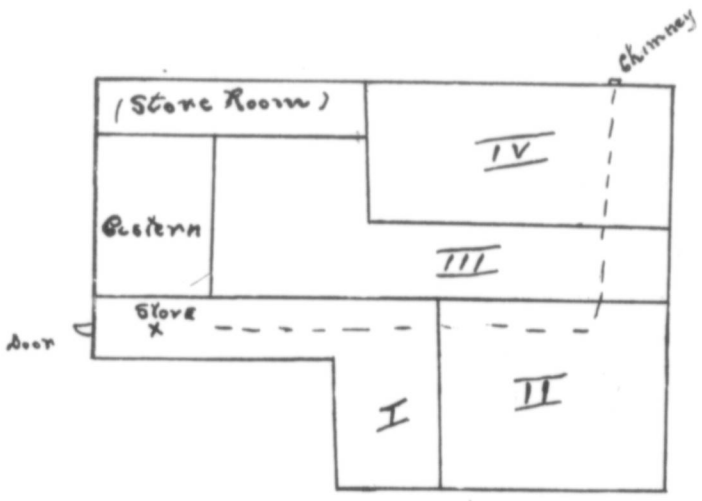
I am perfectly well aware that a great many have used fresh and pure air in the wintering of bees, and with more or less success. I am also aware that artificial heat has been applied. The instances on record are, however, less frequent ; and I do not know of anyone who for a series of years has made a success of this ; nor do I know of anyone who is constantly using artificial heat and fresh air to replace the air made impure by the bees. A combination of these should lead to success. In the application of pure air, the great difficulty has been regularity of current and temperature. When cold outside, it is necessary to exclude or partially exclude outside air to keep the cellar the proper temperature, and this we know leads to foul air. If the cold fresh air is allowed to enter, the temperature falls ; and the bee keeper is often at a loss to know which of the two evils is the lesser.

Again, when the outside temperature is about the same as the inside, there is a tendency to stagnation ; the atmosphere in the cellar becomes vitiated ; the bees are correspondingly restless and proportionately worn out and aged. Sub-earth ventilation has been tried ; but in this the above difficulties have presented themselves to a greater or less degree ; and many have tried these methods for a time, only to abandon them in the end.

To cheer and comfort the fraternity (if comfort can be derived by having brethren in tribulation), I may say, in passing, that Dairymen who require accurate temperatures and degrees of moisture in ripening cheese have experienced all our perplexities, and the more advanced in that calling are studying the question as we are. What we require is to be able to control temperature, and to secure a cheap and practical power

by means of which we can secure a steady ventilation or, in other words, draw or push atmosphere. For some years my thought ran in the direction of electricity; and, although it is not yet within the range of the practical, I believe that the time is not far distant when by a system of storage batteries we can, at a nominal outlay by wind mills, produce electricity which can be used as required for power, heat, and light; and by means of electric carrents, ventilators will open and shut, and heat be applied or cut off automatically as the temperature rises and falls in the cellar. For the present we have the power to force currents in whatever direction we may desire by means of artificial heat. The same heat also serves to regulate the temperature; and here we have a theory that is practical.

The first test was conducted under the following conditions: A large stone cellar was divided into five parts, four of which were used for the bees, and these repositories communicated with one another by means of doors, and also by means of openings fourteen inches square near the top of the room; and through these openings a pipe ran. The size of the pipe was six inches. The remainder of the openings, of course, allowed a circulation of air from one room to another. (See plan below.)



A "Tribune" stove was placed near the cellar door, which communicated with the outside; and through this door the fresh air from the outside had access The air in its natural course, by means of the openings around the stovepipe, passed from room to room; and finally in the fourth room passed out by means of a similar opening in the chimney,—the same chimney into which the regular pipe entered. This chimney has, in addition, a pipe entering it from the stove used in the living room above.

The fuel used at first was wood; but the pipe was too hot and irregular, and gave out more or less odor, particularly the last portion which became cool before entering the flue. Stove coal was subsequently used for 3½ months—2,550 pounds having been consumed.

There were 70 colonies in number one, 75 in number two, 80 in number three, and 75 in number four. The bees were put in number one on October 26th, in number two on November 20th, in number three on November 21st, and in number four on November 22nd.

In the records (with one exception) the variations in temperature were very slight. The night of February 14th the fire went out, and the next morning the cellars registered as follows: number one, 38 degrees; number two and three, 40 degrees; and number

four, 42 degrees. You will notice that the temperature was raised by the bees as it passed from cellar to cellar. There was a wet and dry bulb thermometer in each, and the temperature half way between the floor and ceiling was as follows:

	Dry.	Wet.
1	46	43
2	45	43
3	45	43
4	46	45

The difference in temperature at top and bottom of number two was three degrees, and in number four, six degrees. In number four there was a fire in the room above; in number two this was not the case. I draw attention to this, as some may not consider these variations sufficient when taking the temperature of a cellar. You will notice that number one and four, dry bulb, both stood at 46 degrees; but the wet in number one, the first cellar into which the pure air passed, stood at 43 degrees, and number four at 45 degrees. Into this the air went after passing through the other three cellars, the added moisture we would expect being expelled by the bees from the previous cellars. Moisture and temperature were taken; but how about the impurity? I think I can give several practical proofs that pure air is an important factor—at least the weight of evidence tends to show this

The bees in number one cellar appear to be quieter than in number four. Though a lamp burned for half an hour in number one, the bees did not fly to the light. In number four, although they did not fly to the light to any great extent, there was a tendency in this direction. In fact, all through the winter they were more restless in the last cellar; and, to prevent injury to the bees, fresh air from another source was allowed to enter number four cellar.

There was no perceptible difference in the first three cellars. The bees could be seen clustering quietly in number one, some of the hives being within seven feet of the stove. A thorough inspection was made March 19th,—the contents of the hive were examined at the entrance, and, upon lifting cushions and quilts when possible, not the slightest indication of mould or dampness could be detected. Only two colonies showed the least sign of dysentery; and these bees whose queen had shown symptoms of this disease the winter before, and were kept purposely to see if they would have it again.

Number one cellar contained 60 colonies with bottom boards as on their summer stands, and entrance full width. Fifteen had two inch rims placed under the brood nest. Number two contained fifty hives with the back ends of the hives three inches higher than the front, and the brood chamber three eights inch from the bottom boards; and 25 colonies had two inch rims under the brood nest. Number four had 75 colonies with all the back of hives raised three-eights inch from bottom boards. All the hives were covered with cloth, and over the cloth there was one inch of sawdust. The bees were placed on their summer stands on April 7th, 8th, 9th, and 11th. As to method of adjusting entrances and bottom boards, there appeared to be no great difference in results. With the exception of several starved and mice-destroyed colonies, every one came through alive and in good condition.

The indications of good wintering were:

1st. Their quiet condition.

2nd. Bees clustered compactly.

3rd. Individual bees did not fly to the light of the stove, lamp or outside door, through which the fresh air had access.

4th. There was no brood in the hives when placed on their summer stands.

The air passing from cellar to cellar is not a condition to be desired; but it serves as a splendid object lesson to the bee keepers of this country, and emphasizes, as no other experiment could, the desirability of having pure air. A similar experiment was tried during the winter of 1896 and 1897, and with similar results.

There is one point which I wish to emphasize, and an additional experiment during the past winter goes to show its importance. The chimney into which the foul air passes must be what we call a live chimney; it must have a pipe with hot air constantly passing into it. Why? Because in this way we secure the power necessary to make the current travel one way in the chimney. We know that cold air will rush into warm, and the variations in temperature cause the movement of atmosphere. Last winter I arranged another cellar with the same method in view. The stove was boxed in a compartment about four feet square, as air tight as matched lumber, felt paper and sheet iron could make it. A shaft of fresh air opened under the stove and half way between the ceiling and floor; and at opposite sides, two pipes led into bee cellar—the pipes discharging pure atmosphere along the cellar walls. I could not reach a live chimney, so I put the foul air pipe outside of and about the stove pipe, making a double pipe, thinking that the heat from the stove would act as a sufficient motor to secure a steady current of air. During cold weather everything worked well, but when the fire was low there was not sufficient heat in the pipe, and the atmosphere became stagnant, or the current was reversed, and instead of the foul air being carried off by the pipe the cool air rushed down the ventilating pipe, and into the cellar without passing through the heating compartment.

The direction of a current can readily be detected by means of a sheet of paper held close to the opening. The sheet of paper will be drawn in the direction of the current. There were slight symptoms of dysentery in some; one colony was found dead and taken out, and one was queenless. Altogether it was an improvement on irregular ventilation, but not satisfactory.

During the past autumn we made some slight but important changes in the method of ventilating. The stove pipe, instead of passing through the bee cellar, passes up stairs from the hot air compartment. The capacity of the fresh air pipe has been increased three-fold; and a pipe from the latter has now been carried directly into the bee cellar, so that all the fresh air need not be carried through the hot air compartment. The object of the above is to keep a hotter and steadier fire, and yet be able to keep the temperature down in the bee cellar. This is a matter of very great importance. A good colony of bees, taking one year with another, will more than double itself; yet the winter mortality is so great that the total increase in bees kept in Ontario has been very gradual during the last ten years.

Respectfully submitted,

R. F. HOLTERMANN,
Apiculturist.

Brantford, Dec. 31st, 1897.

PART XIV.

REPORT OF THE PHYSICIAN.

To the President of the Ontario Agricultural College:

SIR,—I have the honor of presenting to you my report for the present year, which I regret to say has been marked by the occurrence among the students of more sickness than any previous year since I became connected with the College.

This statement applies especially to the winter and spring months during which many suffered from "colds," "sore throats," and other ailments of a slight nature, and a few from minor accidents. During these months we also had two cases of typhoid fever, which ran a mild course in each instance. Both were removed to the General Hospital in this city, where they remained under my care until they were removed.

In the month of February, mumps appeared amongst the students and thirty-five or more of them suffered from the disease. Just after the Easter vacation, an outbreak of measles occurred and nine of the students contracted this illness. Some of the cases were very severe. All were removed to the two hospitals of this city, where I continued to attend them, and where, under the skilful nursing of these excellent institutions, all made good recoveries.

The present term opened with an attendance of 146 students—the largest class, I understand, in the history of the College. As in previous years, I carefully observed the by-laws in respect to their examination on admission and in respect to my visits.

The sanitary conditions of the College, as they always have been, are excellent, and it is gratifying to be able to state that no illness could be traced to any defects in that respect.

Sickness amongst the students increases largely the care and work of the matron, and I feel that I cannot conclude my report without speaking in the highest praise of her earnest and unremitting attentions to their comfort in sickness and in health.

Respectfully yours,

WM. O. STEWART,

College Physician.

Guelph, Ont., Nov. 27th, 1897.

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